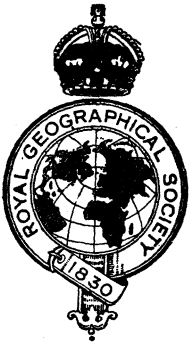
THE GEOGRAPHICAL JOURNAL



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his camp, he may not have been strong enough to risk the attempt. No soldier would see anything improbable in Hirtius's statement that Caesar sent gallopers to let the commander of his cavalry know that he was coming to the rescue even if the scene of the combat was only 7,000—not 3,000 * yards away; and Dr. Forbes, for whose translation of *videbat*, 'discovered' (which Hirtius would have expressed by *compererat* or *cognoverat*) I would substitute 'saw,' forgets that Caesar saw (*videret* †) that his camp was separated from that of the Bellovaci by a marsh, which must also have been 'hourly in evidence,' after he had been many days on the scene. The combat may not have taken place in a meadow by the confluence of the Aisne with the Oise, and the strong place may not have been Mont Ganelon; but I adhere to the view that Mont St. Marc and Mont St. Pierre are the most probable sites of any that have been or, in default of archaeological evidence, can be named. To quote de Saulcy, 'J'ai souvent parcouru, et dans tous les sens, ces magnifiques forêts [Cuise, Compiègne, and Laigne], et je n'y ai reconnu qu'un seul point qui concorde avec la description d'Hirtius; mais il est vrai qu'il présente une ressemblance si saisissante avec le terrain sur lequel tous les faits de cette campagne se sont déroulés, qu'il faudrait être plus que difficile pour ne pas y reconnaître le lieu cherché.'

* Measured on the *Carte de l'État-Major*, the distance *in a straight line* to the meadow opposite Choisy-au-Bac, where Napoleon placed the combat, is nearly 9,000 yards; to the spot midway between Choisy and Rethondes, where General Creuly placed it, more than 6,500. Dr. Forbes may reasonably insist that, as I freely admitted in *Caesar's Conquest of Gaul*, both these sites are less than 8 Roman miles from Mont Ganelon; but when he says that the meadow in question 'was 8 miles from the strong place,' he does not accurately report the statement of Hirtius (20, 1), according to whom the camp on the 'strong place' 'was said to be not further than 8 miles, more or less, from the battle-field' (*quae non longius ab ea caede abesse plus minus VIII milibus dicebantur*).

† *B. G.*, viii, 14, 4.

THE MOUNT EVEREST KINEMATOGRAPH FILM

EVER since the invention of the moving picture one has heard talk of the immense educational value that the film might have if it were properly used. But looking back one is bound to confess that few pictures have come up to the standard of intelligence and sincerity that are essential if they are to be truly educational. There was the wonderful picture in colours years ago of the Delhi Durbar. The moving record of the second expedition of Captain Scott made a well-deserved success, and also introduced us to the humours of the penguin; and in many ways most striking of all was the picture that Sir Ernest Shackleton showed two years ago, when the *Endurance* was crushed before one's eyes. All three were accompanied by lectures, and the last in particular owed very much of its success to the personality of the lecturer.

Other films there have been for which educational value was claimed: travel pictures that were made at great trouble and risk and expense, often admirable in their photographic technique, and portraying scenes of the greatest interest. Yet in one way or another many have failed to reach that precise standard of variety and excitement with serious interest that seizes the imagination and brings the public to be entertained while they are being educated. Therein lies the great difficulty, that to produce a good film is tremendously expensive, and there is the ever-present temptation to heighten the incident, to stage effects, to compete with the product of the studio, and thereby to increase its value as a public entertainment, but ruin it as a sincere record of events.

When the Mount Everest Committee were organizing the first expedition of 1921 they were faced with the alternatives, of making no kinematograph record of the expedition, or of employing a professional operator; and they preferred the former, believing that it would be better to wait than to run the risk of having a picture produced that might be rather out of tune with the spirit in which the expedition was conducted. And it was easier to take this decision because it was hoped that Captain Noel would be able to join the expedition of 1922. His skill as a photographer had been shown in his journey to Tashirak and in a later reconnaissance of the Caspian provinces of Persia. While on the staff of the School of Musketry at Hythe he had produced many instructional films for the work of the school; and his enthusiasm was proved when he resigned his appointment there rather than miss the great opportunity afforded by the Mount Everest Expedition.

General Bruce, in his reports to the Committee, and in his lecture to the Joint Meeting on October 16, bore witness to the endurance, the skill, and the resource which Captain Noel showed throughout the expedition of 1922, and the first-fruits of his work were exhibited at the second Joint Meeting at the Central Hall on November 21. But the conditions at that meeting were unfavourable to a correct appreciation of his results. The great size of the hall, filled with London fog: the difficulties of projection in an operating room still in the hands of the builders, and the absence of the music which is now so striking a part of the show, combined to minimize the finer effect of what now proves to be, in its presentation at the Philharmonic Hall, a singularly impressive spectacle.

The first part illustrates the journey from the plains of India through the dense tropical forests of the Himalayan foothills towards the Jelep Pass, with its sudden transition from the wealth of vegetation and insect life to the high bare and dry highlands above the tree line; then the long marches over the wind-swept plains of Tibet, the camps thronged with ever-curious Tibetans, the industries of the people, the official visits of the Dzongpens, the arrival at the Rongbuk monastery, and the ceremonial reception of General Bruce by the Chief Lama, who lent

strong spiritual aid to the expedition by his blessing of the porter-corps. Captain Noel describes this first part.

Then in an interlude without lecture, but with music, we have a wonderful picture of the lama ceremonies and the " Devil-dancing " that takes place every spring in the monasteries : a picture which appeals even more to the anthropologist and the student of drama than to the geographer. By great good fortune the party included a man who combined in one person the climber, the painter, and the musician, not to mention that his real business in life is to be one of the foremost of the younger surgeons. Mr. T. Howard Somervell recorded the airs which the Nepalese porters sang and the wandering minstrels played on their fiddles : the music of the monastery clarinets, and the rhythm of their drums and magnificent long trumpets. He has arranged this music for an English orchestra of unusual composition, and the show gains thereby a distinction which should compel a second visit from those who saw only the first presentation at the Central Hall.

The third section, described by Mr. Somervell, shows the mountaineering from the start of the reconnaissance party for the East Rongbuk glacier to the reluctant withdrawal after the disaster that befell the third attempt. In a series of beautiful scenes one follows the climbers and the porters in their passage of the seracs, the life at Camp III., the climb to the North Col, and the several attempts on the mountain. Captain Noel had bad luck at the start in that his photographic porters were commandeered for the general transport when the local levies deserted, but by forced marches he reached Camp III. in time to make a most striking picture of the evening descent of the first party to the North Col, and of their return to camp next morning. He then carried his outfit to the North Col camp and photographed the second ascent from 23,000 feet until they were lost to sight against the dark rocks at somewhere over 25,000 feet. His studies of rushing cloud and wind-swept snow are magnificent, and he must be congratulated most warmly upon the result of a remarkable effort of endurance and skill. All who have tried it agree that the mental and nervous faculties are much diminished at these excessive heights. By strict concentration it is possible to do one thing, but it wants a very good man to attend to the many details required of a kinematographer operating with an enormous telephoto lens in camp for four days and nights at 23,000 feet, with the added responsibility of commanding the supports for the high-climbing party above him. Captain Noel is diffident of his results, and it has needed some persuasion to induce him to show some parts of the picture of the highest interest, but somewhat marked by the electric discharge in the camera that it seems almost impossible to avoid altogether in these conditions. We believe, however, that all who see the pictures will agree in thinking them most worthy of his reputation as a photographer, and worthy also of the fine climbing effort which it was his privilege to record.

The Mount Everest Committee, faced with the necessity of organizing a third expedition to complete their enterprise, have to rely in great measure on the proceeds of this kinematograph record for the requisite funds, and after careful consideration have decided that the film should be shown to the public for a season under their auspices at the Philharmonic Hall, in the best conditions possible for doing justice to the interest of the subject and the high accomplishment of the climbers. They hope that every Fellow of the Society will assist them by bringing the show to the notice of their friends. Now, if ever, is the opportunity for the moving picture to prove that it can be thrilling and entertaining, and at the same time educational in the best sense. If these pictures do not appeal to the public at large, it will be because they are resolutely averse to being entertained by real life, however strange and exciting. That remains to be seen; but we are confident that the kinematograph record of the Mount Everest Expedition of 1922 will attract and please many who have a well-founded mistrust of the instrument in its common use. A long career is being mapped out for the film in the principal cities of Great Britain, and later throughout the world. All friends of the Expedition will wish it success everywhere on its travels, with plentiful results for the further prosecution of the enterprise to which this Society and the Alpine Club are jointly committed.

REVIEWS

EUROPE

The Place-names of Lancashire.— Eilert Ekwall, Ph.D., Professor of English in the University of Lund. Publications of the University of Manchester, English Series, No. xi. Published by Longmans, Green & Co. 1922. *Price* 25*s.*

The Place-names of Middlesex.— J. E. B. Gover, B.A. (Cantab.). London: Longmans, Green & Co. 1922. *Price* 5*s. net.*

THESE are both good books of their kind, but Dr. Ekwall's marks an epoch in the study of English place-names. It bears the hall-mark of true scholarship, and one feels that the author has spared no pains to ensure accuracy. Dr. Ekwall has definitely set the pace for students of British place-names; his book will be a standard of reference for all future workers.

Certain criticisms, however, may be offered. On page 18, in discussing O.E. **tang*, **twang*, the author says of Tangmere, in Sussex: "The original situation of Tangmere is doubtful. The place was named from a lake which has now disappeared." This is not necessarily so. The suffix *-mere* is frequently used in O.E. to describe artificial ponds in places where a natural lake is a geographical impossibility; many of these ponds are still in existence, *e.g.* Rockmoor Pond, at the point where Hants, Berks, and Wilts meet. We find also *Thorc mere*, in Birch, *Cartularium Saxonicum*, iii. 1080; *meres byrig*, B.C.S. ii. 787, referring to the prehistoric hilltop camp on Ladle Hill, Burghclere, Hants; *risc maere*, B.C.S. ii. 625, now Rushmoor Pond (Hants, 34 N.E.).

Port (p. 257) is not necessarily connected *archæologically* with Roman sites,

Mountain Names in Hunza.

I was naturally extremely interested in General Cockerill's paper on "Byways in Hunza and Nagar," which appeared in the *Geographical Journal* for August 1922. There are one or two remarks I should like to make.

Regarding the high peak Malungi Dias, 25,668 feet, the name Dumāta was given us at the Hunza capital. I do not think the name given to us has any significance for the peak itself, but refers to the whole massif between the Malungutti glacier and the Hunza gorge. General Cockerill's name, Malungi Dias, was, I believe, given him in the Shingshal gorge, and must refer to the highest peak itself, for it is the only peak visible from there.

On p. 107 General Cockerill observes that the range, which is crossed by the Kilik, Mintaka, and Khunjerab passes, is called the Sarikol range on the 1 inch to 4 mile map of Hunza, published in 1915. This is a mistake on the map, and the name should be deleted. The Sarikol district is on the Pamirs, and I cannot imagine how the name ever found its way to the watershed on the southern border. As General Cockerill knows, these ranges have no local name. After our work in those parts in 1913, I suggested that as the range on which the Irshad pass lies was part of the northern branch of the Hindu Kush, this range extended along the watershed between the Ab-i-Wakhan and Chaprusan to Tong-i-tuk h.s. (19,135 feet); then to peak 21,019 feet, east of the Hunza valley. The Gulquaja and Kilik branches of the Hunza river have cut back into the range and thrown the watershed north of the old alignment, capturing more than one Pamir glacier. The question of the geographical name to be applied to this range is being referred to the Surveyor-General for consideration and decision; and he wishes me to thank General Cockerill for having pointed out the error in the map.

The exploration and survey of the Ghujerab, Khunjerab, Shingshal, and Batura have not been lost sight of, and it is hoped that one of the officers stationed at Gilgit will come forward with proposals shortly and apply for one of our Indian surveyors to accompany him. General Cockerill's work was extraordinarily accurate considering the difficulties of the ground and the lack of triangulated points; but more points are available now and much remains to be done.

KENNETH MASON.

Dehra Dun, 2 November 1922.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1922–1923

Second Evening Meeting, 27 November 1922.—The President in the Chair.

ELECTIONS.—Lieut. Arthur Cyril Allen, R.N.; Herman Andreae; Lieut.-Colonel Stanley Barry; Captain Hubert Beaumont; Edwin John Beer, F.G.S.; Charles Dalrymple Belgrave; Dr. Mark Benson; Frederick George Binney; Miss Elizabeth Thurston-Bowring; James John Breeze, B.A.; Major Rupert Brett, D.S.O.; Evelyn Ronald Brodrick Graham; James Richard Holcombe Cruikshank, B.A.; Miss Constance Marion Chalk; W. Tees Curran; Edward Hilton Eyre Cutbill; George Gordon Dennis; Alfred Ehrenreich, PH.D.; Ernest Arthur Emery, B.A.; Mrs. Enid Gordon Gallien; Lady Hambro; Right Hon. Lord Gainford of Headlam; Henry Hoare; Alexander Gordon Ingram;

BRIGADIER-GENERAL GEORGE PEREIRA'S JOURNEY TO LHASA

By the kindness of Major-General Sir Cecil Pereira we are allowed to publish the following account of his brother's remarkable journey from China to Lhasa and thence to India, extracted from letters received in the last few months.—ED. *G. J.*

GENERAL GEORGE PEREIRA left Tangar on 11 May 1922 with eight horses and twenty mules, his boy, six men, and four soldiers. He travelled up the Sining valley, seeing a few Chinese villages, passed Shara Kuto 27 miles from Tangar, and shortly afterwards crossed the Jih-yueh range, the geographical boundary between China and Tibet, though the present political boundary is the Tang-la range running east and west south-west of Jyekundo. In this area he met Chinese, Tibetans, and mounted Mongols. The altitude was about 11,000 feet. With the exception of lamas all the inhabitants are nomads who tend their flocks, and there are small patches of cultivation. The country consists of grass plains traversed by mountain ranges. Hares, marmot, chicoe, and lizards were seen. Sheep, chickens, and eggs could be bought. At distances varying from 12 to 20 miles to the north ran the Koko range south of the lake of the same name.

Gunga Nor was reached on May 15, and in the surrounding plain there were herds of horses and cattle apparently untended, though occasional Tibetan tents were seen. The route continued across the same plain, scrub and grass covered, and watered by two streams. General Pereira had gone ahead of his caravan and spent a chilly and foodless night in the open owing to the caravan losing its way, and he did not find them until the following morning. On May 19 he crossed the Hu-ka-ya-hu Pass, 12,000 feet, and then descended to the Ta-ho, where he found a Chinese company of sixty to seventy Mohammedan soldiers. In this valley he saw the first trees since leaving the Sining valley.

Two days later there was a heavy snowstorm and his mules broke down, unable to stand the severe climate with very poor grazing at times, and he was compelled to return to Ta-ho-pa to hire extra transport and an escort, as Golok raiding parties were reported in the neighbourhood. Though the military use mule transport, as their mules are fit and they travel with light loads rapidly across areas where the grazing is poor, on the journey mules were not found satisfactory and were the cause of constant delays. Yaks are slow but sure.

The big Cha-su-ra Pass (14,607 feet) was crossed on May 25. There was snow on the plain beyond, and in the evening a strong west wind. The following day a view was obtained of the Amn'e Machin peak in the far distance to the south-east; it was seen from an altitude of 13,000

feet, and it must be well over 25,000 feet as it towers above everything around. On May 28 he passed Tong-ri-tsonak (lake) (on maps shown as Tos-sun Nor), and he camped near a big company of Tibetans with six hundred yaks. These were the first inhabitants he had seen since leaving Ta-ho-pa; they were very friendly. As these Tibetans were bound for Jyekundo he travelled the next stage with them.

On June 2 he reached the Hwang-ho (Yellow River), and forded it where it was 2 to 2½ feet deep and 30 yards wide. From here on there were many Tibetan camps with yaks and sheep and good grazing until Ch'a-la-tu camp, 14,802 feet, was reached on June 9.

The following day he crossed the Ch'a-la-ping plateau, over 15,000 feet, and on June 12 the Ya-kou Pass (15,439 feet), the highest point on the route; shortly afterwards the Ch'a-ho, the headwaters of the great Yalung River, was crossed. He reached Chu-chieh monastery (in Tibetan Ju-chieh Gomba) on June 17, nearly 450 miles from Tangar. The monastery contains about a hundred lamas of the Red sect. With the exception of mud barracks at Ta-ho-pa and Ch'a-pu-ch'a and the small villages near it, this was the first building seen since entering Tibet.

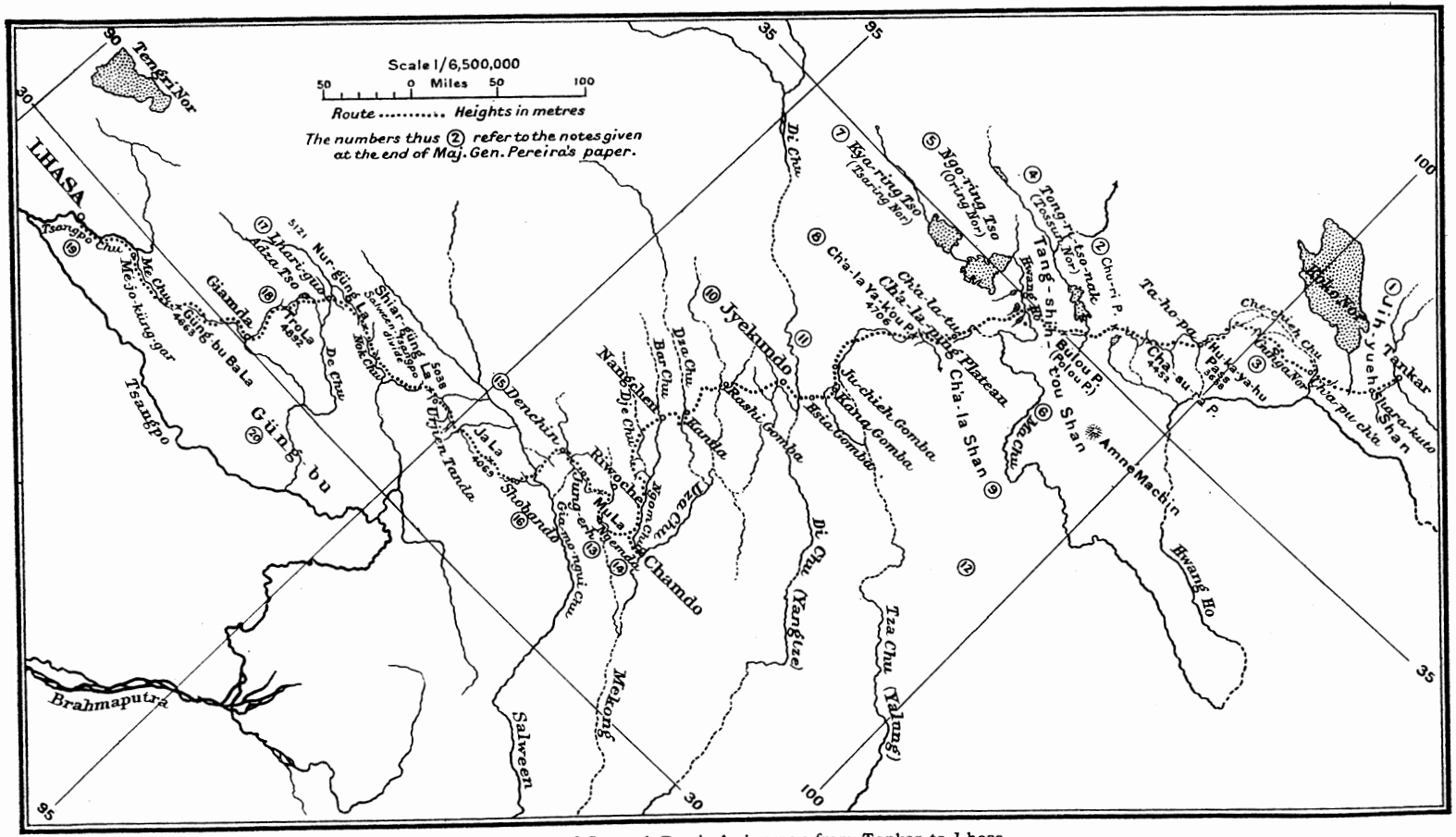
On June 18 he camped at Kana Monastery (two hundred lamas), and on June 20 at Hsiu Gomba, reaching Jyekundo on June 23, 518 miles from Tangar.

Before leaving Jyekundo on July 10 he sold nearly all his mules and horses and hired twenty-three "ula" yaks.

The first day's journey crossed the Ba-tang plateau (13,798 feet), after a climb of nearly 2000 feet. There were continuous climbs and descents into valleys with Tibetan camps, good grazing, and many flowers. He crossed the Sing-nak-ri-ya ridge, which rises to a height of 15,724 feet and is the divide between the Yang-tse and Mekong rivers. The country was practically devoid of trees. Rats (ara), marmots, hares, and gazelle were seen.

The general trend of the country in this part made the route a succession of precipitous climbs and descents over rocky tracks and occasionally across marshy places; then it led through beautiful grassy valleys with good grazing and many flowers. There were occasional Tibetan camps with flocks taking advantage of the good grazing; some downpours of rain and at times high winds that threatened to blow away the tents. To add to the discomforts, loads occasionally fell off the yaks when they were fording streams, with the result of wet clothing and blankets.

On July 12 he passed Rashi Gomba, a monastery of a thousand monks with a fine gold roof in the centre of the temple. The following day he crossed the valley of the Lung Chu (Wind River) and traversed some fir and bush tracts, the first tree region he had seen in Tibet excepting the Ta-ho-pu valley. He passed a Chinese caravan of twenty mules that had left Lhasa forty-five days previously. The Dze Chu (east



Sketch-map of General Pereira's journey from Tankar to Lhasa.

branch of the Mekong) was 80 yards wide with a very strong current, and is crossed in a coracle managed by a single paddle ; transport animals have to swim.

The " ula," the system of hiring yak transport by the stage, was found to be extremely well organized and a great improvement on buying mules and ponies for the journey. Tibetan villages, like Chinese, are run by a headman who is responsible for the provision of " ula."

Kanda was reached on July 15. It is a small village on the Mekong. or Dza Chu. Teichman's route had been followed so far (see *Geogr. Journal* map, January 1922). Kozloff's, Rockhill's, and Bower's routes were all crossed further ahead.

The Mekong (Dza Chu), passed on the 16th, was 200 yards wide; there was only one coracle available and the animals swam, the yaks being encouraged by being pelted with stones. These river crossings were always lengthy proceedings.

The China–Tibet frontier was crossed on July 22 before reaching Tang-kwa, the route leaving the Tibetan kingdom of Nang-chen, which is under Chinese rule, and entering territory governed from Chamdo.

At this period there was constant rain ; the route was constantly up and down stony hills, with many streams to be crossed and hardly ever a bridge. The villages are extremely small, two to seven houses, the houses built of mud and wattle, with plank floors and log roofs which very often leak. The windows occasionally have wooden shutters or merely a wooden framework, but without paper coverings as the Chinese have. Chamdo was reached on July 28, about 260 miles from Jyekundo and nearly 800 from Tangar.

Officials reported that the season had been abnormally wet, and that the Ngom Chu had not been so high for thirty years: it was now an impetuous torrent. Since leaving the China–Tibet frontier the country had been well bridged. Some of the bridges were remarkably well built and rested on stone piers which withstood the great force of the rapidly flowing rivers: a vast improvement on the rope bridges of western Szechwan. The bridge across the Ngom Chu near Chamdo consists of five piers each about 22 feet square ; the piers have an outer casing of wood and are filled with stones, and the roadway is supported by cantilevers.

Chamdo is a dirty little village on low ground on the narrow strip of ground between the Dza Chu and the Ngom Chu, which unite here and form the Mekong. To the north of the village are the ruins of the great Chamdo monastery destroyed in 1912 during the fighting between the Chinese and Tibetans ; part of it has been restored recently.

General Pereira was delayed at Chamdo until he had permission to proceed to Lhasa, and he started on September 6 with the following retinue : his Chinese boy, a half-caste muleteer that he had engaged at Tangar, a Chinese with a fluent knowledge of Tibetan, and one Tibetan

sent by the Drepon who is the representative of the Dalai Lama in Chamdo. He had a "ula" of eighteen yaks and six horses. On September 10 he crossed the Mu La, 15,667 feet, the Mekong–Salween divide. The Tibetans, unlike the Chinese, are very good at local geography; they know what rivers the streams run into, and the names of places, whereas the Chinese are grossly ignorant of these details.

After leaving Jung-erh on September 11 he saw about 40 miles to the south a great snow-clad range called the Tu-re-la, the only thoroughly snow-covered range seen so far, with the exception of the big Amne Machin mountain.

The weather was fine after leaving Chamdo and tents were not used, as a room in a house was generally available.

Denchin was reached on September 14, the chief official here being called the Ken-jung, who has the same rank as the Drepon at Chamdo.

The Salween (in Tibetan Gia-mo-ngui Chu) was reached on September 16; its position is incorrectly marked on maps. The following day he crossed it in coracles. His two private horses had now swum the Yang-tse, Mekong, and Salween, and had forded the Yellow and Yalung rivers, no mean equine record.

He got to Shobando on September 18, and was on the main road to Lhasa described by Abbé Huc. September 24 he reached Urjien Tanda and crossed the Shiar-gung La, 16,528 feet, with 2 to 3 feet of snow at the top. It has the reputation of being one of the worst passes on the road, and the track is very steep and rocky. The mountains round were all snow covered, possibly from a recent fall. This is the divide of the Salween and Tsang Po.

Three days later he journeyed up the beautiful Nok Chu defile with magnificent views between the hills, which rise about 2000 feet above the river. The valley-sides are covered with trees, chiefly firs, and he passed through many delightful woods. The Nok Chu is a foaming torrent 30 yards wide, which was crossed twice by bridges.

On the 28th he passed a caravan of 150 horses bound from Batang to Lhasa. This and the following days he had to camp out, on the 29th at a height of over 15,000 feet, and extremely cold. He had on the 29th crossed the Nur-gung La, which he estimated to be 16,800 feet; unfortunately spirit for his boiling-point thermometer had run out. This pass, he considers, excels the Shiar-gung La in difficulty, the track being if possible steeper and consisting of large and slippery boulders.

October 2 he crossed the Banda La (Archa Pass of the Indian map); he estimated the height as 16,200 feet, the third highest pass on the road. He soon after got a fine view of the beautiful Adza Lake of light blue colour among the snow-covered mountains. The only inhabitants seen were a few nomads.

On October 3 the Tro La was crossed, and the height of the pass was estimated at 16,050 feet; the going was better and easier than that of the

previous passes, but the zigzag ascent was very steep and the top of the pass was covered with snow. This was the last of the very high passes. The description "easier" is only comparative, as the tracks over the pass and through valleys abound with large rocks and the cold at high altitudes is always very great. In addition there is the constant crossing of streams which also have their full share of boulders.

To the west of the Tro La he passed some square towers 35 to 40 feet in height, which were built when the Jung-yer Mongols or Eleuths were powerful and raided from the Koko Nor district. They were crushed by the Emperor Chien Lung, who banished them to Chinese Turkestan, where a tract of country is still known as Jungaria, and General Pereira met some of their descendants when shooting in the T'ien Shan some years ago.

Giamda was reached on October 6, a comparatively large village of forty families, of which seventeen were Chinese. The day was sunny and the scenery lovely, the evergreens mingling with the yellow tints of the autumn. There were many flowers. It was possible to get eggs and potatoes, a great luxury.

Inner Tibet is essentially a country of high mountains and deep valleys. At this time of year, except at great heights, the weather is as mild as in England in autumn, with sun most days, and there had hardly been a drop of rain since leaving Chamdo.

On October 11 he crossed the last pass of the journey, the Gungbu Ba La, height estimated as 15,300 feet, by far the easiest pass on the whole road. On October 14 his thirty-fourth stage took him to Mé-jo-kung-gar. The character of the country now changed, and he traversed a broad flat valley; the enclosing hills were lower, 500 to 800 feet, with grass and scrub and practically no trees.

On October 17 he completed the thirty-seventh and last stage and entered Lhasa, 670 miles from Chamdo, 6360 from Peking, of which over 3500 had been traversed on foot. He was the first European to enter Lhasa from China since the celebrated Abbé Huc in 1845.

Explanation of numerals on the accompanying map.

The following are some of the more important notes given, at the places indicated by the figures, on General Pereira's MS. map of his route from which the accompanying sketch-map was taken:

1. Jih-yueh Shan (Sun Moon Range) is the boundary range between Kansu and Chinghai.
2. Chu-ri or Chi-da Pass (in Chinese A-mo).
3. Gunga Nor (Egg Lake) or Yün-Kai (fresh water).
4. Tong-ri-tso-nak (Lake of 1000 hills). In Mongol Butter Lake; on maps Tossun Nor.
5. Ngo-ring Tso in Tibetan means Blue Long Lake. The Mongol name is unknown.
6. In Tibetan Ma Chu, or Mother of Rivers.

7. Kya-ring Tso in Tibetan means Grey Long Lake. The Mongol name Tsaring Nor is unknown.
8. Ch'a-la Ya-K'ou (Pass) is on the Hwang Ho–Yangtze watershed.
9. Ch'a-la Shan. The Mongol names Baian-tukmu and Baian-Kara are unknown.
10. Jyekundo contains 240 families (200 Tibetan and 40 Chinese). There is a garrison of 70 Chinese cavalry, with 130 around in small detachments. The name Jyekundo or Jyeku in Tibetan, Chiehku in Chinese, officially Yüshuhsien, meaning Jade Tree City, from Tibetan name of district Yül-shul, meaning "country formed." Kansu Chinese pronounce it Yü-fu. It is inhabited by the 25 Ga-ba tribes, the district extending north to the Ch'a-la Shan.
11. 80 yards wide, deep and muddy, with strong current.
12. A note here states that the use of Mongol names is a great error. There are Mongols around Koko Nor (Blue Lake), and this Mongol name is therefore correct, the Chinese using Chinghai, which also means blue lake. Gunga Nor, a Mongol word, is also near where Mongols live. Further south there are now no Mongols, and such Mongol names as Tossun (it apparently should be To-su, meaning butter) Nor, Baian-tokmu for the great range, Oring Nor, etc., are entirely unknown to any Tibetan or Chinese. Amné Machin (pronounced by the Tibetans Anyé Măchīn) is the only Mongol name known to inhabitants. The Chinese name for this mountain is Ma-hi Hsüeh Shan.
13. Jung-erh (Rockhill's Mer Jong). Rockhill evidently took the name Mer Jong from Meru, name of the district, and Jong for Jung-erh.
14. Ngenda is Rockhill's Nyulda. It is placed too far north on the maps.
15. Denchin is Rockhill's Nar-pei-hu. The route from Denchin to Shobando has never been traversed before by a white man.
16. Shobando (officially Shumdo), an important place, with roads running north to link up with Nagchuka and Jyekundo, main road to Lhasa and Chando, and south a road by Poyul to Kala.
17. Dhari-guo (pronounced Lharin-guo, Lhari meaning Mountain of Spirits. It is the Lharugo Giachug of the Indian map, and is an important place, as the small road from Denchin comes here down the De Chu valley. The Indian map wrongly shows it as going to Sa-chu-ka. The De Chu is an important and deep river 30 yards wide.
18. As usual, streams change their names below a junction; for instance, Tro Chu becomes successively U Chu, Niem Chu, and Jya Chu at Giamda. Below its junction with the Si-arp Chu it is called the Güng-bu Zong Chu.
19. It is doubtful whether natives consider the Tsang-po Chu as the main branch of the Tsangpo, but in any case the pronunciation of the two names is the same. The Indian map calls it the Kyi Chu; everywhere the natives call it the Tsang-po Chu. At Lhasa the official name is Kyi Chu.
20. The Güng-bu district (Kong-bo of Indian map) extends from the Güng-bu Ba La on the west to Giamda, and thence south-east to Tsé-la-gong on the Tsang-po.

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THE ALPS OF CHINESE TIBET AND THEIR GEOGRAPHICAL RELATIONS

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Read at the Meeting of the Society, 11 *December* 1922.

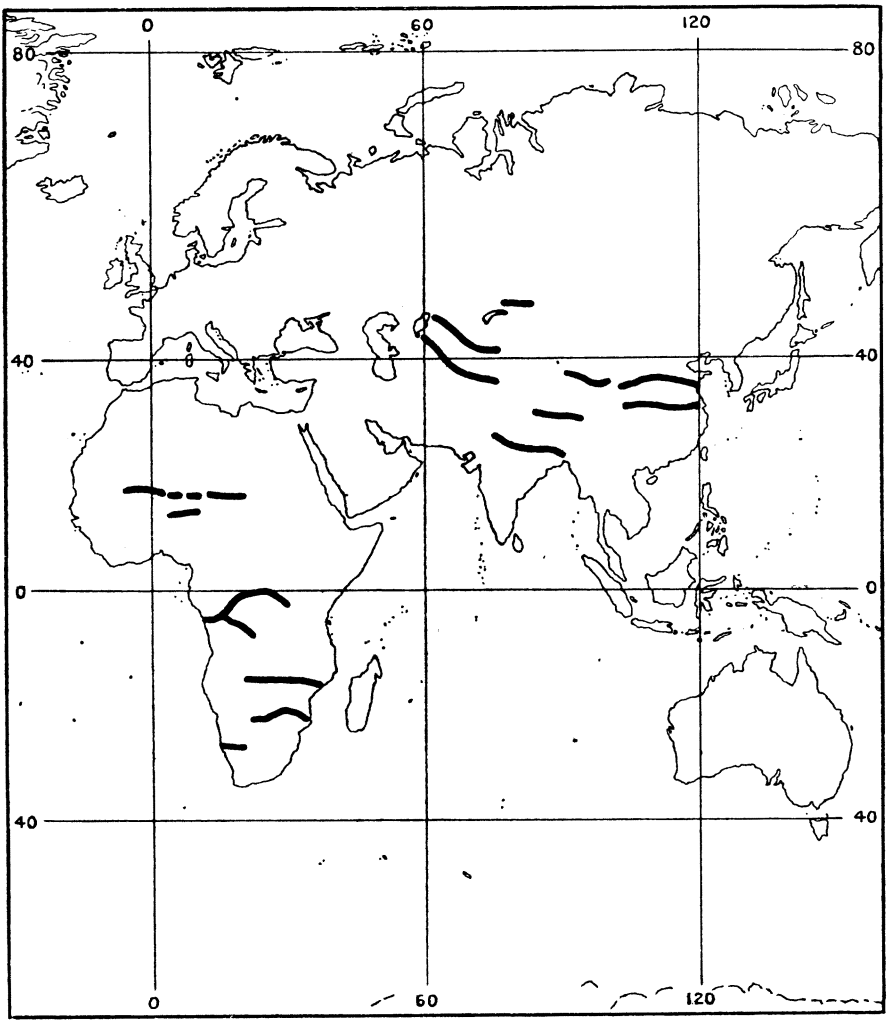
I. Introduction—the Problem of North-west Yunnan.

THE coasts of Burma and West Sumatra separate two areas which present one of the most striking contrasts in the map of the world. West of that line the geographical forms are simple and the units large; the coast-lines are long and straight; the islands are few and their outlines, as of Madagascar and Ceylon, are regular; the lands are vast continental blocks such as the peninsulas of India and Arabia and eastern Tropical Africa. East of Burma and Sumatra, on the contrary, the geographical forms are complex; the arrangement of land and water is exceptionally intricate; the coast-lines are deeply indented, and some of the islands, such as Celebes and Halmahera, are extremely irregular and project in long narrow sinuous peninsulas. The lands vary greatly in structure; some are fragments of a fold-mountain chain; others are relics of an old plateau; some have been piled up by volcanic eruptions; and others built as coral reefs.

This contrast between south-eastern and south-western Asia is dependent on differences in their mountain chains, which there truly answer the description of "the backbones of the lands." The relation between the land-forms and the mountain structure of south-eastern Asia is however obscured by uncertainty as to its mountain plan. The southern border of the Eastern Archipelago consists of fragments of a great chain of fold-mountains, the Malay Arc, which was formed by similar processes and at the same date as the Alps and the Himalaya. The Malay Arc bends northward at its western end, and is continued as the Burmese Arc; it also bends northward at its eastern end off the northern edge of the Australian platform. The combined Burmese–Malay Arcs are, according to one interpretation, the main continuation of that Alpine–Himalayan mountain system which includes the chief mountains of Europe and Asia from the Pyrenees to Assam. Upon this view the further eastward extension of the Alpine-Himalayan line was

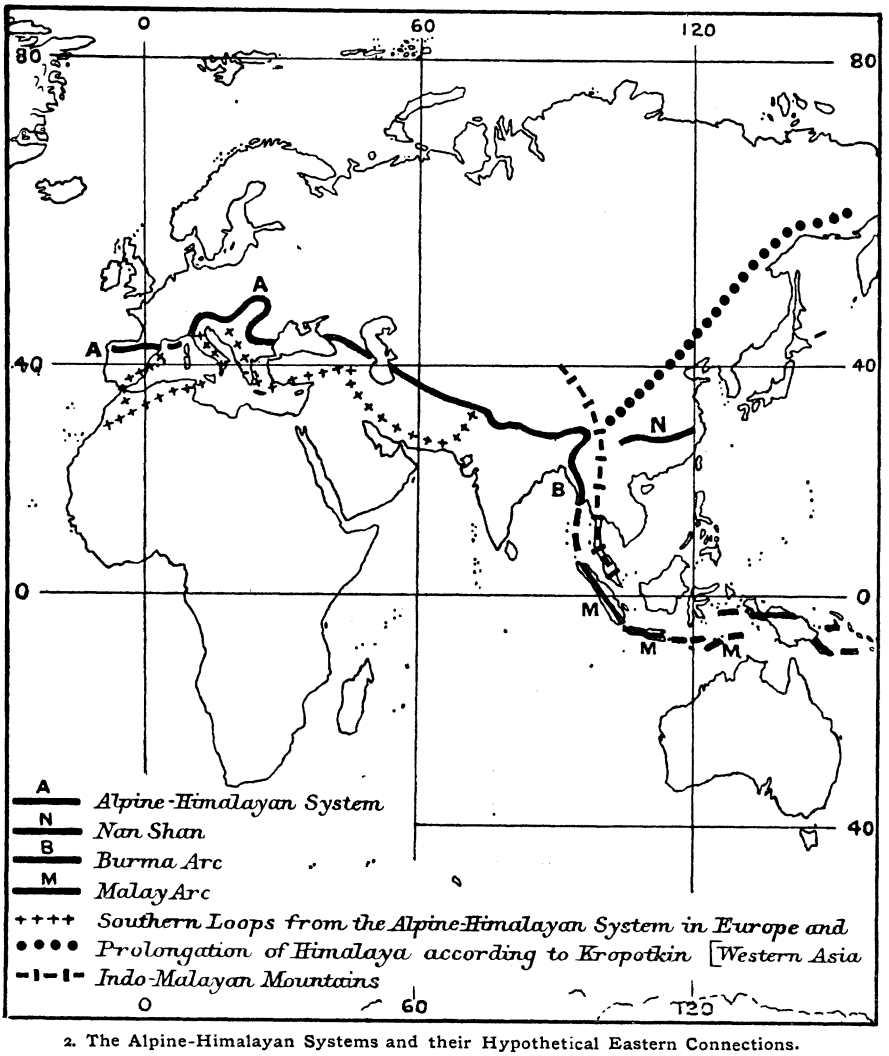
blocked to the east of Assam by the older Indo-Malayan System, which forms the great projection of south-eastern Tibet into Indo-China. This firm mass resisted further crumpling and diverted the later Alpine-Himalayan folding southward, and the surf-line of that crustal storm is preserved as the Burmese and Malay Arcs.

A different interpretation has however been advanced by Kropotkin in his ' Orography of Asia,' and amongst English authorities on western China by Archibald Little. Impressed by the great snow-clad mountains which are known as the Alps of Szechwan, and especially by the range which Little called the " Ta-shüeh Shan " or the Great Snow Mountains, they considered that the Himalaya extend eastward from Assam into



1. East-and-West Valleys due to Early Folds.

Central China; thence, according to Kropotkin, the line is continued northward as the Great Khingan Mountains, passes into the mountain chains of north-eastern Asia, and, crossing Behring Strait, is continuous with the fold-mountains of western America. This problem is intimately connected with the development of the river system of south-eastern Asia and with the geological history of the Indian Ocean. The evidence of Indo-China and south-western China on the latter question is correlative with that of the African rift-valley system. Hence arose the interest felt by one of us for many years in the geographical and geological investigation of south-eastern Asia; we were accordingly glad of the opportunity during the present year for a visit to Yunnan in order to



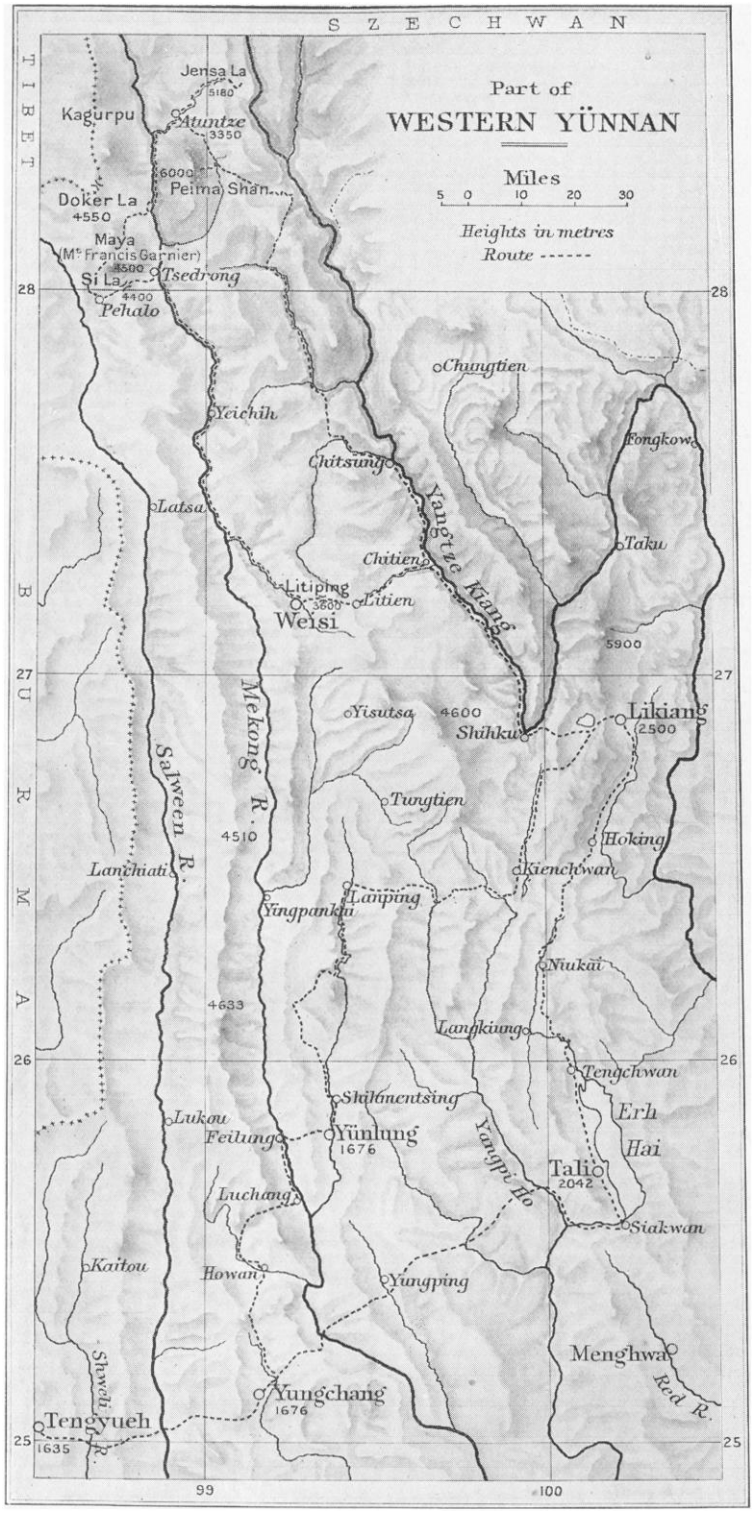
2. The Alpine-Himalayan Systems and their Hypothetical Eastern Connections.

collect further evidence on its geographical problems. The kind support of Sir Francis Younghusband, then the President of the Society, helped to secure the sanction of the Foreign Office for our visit. The Sladen Trustees gave us a generous grant in aid, and our journey was therefore conducted as one of the Percy Sladen Memorial Expeditions.

II. Itinerary.

We reached Bhamo on the Upper Irrawaddy on 7 May 1922. There, owing to the kindness of the District Commissioner, mules were ready for us, and we left the next day. We reached Tengyueh (145 miles) by an eight days' march. As our Indian servants could not accompany us further they were sent back; we engaged a Chinese staff, secured mules that were used to the mountain tracks, and obtained permission from the Chinese authorities to go to Likiang, on the border of Chinese Tibet, where our further movements could be decided. From Tengyueh we proceeded to Yungchang, where we left the main road and turned aside into country which was all geologically, and some of it geographically, unknown. From Yünlung, one of the best known centres of the salt-mining industry, we followed up a river, the Loma Ho, into an area which is represented by a blank on General Davies' map of Yunnan. We reached villages which, according to their headman, had not been previously visited by Europeans. The district was apparently inaccessible until after the revolution of 1911, but since then the people are reported to have become more peaceful and law-abiding. One of the changes produced by the revolution we saw at the salt-mining town of Shihmentsing, where the largest temple has been turned into a school, and owing to its ample endowments education in the town is now free and practically universal. We were allowed to camp in the quadrangle, and delayed our start next morning to see the school at work. Ascending the Loma Ho we passed a series of hot springs, some of which are active and some extinct. They indicate recent earth-movements along the valley. We also passed mines of mercury, silver, and copper.

At Likiang we had to engage fresh mules, secure a new escort, and obtain permission from the magistrate to enter Chinese Tibet. Here we were met by a double check. Our money, which had been forwarded by draft, had not arrived, and the magistrate objected to our going further to the north owing to the disturbed condition of the country. During the discussion it came out that his action was due to peremptory orders from Yunnanfu, the provincial capital, and from Tengyueh, that he was to prevent our going on by all the means in his power. The only policy available was to assure him that these orders could only have been issued by people who were ignorant of the magnificent improvement in the district effected by his administration, and that our inquiries of the local merchants showed that there was no serious risk. He agreed to



TO ILLUSTRATE THE PAPER BY PROFESSOR GREGORY ON THE ALPS OF CHINESE TIBET

let us go on, provided he had no further orders from the capital, if I would sign a letter stating that we went on at our own risk and responsibility. He probably thought we should decline this offer; but we accepted it at once, and as soon as we had secured part of our money, rushed on to reach country where we should be safe from recall. We descended from the plateau of Likiang (8200 feet) into the deep valley of the Yangtze (6200 feet), which though there over 2400 miles from the sea is a great river. It was then in flood owing to the melting of the snows in Tibet. A march of 40 miles up its valley enabled us to confirm Loczy's account of its structure; so we turned westward to the Mekong and crossed the Litiping Pass to the Chinese "western fortress," Weisi. Thence we travelled north up the basin of the Mekong in order to examine its structure. We crossed the Mekong by a rope bridge at Tsedrong, and thence, with three local porters and four of our own men, climbed over the divide into the valley of the Salween. At Pehalo, however, we found that the Salween valley was so smitten with famine that work there was impossible, and we returned to the Mekong over a pass at the northern foot of Mt. Francis Garnier. After rejoining our caravan we resumed the northward journey to Atuntze. Thence in company with M. Peronne, who has long been resident in that town, we made some excursions into the mountains on the Mekong–Yangtze divide, among which we observed remarkable instances of Himalayan earth-movements. From Atuntze we returned past the mountain mass of Peima Shan, to which we made a branch excursion, but bad weather frustrated the attempt to cross its glaciers. The route down the Yangtze being flooded we travelled south by a mountain track and joined the Yangtze road at Chitsung. Thence we returned to Likiang, where, owing to the kindness of the Rev. P. Klaver of the Pentecostal Mission, mules for the journey to Tali were secured without loss of time. We followed the road through Hoking. The return journey was troublesome owing to the flooded condition of the country after the abnormally heavy rains. After Tali we joined the main route across central Yunnan to Tengyueh, where Mr. Houston, the Imperial Commissioner, had engaged mules for the descent to Bhamo, which we reached on September 8.

III. The Mountain System of South-west China.

1. *The Indo-Malayan Mountains.*—South-eastern Asia is one of those regions of which the geography is mainly dependent on the mountain structure. The region has been built up on a foundation due to mountain formation at two different periods. The older mountains are contemporary with the Hercynian System of Europe, which is so named after the Hartz Mountains in central Europe. This Hercynian System also includes the hills of Brittany and the Urals of Russia, and it is represented in the British Isles by the Mendip Hills, the Pennine Range, and the Peak of Derbyshire. Mountains formed at the same date are

extensively developed in Asia, and Suess gave them the somewhat inappropriate name of the Altaids (cf. *Geogr. Journ.*, vol. xlv. p. 503). In south-eastern Asia these Altaids, the Asiatic representatives of the Hercynian System, form the Indo-Malayan Mountains, the significance of which was first appreciated by von Richthofen. They are of primary importance in the geography of south-eastern Asia, although their influence on the present relief is indirect. They were formed at about the age of the Coal Measures, and therefore in an early period of the Earth's history. Their crests have been planed down, and their foundations in some localities lie beneath widespread plains and at others stand up as massive plateaus. When these plateaus are exposed to rain and rivers, deep valleys are cut out along the less resistant rocks; the hard masses form mountain ranges, and fresh earth-movements are often guided by lines of weakness due to the older movements. The later remodelling of south-eastern Asia therefore shows many coincidences with the Hercynian mountain system.

2. *The Himalayan Movements in Yunnan.*—The second great period of mountain formation was modern, and to it are due the main existing mountains of the world. The earth-folding of this period formed, amongst other mountains, the Alps, the Himalaya, and the Burmese-Malay Arc. The mountains then formed can be most easily recognized when they include rocks younger than the Hercynian movements.* The only rocks in western Yunnan deposited between the Hercynian and Himalayan movements are a series of salt-bearing red beds like those of the English Midlands. These rocks have been intensely folded and sometimes even inverted; and these disturbances are necessarily post-Hercynian. Unless there has been a period of mountain formation intermediate between the Hercynian and the Himalayan, the folding of the red beds must be due to the Himalayan movements.

In the case of mountains formed of pre-Hercynian rocks, it is fortunately sometimes possible to determine that their upheaval was due to post-Hercynian disturbances, and must therefore be attributed to the Himalayan movements. For example, the peaks beside the Si La show complex over-folds which are relatively shallow; they rapidly diminish in intensity as they are followed downward, and the lower parts of the mountain do not share in the corrugation. The sudden cessation below of the Si La folds indicates that they were part of a relatively shallow folded layer, and are probably Himalayan in date. The movements that formed the Indo-Malayan mountains gave this area its grain, which lies north and south; hence, as the mountains due to denudation are dependent upon this grain, they also trend in that direction. We found, however, clear evidence of mountain movements of a later date, some of which follow the grain of the area while others go approximately at right angles to it.

* These movements culminated in south-eastern Asia in the Middle Permian.

The distribution of the mountains in this area of 20,000 feet and over is still unknown, and its discovery offers work for many mountaineering expeditions ; but so far as the evidence is known to us these lofty mountains are arranged on two lines which run approximately east and west. The northern of these lines is the Tashuih Shan (*i.e.* the Great Snow Mountains) which rise above the ancient Chinese road to Lhasa between Batang and Tatsienlu ; some of its summits were measured by Kreitner and found to have an elevation of 26,000 feet. West of the Yangtze Kiang are further high mountains, of which the range is little known as they stand on the still forbidden borderland of autonomous Tibet, but Litton, Ward, and others have referred to the existence there of a high mountain wall which runs westward and forms the southern boundary of the Tibetan plateau. South of the Tashuih Shan lies a series of valleys and basins which are lowlying and fertile in comparison with the steppes to the north. South of this line of depressions the mountains rise again to the peaks of Kagurpu, to those near Atuntze, and the numerous snow-clad mountains of southern Szechwan. Their geographical outlier, the snow-capped range of Likiang, has been overthrust from the west, and it appears to be the southernmost mountain directly due to the Himalayan movements. Bacot has remarked ('Tibet Revolté,' 1912, p. 257) that the Salween near Drongneu has cut its way through "a second Himalayan chain," and our observations, on both the geographical and geological structure of the country, support the probability of that identification. The snow-capped peaks rise from a plateau of which the surface is now a peneplane with a general slope downward from north to south ; the level falls from 12,000 feet in parts of northern Yunnan and Szechwan to 7000 feet where remnants of the plateau surface can be recognized between the deep valleys of southern Yunnan. The slope of this surface must have been due either to tilting along an axis trending east and west, or to denudation by rivers flowing from north to south. If the last uplift had been along lines from north to south, then the surface slopes, whether due to tilting or denudation, would have been downward to west or east. The distribution both of the Alpine peaks and of the plateau slopes indicate that the last mountain uplifts in this district were along axes trending east and west. Near Hoking there is an especially striking example of the east and west mountain folds, for in the range west of that city the beds have been flung on end ; instead of their normal course of north and south they suddenly turn east and west. These uplifts happened at about the culmination of the Alpine–Himalayan upheavals, with which they agree both in date and trend. The movements of this epoch were naturally not all on lines trending east and west, for their direction is affected by the grain of the country and by the reaction between the solid plateau of south-western China and the weaker rocks around it. The course of these uplifts agrees in some respects with Deprat's Yunnan Arc, but it

is doubtful whether there are any mountains along the central part of that arc, as marked by Deprat (' Mém. Serv. Géol. Indochine,' vol. i. pt. i. p. 303), due directly to uplift.

The belts in south-eastern Asia affected by the Himalayan movements occur in three different conditions. The first is along the direct continuation of the main line of the Himalaya, and it is still marked by chains of lofty mountains. The second is found on the belt of down-like country and dissected plateaus where once stood the foothills south of the main chain. The third condition is seen in the Burmese–Malay Arcs, with their great loop to the south. The first type includes snow-clad mountains, which rise to between 18,000 feet and 26,000 feet. The second condition is seen in the dissected plateau of western Yunnan along the route from Yunnanfu and Tali to Tengyueh. The third is met with in the highland rim of the Burmese–Malay Arcs. The first and third of these conditions are represented by conspicuous mountain chains which are still important geographical divides ; but the second condition occurs in an area which has been levelled to a widespread plain, and its original structure is only shown when deep valleys expose the folds and overfolds in the rocks.

It may be suggested that if these three geographical types were due to movements of the same kind and date, they should not now be in such very different geographical preservation. The explanation of this apparent difficulty is that the movements of the second series occurred in the foothills, which have been planed down by rivers from the adjacent mountains. Moreover, the mountains of both the other types have been subject to enormous denudation. The continuity of the original mountains has been broken by wide gaps which, in the western part of the Burmese–Malay Arcs for example, are larger than the remnants.

There is nothing in the condition of preservation of Kagurpu, or of the Tashuih Shan near Batang or other of the Alps of Chinese Tibet, or of the mountains of the Burmese–Malay Arc, to disprove their formation at the same period as the mountains of the Alpine–Himalayan systems.

3. *The Eastern Continuation of the Himalaya.*—We consider then that the structure of western Yunnan is best explained on the view that the line of the Himalaya is not wholly bent back around Assam, but that one division of it continues eastward into China. Two routes have been suggested as the eastern prolongation of the Himalaya. Kropotkin held that the Great Khingan Mountains are the direct continuation of the Himalaya ; but that view seems untenable owing to the essential difference in structure between those two mountain chains. Mr. Kingdon Ward has suggested that the Himalaya are continued as the Tsinling chain, upon which hypothesis no final conclusion is possible until more is known of the Taliang Shan (*i.e.* the Great Ridge Mountains) of southern Szechwan. If their axial lines trend approximately south-south-west to north-north-east and have been caused or renewed by movements of

Himalayan date, they may be a link between the Himalaya and the Tsinling Mountains; but the last contribution to their geology, the memoir by Legendre and Lemoine ('Massif Sino-Tibetan,' 1916), though giving no conclusive evidence, indicates that the Taliang Shan are due to the dissection of mountain lines of Hercynian age which had a general trend of east to west.

The evidence renders probable the continuation of the main Himalayan line across southern China through the Nan Shan Mountains which separate the Yangtze Kiang from the Si Kiang (West River). Information as to the geological structure of these Nan Shan is still meagre, but there is evidence that this region was affected by mountain-forming movements at the date of the uplift of the Himalaya. For example, there is a chain of mercury ores in Kweichow, and all the chief mercury mines of the world are in belts that have been intensely compressed by mountain-forming movements of the age of the Alpine and Himalayan systems. The mercury deposits of Kweichow were probably formed at the same time as those of the other chief mercury fields and under similar circumstances; so their occurrence supports the view that southern China was upheaved into a mountain chain at the same date as the Himalaya. This Nan Shan chain was bent northward at its eastern end by the resistant mass of ancient rocks along the coast of south-eastern China.

On this conclusion the continuation of the Himalaya in China follows approximately the course of the eastern end of the Yunnan Arc and "Sino-Annamitic faisceau" of Deprat ('Mém. Serv. Geol. Indochine,' vol. i. pt. i. 1912; 'Géologie Générale,' pp. 300–301). Deprat gave the name of the Yunnan Arc to a zone of folding which runs from Tibet parallel to the three rivers and east of the upper part of the Yangtze, where it includes the peak of Likiang; it then widens southward to include the area between the Tsang Shan of Tali and the divide between Tali lake and the Yangtze Kiang; in the longitude of Yunnanfu it ranges southward for 140 miles nearly to Linan in the basin of the Red River. Between Yunnanfu and Linan its trend is west and east, and it butts against the Sino-Annamitic chains; it passes into south-central China on a course to the north-north-east and disappears before reaching the Yangtze, leaving the Nan Shan constituted by the Sino-Annamitic folds which pass on to the Pacific border near Shanghai. The only part of this Yunnan Arc that we crossed was in the region of Tali and Likiang. The country including the essential part of the Yunnan Arc between Tali and Yunnanfu has been well described by Mr. Coggin Brown. Its surface is very irregular; but the undulations appear due to the denudation of an ancient plateau in consequence of the formation of deep basins by subsidence after the mountain-folding had ceased; there is no clear evidence for the survival in this area of any mountain due directly to the Himalayan folding.

According to our interpretation the direct prolongation of the Hima-

layan axis crosses southern China, and the Burmese–Malay Arcs form a loop to the south comparable to the Persian loop in western Asia and the Apennine loop in Europe.

In correlating the mountain lines of Asia and western Europe one important difference must be remembered. In central and western Europe the pressure which crumpled the Earth's crust into the mountain chains of the Atlas and the Alps was exerted from the south. From the Black Sea eastward across Asia the pressure was from the north. Hence in western Europe and northern Africa the mountain chain which is homologous to the Himalaya, as the inner member of the mountain system, is the Atlas; the Alps are homologous to the outer division and therefore to the Burmese–Malay Arcs.

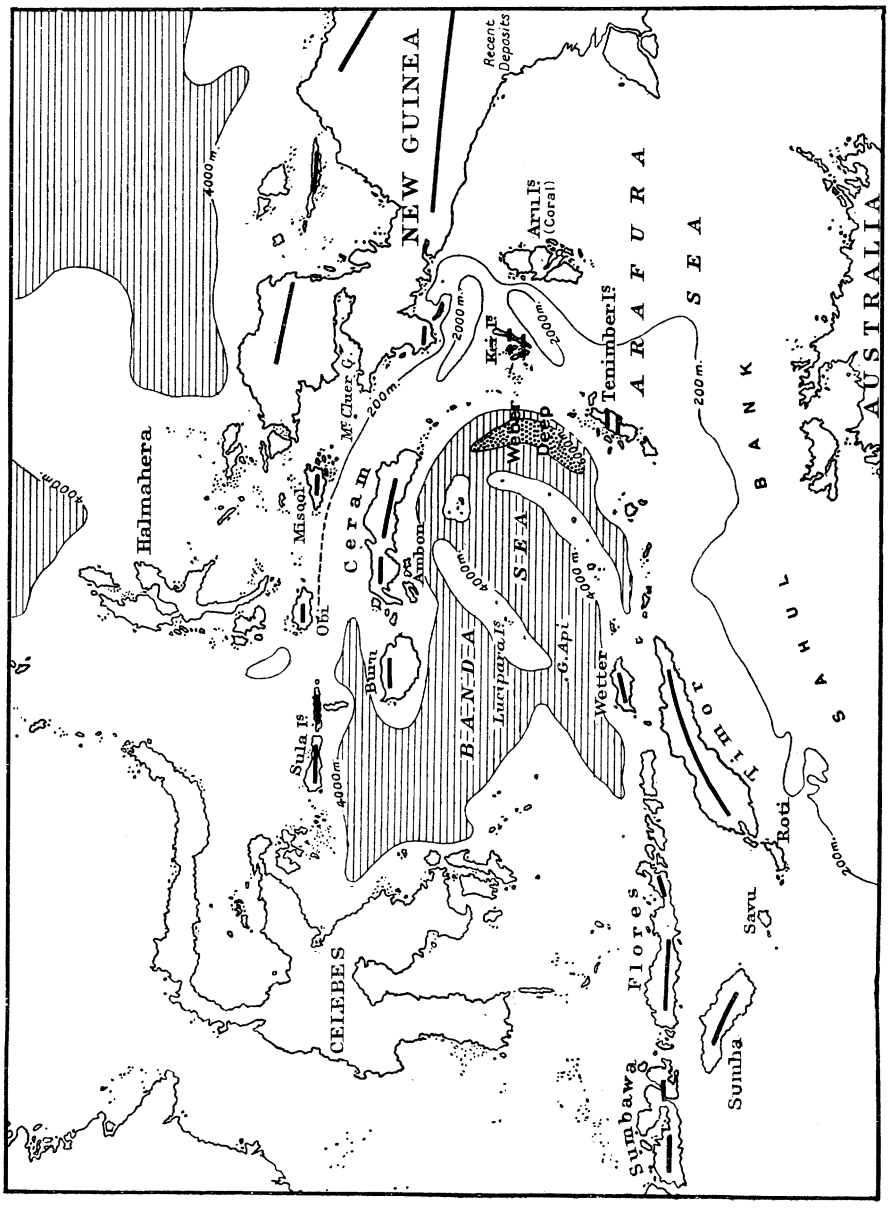
4. *The Subsidences within the Mountain Zone.*—On the relief of the pressure which made the fold-mountains, large areas sank between the outer and the inner series. Thus in Europe were formed the basins of the Mediterranean and the Black Sea, and in eastern Asia the deep basins that broke up the land into the Eastern Archipelago.

Further west the great basins of southern China and of Indo-China and Burma as well as the Gulf of Martaban are to be regarded as due to similar subsidences between the direct prolongation of the Himalayan line and its southern loop.

5. *The Malay Arc and its Eastern Termination.*—We have seen therefore that the supposed hairpin bend of the Himalaya around Assam is not a simple loop, but is part of the mountain knot by which the Burmese Arc is joined to the main mountain axis of Asia. At the eastern end of the Malay Arc the same problem arises, since that arc is generally represented, *e.g.* in the instructive lecture delivered to the Society by Dr. Molengraaff in 1921, as ending in a sudden reversed bend around the Banda Sea.

According to Suess ('Antlitz,' 3, 1901, pt. i. pp. 304–307, 331), on the other hand, the Banda Arc is not a chain of fold mountains but an "arc-shaped horst," and the two peninsulas north-west of New Guinea, which are separated by McCluer's Gulf, are the continuation of the Sula–Obi–Misool line on the north and of the Buru–Ceram line on the south, while the Timor Arc continues eastward as part of an east-to-west chain which is independent of the two northern lines. Bohm (1906) has adopted the same general view. The geological evidence appears to us consistent with it. The Tenimber Islands have been shown by Professor Brouwer to include vertical Mesozoic rocks, which he compares to those of east Ceram; but their strike varies from east and west to 25° N. of W., and is therefore that of the island chain extending westward from Tenimber to Java and is not due to folding on the line of the Banda Arc. In the Kei Islands also the strike of the older and more steeply tilted beds trends east and west (see *Verbeek, Jaarb. Mijnw.*, 37, 1908, pl. xv. figs. 421, 431, 440) and is part of the general east-to-west

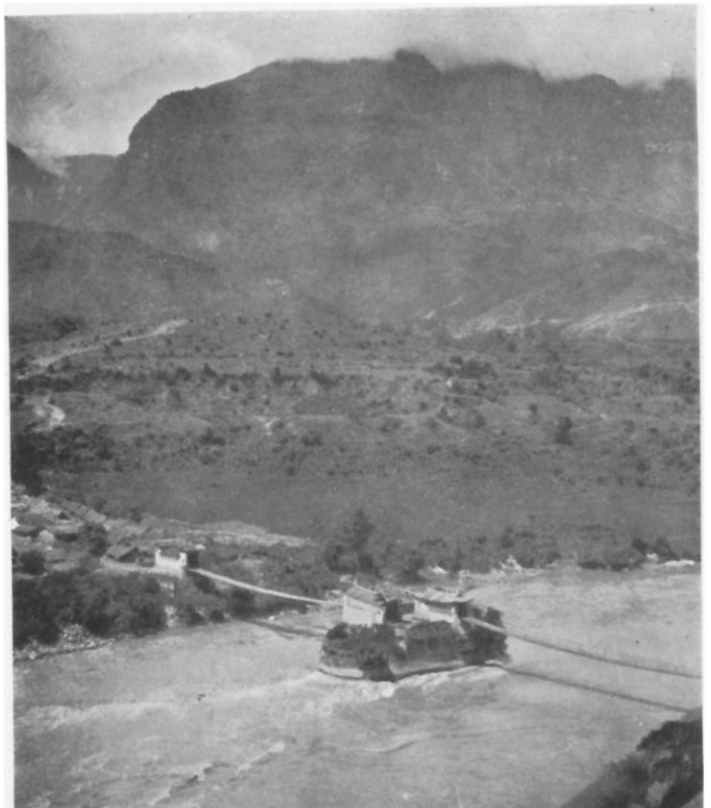
grain of this region, which is older than the Banda Arc. It is true that in Great Kei there are some shallow folds with gentle dips which trend from south-south-west to north-north-east, parallel to the eastern part of the Banda Arc; but they may be explained by a gentle tilt of the foundation toward the Banda subsidence, and they do not indicate a chain of fold mountains connecting those to the north and south of the Banda Sea.



3. THE BANDA ARC

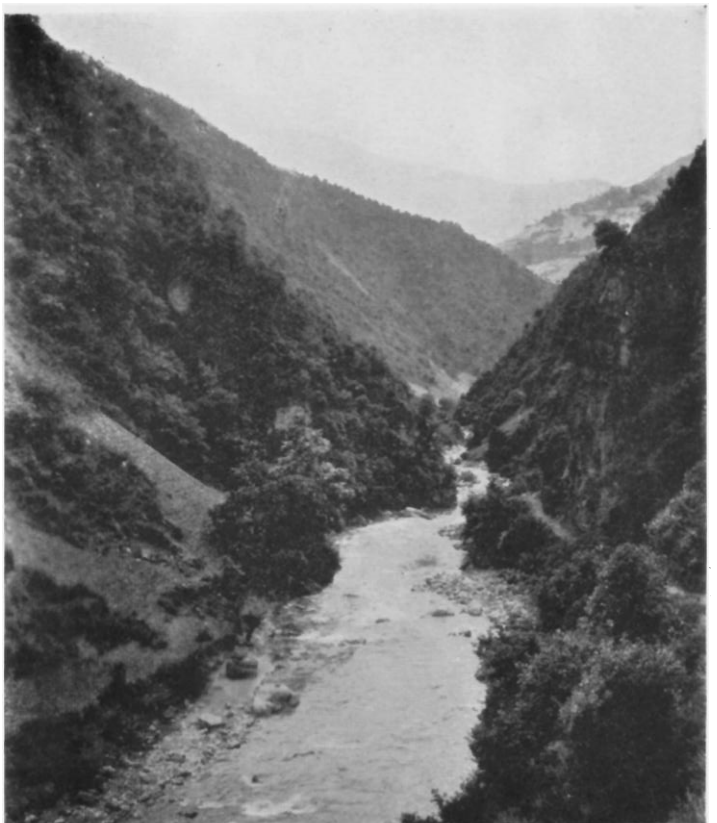
The characteristic rocks of the Ceram–Buru line and of the islands of the eastern end of the Timor chain have not been recorded from the Kei Islands, which form the middle and essential part of the Banda Arc. The geology of the Kei Islands shows that they stand in a long-established valley between the mountain axis of New Guinea, Ceram, and Buru on the north, and the line through Timor and northern Australia on the south. There appears as yet no evidence of the formation of a chain of fold-mountains running north and south to the east of the Banda Sea. The existing evidence is consistent with the conclusions that the Buru-Ceram line is a prolongation of the northern mountain axis of New Guinea; that the Java–Timor series is a prolongation of the mountain lines of south-eastern New Guinea, and that the Kei Islands stand on an intermediate horst.

The Alpine–Himalayan line is therefore recognizable from the Pyrenees to Papua. Both ends appear to be cut off abruptly, the Pyrenean by the Atlantic, the Papuan by the Pacific. There is strong evidence that the line was continued further in both directions, the Pyrenean across the Atlantic, and the Papuan far out into the mid-Pacific. If, as seems probable, the formation of this great fold-mountain chain was due to the pressure of the northern cap of the world against the tropical or subtropical zone, this action should also have affected the floor of the Pacific. That this zone of mountain-folding did affect the Pacific basin is indicated by two lines of evidence. East of New Guinea extends the area of the coral atolls of the Pacific; and according to Darwin's theory, which seems now to be generally accepted, each atoll is a garland of coral marking the site of one of the mountains of a submerged continent. The existence of land extending far out from eastern Asia and northern Australia into the Pacific and possibly connected with America would explain many striking resemblances between the animals and plants of tropical Asia and Australasia and of the opposite regions of America. The remarkable resemblance of the flora of south-eastern Asia to that of the southern parts of the United States, which was recognized by Asa Gray, has been fully confirmed and is supported by the evidence of various groups of animals. Two objections to this view may be taken. One is that all these cases of community were established by the organisms having spread, not across the Pacific, but around it *viâ* Behring Strait or the Antarctic Continent. The second objection is that the evidence is inadequate, since clear evidence of any such Pacific land would have been afforded by such groups as the higher mammals and the birds; but if a land connection had been raised by the earlier uplifts of the Alpine–Himalayan Series and had been broken and parts of it submerged beneath the ocean in the Miocene, that land connection would not have been available to the more recently developed birds and mammals. They could only have passed from Asia to America by the northern route.



THE TWO-SPAN CHAIN BRIDGE ACROSS THE SALWEEN RIVER ON THE ROUTE FROM TENG-YUEH TO TALI

The foothills consist of red sands; the range to the west consists of crystalline limestone, quartzites, and schists.

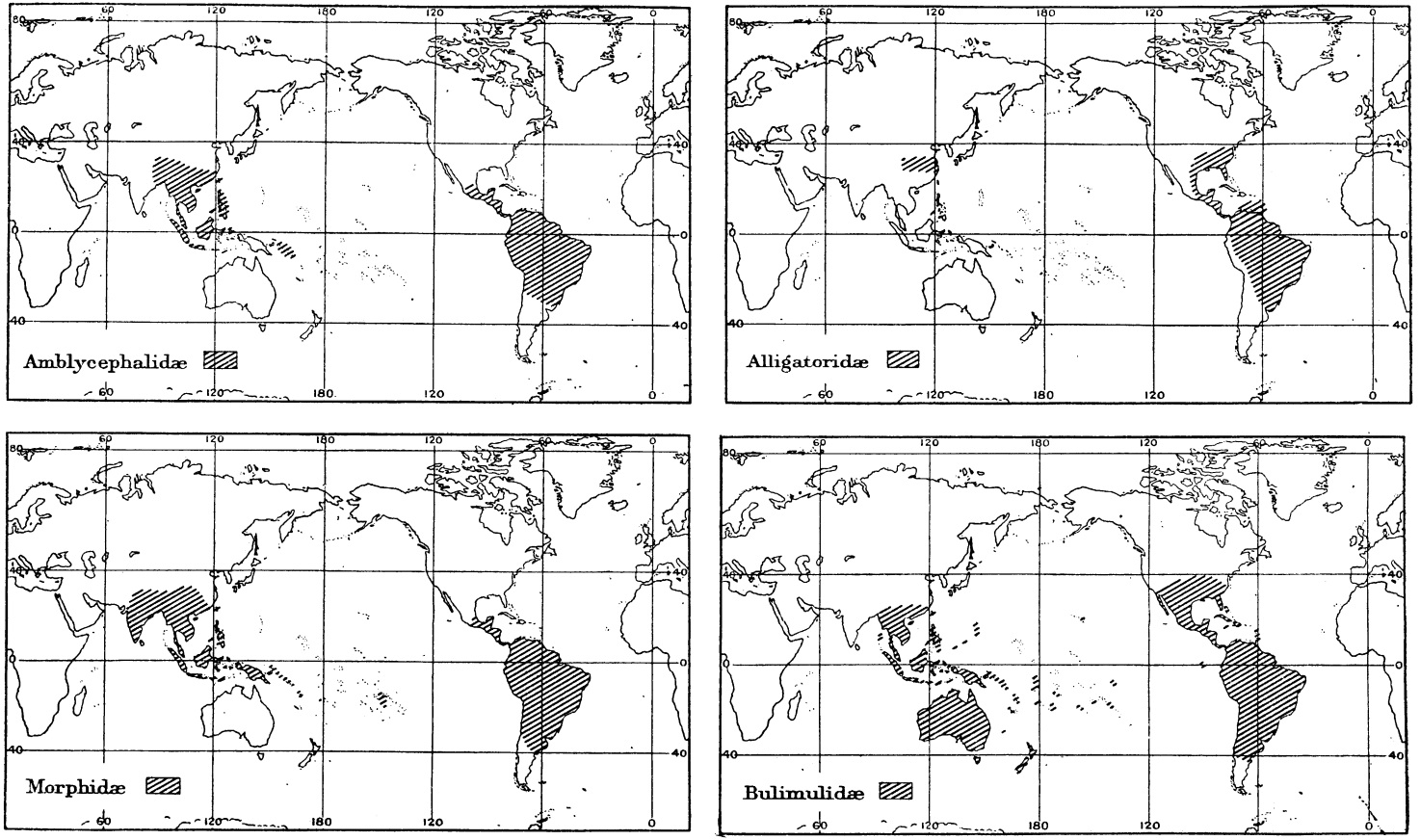


LOOKING SOUTH-WEST DOWN THE WEISI RIVER AFTER ITS PASSAGE THROUGH A DEEP GORGE

THE GORGE BELOW LONDRE

The ridge is part of the floor of the old high-level valley, dissected by the Mekong and its tributaries.

RAPIDS OF THE MEKONG AT NANTAO



4. TRANS-PACIFIC BIOLOGICAL RANGES

[*Redrawn from Bartholomew's Atlas.*

The danger of trusting to one or two of the highest and most recently developed groups is shown by the fate of the famous " Wallace's Line," which was drawn to separate the Asiatic and Australasian sections of the Eastern Archipelago. When the distribution of some older forms of life was duly considered that line disappeared and it has been replaced by Weber's line across the Sunda Sea, on a route much farther to the east.

This biological evidence is attended by the drawback that as only those animals and plants that were in existence in the Oligocene or Miocene could have used a trans-Pacific route, their ancestors may have crossed by a northern Pacific land bridge and have been exterminated from the northern lands. When however representatives of these groups are found living on the islands far out in the tropical Pacific, and there is no evidence of their occurrence in northern Asia or America, a mid-Pacific route would appear more probable. This conclusion is especially probable for those Asiatic and American forms that are so similar that they have been regarded as almost specifically identical; they are more likely due to survival, under unchanging climatic conditions, from a once continuous tropical or subtropical habitat than that the species should have wandered for so great a distance and across different climatic zones without having undergone greater change.

There is much biological evidence consistent with the physical evidence for a great land in the tropical Pacific in continuation of the Asiatic mountain lines.

IV. The Parallel River System of Chinese Tibet.

1. *The Parallel Courses of the Three Rivers.*—The other main geographical problem on which we hoped to obtain further information deals with the parallel course of the upper parts of the three great rivers of south-eastern Asia. Eastern Tibet is drained by the Yangtze Kiang, the Mekong, and the Salween; they converge as if they were about to unite, but instead of joining they run parallel across the high platform of Chinese Tibet, for a distance of about 170 miles, for 130 of which they are in a belt about 50 miles wide. Then they suddenly diverge. At Shihku the Yangtze starts to the east-north-east on an extraordinarily zigzag course until, after leaving the western mountains, it flows in broad curves across eastern China to the Pacific. The Mekong further south is diverted to the south-east; the Salween, by a series of jerks to the west, reaches the Bay of Bengal. The Salween and the Yangtze, in places only 42 miles apart, have their mouths separated by a distance measured in a straight line of 2000 miles.

This behaviour is unique in the river systems of the world. Yule compared the approach and divergence of these rivers to a fascis of thunderbolts in the hand of Jove. Sir Sidney Burrard and Sir H. Hayden in the 'Geography and Geology of the Himalaya' (1908, p. 127), say that " The parallelism and proximity of the Yangtze,

the Mekong, and the Salween in their exits from Tibet are amongst the most extraordinary features of the Earth's land surface." "Cette région tibétaine," says Bacot ('Le Tibet Révolté,' 1912, p. 166), "des grands fleuves est unique ; quatre gorges parallèles, démesurées, absolument pareilles. Ils n'est rien, je crois, de si geometrique ailleurs dans le monde." Forrest, Bouterwek, Kingdon Ward, Bailey Willis, Deprat, L. Darwin, and others have referred to this question or discussed it.

The explanation of the anomalous feature of this river system is possible on two lines. They may be gutters excavated as overflow channels by the rivers that discharge through them. Tibet is "the roof of the world," and the drainage on a roof is often along parallel lines between the ridges, and the gutters may discharge into different water-butts or on to different slopes around the house. This hypothesis, or some form of it, is favoured by Bailey Willis, amongst other authorities. A second possible line of explanation is that the south-eastern rim of Tibet was once a continuous band of mountains which turned the drainage into central China, whence it discharged to the Pacific ; that, this rim having been cleft by earth-movements, the rivers from Tibet flowed southward through the clefts until they reached old valleys to the south of the mountain rim and were diverted by them to east or west.

That the valleys are tectonic, that is are due to earth-movements and not to excavation by rivers, has been advocated by Deprat ('Mém. Serv. Géol. Indochine,' vol. i. 1912, p. 300), who has shown that the great lakes and valleys in south-eastern Yunnan are due to subsidences on lines which run generally from north to south.

2. *The Structure and Relative Age of the Three Valleys.*—In considering the history of these three rivers it must be remembered that their valleys have one important feature in common. Each of the three valleys was formed in two stages. A high-level valley, which was broad and relatively shallow, was first formed ; subsequently, along its floor was cut a deep trough, which has been either left as a narrow canyon or enlarged into a broad valley.

The canyon parts of these valleys are due to corrosion, as Mr. Kingdon Ward has clearly shown; for though they are in general straight and direct, when examined in detail they have the sinuous course and overlapping profiles characteristic of river-cut valleys. But these canyons occur on the floors of old straight valleys the position and courses of which may have been determined by earth-movements.

The most significant fact as to the origin of the parallel sections of the Yangtze and the Mekong is that they both have essentially the same structure in spite of the great difference in the rocks they traverse. In both cases the rocks on each side slope downwards away from the valley. The essential structure is that of a trough along the middle line of a broken arch ; the valleys of the Mekong, the Upper Yangtze, and other rivers in Chinese Tibet were formed as tension clefts by the rupture of

hard rocks which were pulled apart on the stretched upper side of an arch. They have an origin similar to that of fiord valleys, to which they have many resemblances in plan and form.

Of the upper Salween we did not see enough to determine its structure; and where that river is crossed by the road from Tengyueh to Tali it flows through a broad valley along a band of limestone which is easily worn away; it also is parallel to lines of fracture, for the range that forms the western side of the Salween ends to the west in the weathered fault scarp which forms the eastern wall of the Shweli valley. The Salween valley, owing to its greater breadth and depth and the gentler slope of its sides as seen from the Tengyueh–Tali road, appears much older than that of the Mekong, which there flows at the bottom of a narrow canyon, 2000 feet higher than the level of the Salween.* The form of these valleys is so inconstant that it gives no certain evidence of their relative ages; in some localities the conditions described are reversed. Thus at Luchang, where we descended to the Mekong south of Feilung bridge, the valley is a deep narrow cleft with no room for extensive alluvial deposits; but a few miles further upstream the valley broadens out and has vast drift deposits upon its floor, and it then presents an aspect of much greater age than does its gorge at Luchang. The part of the Yangtze parallel to the Mekong shows the same variations.

Similarly, although the Salween valley south of the bridge has comparatively gentle slopes, a short distance to the north the valley narrows, and the walls are described by E. C. Young (*Geogr. Journ.*, **30**, 1907, p. 160) as "extraordinarily precipitous"; it has there the characters of a relatively young valley. Where each of the three rivers crosses old depressions or belts of soft rock, their valleys may be wide with sloping banks and may contain enormous deposits of sand and gravel. Where they cross harder rocks their valleys contract into narrow cleft-like canyons.

The larger size and greater depth of the Salween valley and the lower level of its floor are explicable by the meteorological conditions. Most of the rain in that part of Asia comes from the west, and the western rivers receive a larger water-supply from an equal area of land than those further to the east. Hence it is only natural that the level of the Salween should be lower than that of the Mekong. The fallacious conclusions as to the sources of the Irrawaddy based on its unexpectedly large volume illustrate the heavy rainfall in Upper Burma.† The fact that

* The suggestion that the Salween is the oldest of the three rivers was made by De La Touche (*Mem. Geol. Surv. India*, **39**, 1913, p. 20), and also by Mr. Kingdon Ward.

† The measurements by E. C. Young (*Geogr. Journ.*, **30**, 1907, p. 179) show that at the date of his observations (December 1905), the Nmai Hka, the main eastern branch of the Irrawaddy, had a larger discharge than the Salween in spite of its much smaller collecting ground.

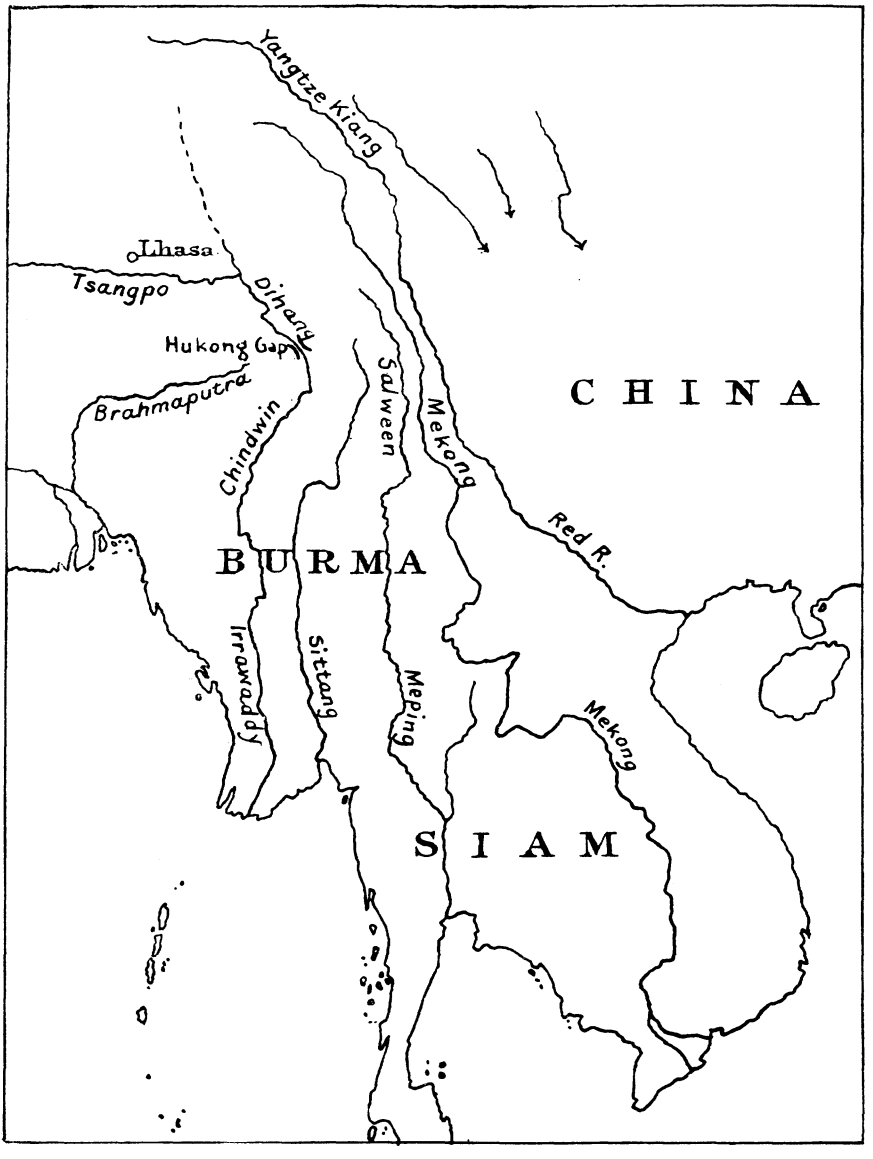
the Yangtze has a larger discharge in the spring than the Mekong is apparently inconsistent with the western source of the rain; but the Yangtze receives the drainage from larger snowfields in Tibet. The three valleys seem approximately of the same age. Their differences in size, form, and level are due to the unequal volumes of the three rivers, resulting from the irregular distribution of rainfall and snowfall, and to the varying durability of the rocks in which the valleys have been cut.

3. *Comparison of South-east Asia and East Africa.*—To understand the origin of the river system of Chinese Tibet it is necessary to consider the geographical history of the region, and as it is so little known much light is thrown on the subject by the comparison of south-eastern Asia with East Africa.

The geological history of East Africa has many features in common with Indo-China, though with some striking differences. The features in common are due to the fact that both East Africa and south-eastern Asia were formerly parts of one continent. They have been severed by the foundering of the Indian Ocean. The collapse of the crust over that great area weakened the lands that were left upstanding beside it. East Africa was split by the Great Rift Valley, and the sinking of large earth-blocks formed the African lake basins, their associated valleys, and the basin of the Red Sea. These subsidences were accompanied by vast volcanic eruptions which covered tens of thousands of square miles with thick sheets of lava. The breaking up of the old continent enabled the sea in Eocene times to invade the Gulf of Aden; the basins of the Red Sea and Lake Nyasa were formed by the Oligocene, and their formation was followed by a general uplift, the recession of the sea, the development of great lakes, and the occurrence of more rifts and renewed volcanic eruptions. Finally, a series of earth-movements made the walls that are still existing in some parts of the valley.

South-eastern Asia has had a similar sequence of geographical events. It was part of the same continent as East Africa and was broken up by subsidences on north and south lines, which allowed the Eocene sea to submerge the coast-lands and extend up the valley of the Irrawaddy. Then followed an uplift that expelled the sea, fractured the crust, and occasioned a series of volcanic eruptions the last of which happened in historic times. The volcanoes were isolated vents and did not build up vast lava plateaus as in East Africa. The east Asiatic fractures moreover, though very numerous, are less regular and less continuous than in East Africa. These two great differences are intelligible when it is remembered that the north-and-south fracturing of the crust in East Africa operated upon a rising broad dome or arch, the surface of which was therefore under tension and was being pulled apart; in south-eastern Asia the fractures cut across an area which had undergone intense lateral compression. Mountain chains of the Alpine type, which

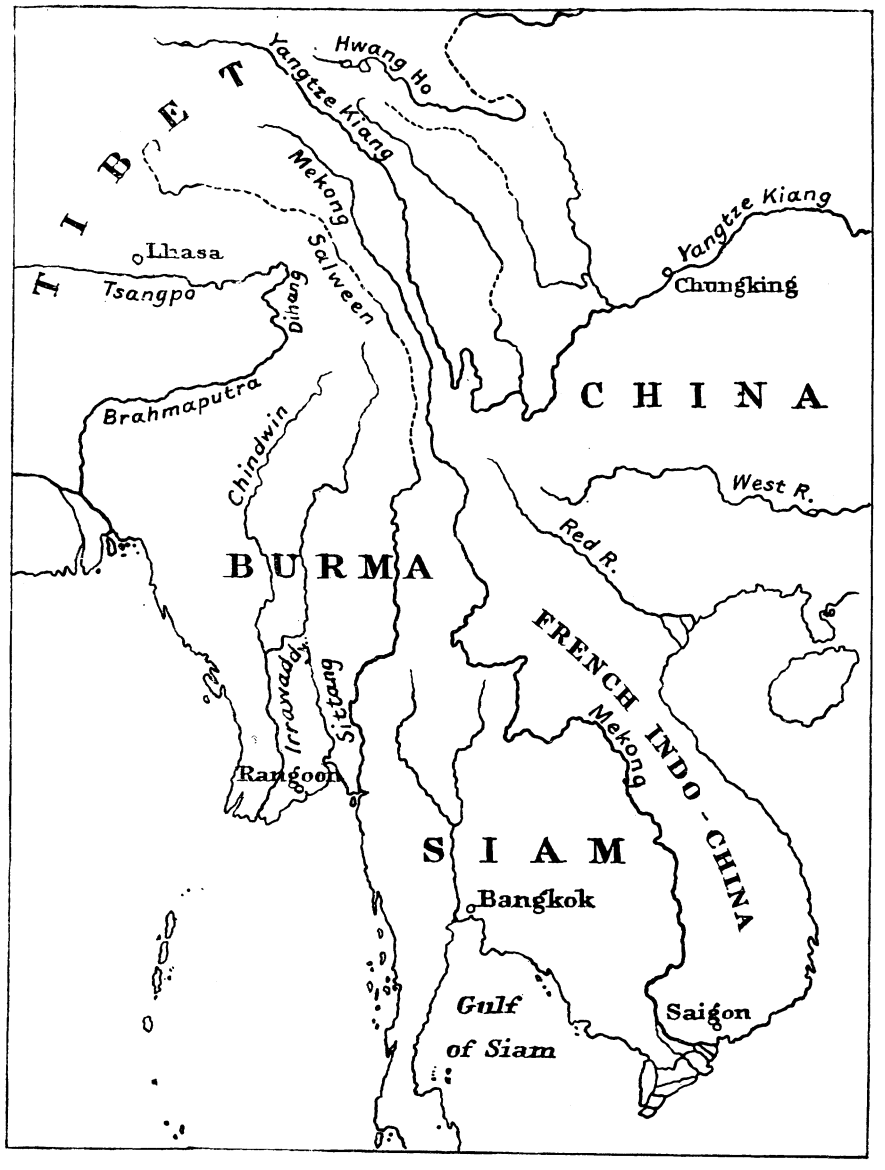
are due to compression, are not as a rule the seat of great volcanic eruptions; where, as in the Caucasus, volcanoes stand upon such fold-mountains they occur where the folds have been broken by subsequent cross fractures. The absence of volcanic activity is one of the characteristic features of mountains formed by intense folding. Hence the essential difference between the topographical features of East Africa



5.—THE POST-HIMALAYAN RIVER SYSTEM OF SOUTH-EAST ASIA

and of south-eastern Asia related to these north-and-south fractures is that in East Africa these features have been developed in an old plateau which was under tension, and in south-eastern Asia they have been developed in a folded area that was then recovering from intense compression.

4. *Evolution of the River System of South-east Asia.*—The stages



6.—THE EXISTING RIVER SYSTEM OF SOUTH-EAST ASIA

in the geographical development of southern Asia summarized in the previous section have guided the evolution of the river system. In the middle period of the Earth's history, when India and East Africa were parts of a single continent, the Earth underwent a slow gentle buckling of the crust which produced a series of east-and-west valleys; they are shown in Africa, for example, along positions still occupied by the Congo, the Zambezi, and the older parts of the Niger. At the end of that period intense folding of the crust accompanied the upheaval of the Alpine System; that period of mountain formation was followed by movements on lines trending north and south, and they led in East Africa to the formation of the Nile by the union of the upper parts of three of the east-to-west river basins. In Asia there is evidence of great east-to-west valleys which were probably contemporary with those of tropical Africa; the Tsangpo (the Upper Brahmaputra), the Hwang Ho, the Yangtze Kiang, and the Si Kiang (West River) are probably the modern survivals of these ancient rivers. The Himalayan upheaval confirmed some of these valleys, such as the Ganges and the Upper Brahmaputra; but it fundamentally altered the general drainage from Tibet, for it left Central Asia upraised as a vast block with long slopes downward to the east and south. The southern drainage after the close of the Himalayan movements was discharged by four main rivers: (1) the Dihang, which carried the drainage from the Tsangpo and much of western Tibet southward, through the broad Hukong Gap, into north-western Burma; there it formed the Chindwin, which continued southward as the Lower Irrawaddy; (2) the Upper Irrawaddy in north-eastern Burma, which was probably not then connected to the Lower Irrawaddy but discharged to the sea as the Sittang River near Pegu through the broad valley between the Shan Plateau and the Lower Irrawaddy; (3) the Salween, which then probably continued through the Meping and Menam rivers to the Gulf of Siam at Bangkok; (4) the Mekong, which doubtless discharged, as at present, across Tongking, though not along its present course; and (5) the Yangtze, which was probably continued from its great bend at Shihku through the valley of Kienchwan (Chien-chuan Chou) past Tali and through the Red River to the Gulf of Tongking near Hanoi. This simple river system was broken up by subsidences probably consequent on the reaction from the Himalayan compression. One subsidence made the valley of Assam which diverted the Dihang through the Lower Brahmaputra to the Ganges; this change beheaded the Chindwin, which till then had been the main stream of the Irrawaddy. That river, however, was compensated for the loss of its Tibetan head streams by capturing the drainage of north-eastern Burma, by beheading the Sittang river, through the reach around the end of the Sagaing range. The Salween was diverted by the formation of a series of young gorges westward to the Gulf of Martaban. The development of the Yangtze

THE PLATEAU OF YUNNAN DISSECTED BY THE VALLEYS OF THE SHUNPI-HO AND ITS TRIBUTARIES

RIVER YANGTZE KIANG FROM A PASS SOUTH OF CHI-T'SUNG
The level spurs on each side are remains of the old high-level valley.

THE DISSECTED PLATEAU OF YUNNAN NEAR YUNG-PING

LOOKING FROM THE JENSA LA DOWN A GLACIATED VALLEY AND ACROSS THE MEKONG VALLEY TO KAGURPU

gorges enlarged that river by the capture of the former Tibetan tributaries to the Red River.

It is only with the three eastern of these five rivers that we are here especially concerned. That they have undergone some such changes is shown by the structure of their valleys. Each of them lies on the floor of a broad shallow valley, which was certainly formed after the Himalayan folding and is probably Pliocene. No deposits have yet been found in the upper parts of these valleys which demonstrate their age; until fossils are obtained the date of their formation can only be given as lower Pliocene or possibly a little earlier. On the floors of these old valleys deep basins and valleys have been formed by subsidence along faults or excavation by rivers; the majority of these basins trend north and south, though some curve round to a course of approximately east and west. Analogy with adjoining areas indicates that the basins had been formed by the late Pliocene, and their formation enabled the rivers to cut deep canyons on the floors of the old valleys connected with these basins.

5. *The Supposed Recent Regional Uplift of Central and West China.* —The agency which enabled the rivers of Yunnan and of western China to cut their canyons, has been generally regarded as a regional uplift. All that part of East Central Asia has been represented as having been upraised at least 6000 or 10,000 feet in very recent geological times; but the evidence for so great an uplift at so recent a date seems inadequate, and a simpler explanation of the facts is possible. The uplift has been introduced to explain the formation of the deep valleys in a country that was formerly a level plateau.* It is often assumed that such level surfaces can only be formed at a low elevation; and, if that were so, uplift would be necessary before they could be dissected by deep valleys. If a wide uplift had occurred in this region marine beds of a recent age would be expected on the borders of the upraised area, and especially where it is nearest the sea as in Burma. One of the striking features in the Burmese coast of the Indian Ocean is the poverty of raised beaches. There are many recent deposits on the surface of the plateau, but they were formed on land or in fresh water. We know no direct evidence of any post-Pliocene high regional uplift of this area, but of weighty evidence against it. The evidence of the glaciers of Chinese Tibet is rather in favour of a subsidence of the area than of its uplift. If the country had been uplifted at the date assumed, the glaciers should have recently increased in size, whereas on the contrary they have become smaller. The decrease in the glaciers appears, however, to have been due rather to variations in the local snowfall than in the level of the land. The physiography of central and south-western China appears intelligible without the assumption of a recent regional uplift, for the formation of wide

* This view is due in the main to Messrs. Bailey Willis and Blackwelder for the Yangtze Kiang basin, and it has been supported by Deprat for Tongking and eastern Yunnan.

plains at high elevations above the sea is shown to be possible by western Australia and the eastern Sudan. In both countries the wind and sluggish streams have developed high-level plains. Any change in rivers by which their currents become swifter and their fall steeper enables them to wear away their beds. This change may be produced on a high plain by the subsidence of the surrounding country or of deep internal basins. The formation of the Irrawaddy valley and the foundering of the deep basins which are so important in south-eastern Asia would have turned previously quiet rivers into cataracts, which would wear away their beds and break up the original plateau by corroding deep valleys into it. Subsidence and not regional uplift appears the cause of the deep canyons which are the predominant feature in the topography of south-western China and its high borderlands.

V. Summary of Conclusions.

These geographical problems depend for final solution on the structure of Chinese Tibet and of adjacent countries of which our geological knowledge is still rudimentary. The full discussion of the problems involves evidence too exclusively geological for statement in this *Journal*, and our collections have not yet been studied. All we have been able to attempt in this paper is to state the general conclusions as to the mountain structure and evolution of the river system of western Yunnan indicated by our field observations. They show evidence that the Alps of Chinese Tibet have been uplifted by earth-movements belonging to the Himalayan series and are a continuation of the main line of the Himalaya ; that the anomalous features of the river system are due to meridional ruptures which enabled the drainage from south-eastern Tibet to escape over the platform of western Yunnan through parallel valleys ; and that on the floor of each valley a deep canyon has been excavated in consequence of the foundering in recent geological times of areas within or adjacent to the plateau of south-western China and of the neighbouring territories.

Before the paper the PRESIDENT said : It is my privilege and my great pleasure to ask His Excellency the French Ambassador to present to Professor Gregory the Gold Medal which has been awarded to him by the Société Géographique of Paris.

H.E. the COMTE DE SAINT AULAIRE (French Ambassador) : Je suis très reconnaissant à Monsieur le President de la Royal Geographical Society d'avoir bien voulu m'inviter à remettre la Médaille d'Or de la Société de Géographie de Paris à M. le Professeur Gregory. C'est pour moi l'occasion de rendre hommage a l'œuvre admirable accomplie par votre Société pour le progrès de la Science et l'honneur de l'humanité. C'est aussi pour moi une agréable occasion de me féliciter des excellents rapports qui existent entre nos deux Sociétés sœurs. Leur collaboration dans l'étude de notre planète est un excellent exemple pour nos deux Gouvernements. Puissent-ils s'en inspirer et collaborer, avec la même cordialité, sur les points de cette planète où leurs intérêts sont les mêmes et, plus particulièrement, sur les points où leurs intérêts semblent différents, ce qui certainement provient d'une erreur d'optique.

Quant à M. le Professeur Gregory, je le prie de m'excuser si je suis mal qualifié pour louer ses travaux comme ils le méritent et dire la haute estime qu'ils inspirent à vos collègues de Paris. J'aurais voulu qu'un des membres les plus autorisés de notre Société de Géographie fut ici ce soir à ma place. Les diplomates sont bien des voyageurs ; mais ce ne sont pas des explorateurs et encore moins des savants. Pour bien des raisons quand ils parcourent le monde, ils voient, à peu près exclusivement, un horizon qui est le même sous toutes les latitudes, l'horizon d'un sleeping-car ou d'un salon de paquebot. Cependant, comme ils sont pleins de cette présomption qui est l'inséparable compagne de l'ignorance ils refont de temps en temps la carte du monde. Espérons du moins qu'avant de la refaire, ils tachent de la comprendre en consultant les géographes, afin de ne pas avoir à la refaire trop souvent et que, grâce à vous ils tiennent compte des réalités. C'est à cette condition seulement que leur travail sera une garantie de paix et non un germe de guerre.

Je n'aurai donc pas la témérité de rechercher pourquoi le choix de la Société de Géographie s'est porté sur M. le Professeur Gregory. Je crois cependant ne pas me tromper en supposant que si ses explorations dans l'Afrique Orientale lui ont valu d'être considéré en France et dans le monde entier, selon l'expression de M. Grandidier, Secrétaire Général de notre Société de Géographie, "comme l'un des plus éminents voyageurs scientifiques contemporains," c'est parce qu'il étudie notre planète d'un point de vue à la fois très large, très haut et très profond. Le Professeur Gregory est habitué à voir au-delà de la surface des choses car il est un maître de la géologie. Or, selon l'expression de votre éminent Président la géologie est indispensable au géographe comme l'anatomie est indispensable au peintre. Si nous suivons le Professeur Gregory il nous emene très loin dans le temps et dans l'espace. En ce qui concerne le temps, bien qu'il soit très prudent sur l'âge de la Great Rift Valley, il nous donne à entendre, je crois, qu'elle est moins récente que certaines formations qui, pour les géologues ne date que d'hier comme l'Himalaya par exemple, c'est-à-dire, qui n'ont que quelques millions d'années d'existence. Quant à l'espace le Professeur Gregory nous fait aussi la mesure large. Non seulement il a pris pour sujet un phénomène qui s'étend de la Palestine à l'Afrique du Sud, cette série d'antailles dans l'écorce terrestre qui sont comme de formidables coups d'épée de quelque géant préhistorique au temps où les mondes se battaient entre eux, un temps relativement éloigné peut-être, quelques milliards d'années par exemple ; mais sa science déjà planétaire devient cosmique et nous montre dans la lune exactement les mêmes blessures, de sorte que s'il y a eu duel entre la terre et la lune nous constatons—et c'est bien réconfortant pour un pays aussi sportif que l'Angleterre—que la terre n'a pas reçu les coups sans lui rendre.

Cette observation suffit à démontrer que M. le Professeur Gregory possède aussi un mérite que je mentionnerai parce que c'est le seul que je sois capable d'apprécier pleinement et qui justifie un peu mon rôle ce soir : il intéresse à la fois des savants comme vous et des ignorants comme moi. C'est là je crois le signe de la vraie science qui est humaine et universelle, qui satisfait la raison des hommes et enchante l'imagination des enfants ou même de ces vieux enfants que sont souvent les diplomates.

Je prie M. le Professeur Gregory de vouloir bien accepter cet hommage d'un ignorant à un savant en même temps que la Médaille d'or qui lui est décernée par la Société de Géographie de Paris et que j'ai l'honneur de lui remettre.

His Excellency then presented the Medal, and

Professor J. W. GREGORY, in returning thanks, said : It is impossible

adequately to express my thanks for the high honour which is conferred upon me by this award of the Geographical Society of Paris and its presentation this evening by His Excellency the French Ambassador. My gratitude is none the less deep because I feel that this award is less to me individually than as a representative of those British geographers who have been working on the mainland of East Africa in the same spirit and with the same ideals as the French geographers who have done so much for the advancement of geography by their magnificent work in Madagascar. The award is a further sign of that close intellectual sympathy and that constant interchange of thought and knowledge between France and Britain which has been the most long-continued and most fruitful example of the international fraternity which your people, Your Excellency, first embodied as an ideal for the whole world. I feel particular pleasure at receiving this award at this time as I have so recently had the opportunity of seeing some of the great work, both scientific and religious, of the French Mission to Tibet which has been carried through to success, in spite of difficulties and dangers which make the story of that Mission one of the noblest as well as one of the most tragic in the adventurous history of missionary enterprise. I must again express my profound thanks both to His Excellency and to the Geographical Society of Paris for the high distinction of this award.

The PRESIDENT: Professor Gregory does, indeed, require no introduction, for his contributions to human knowledge in geology and geography are well known. Further recognition has been given to his services to science by the award which has just been presented to him so gracefully by His Excellency the Ambassador of France, a graceful act which you and I appreciate as much as does Professor Gregory himself. Moreover, Professor Gregory is a man of many interests. I have myself been brought into close personal contact with him in another sphere of human activity, namely that of education, for he was a brilliant and most useful member of an important Commission which inquired into the working of the greatest of the Indian Universities, that of Calcutta, and which issued a monumental—I know, for I had to read it—and what may be described as an almost encyclopædic report upon the whole question of higher education in that vast continent. The labours of that Commission had hardly come to an end when Professor Gregory hurried off to a part of the world to which he had been attracted more than a quarter of a century before, namely, East Africa; and the results of his labours there were given to the world early in 1921 in a book entitled 'The Great Rift Valleys and the Geology of East Africa,' an account which the author himself described as "A narrative of the origin and history of the great rift valleys of that country and of their relation to the contemporary Earth-movements which transformed the geography of the world."

At first sight one would not imagine that there was any very direct connection between East Africa and Western China, the country to which Professor Gregory is going to conduct us this evening. Nevertheless, as he will no doubt explain to us in the course of his lecture, there is a very direct connection between the two, for it was not until the crust of the Earth in that part of the globe fell in and the Indian Ocean took its place that East Africa and South-East Asia, which were then part of one continent, became separated by a great ocean. It is true that this happened a longish time ago; at any rate what would be regarded by those of you who are not geologists as a longish time, for it took place, I believe, in the early Eocene period; and when a few moments ago I suggested to Professor Gregory that that meant a matter of some two million

years ago he rather snorted and said, "Well, some people might say so, but it was really from fifteen to twenty million years ago." But in spite of this long lapse of time it is an undoubted fact, as he will explain to us, that the subsidence of the Earth's crust in that region did leave an abiding and a very distinctive character upon the land upon each side of it, with the result that Professor Gregory, with his great knowledge of East African geology and geography has been able to throw a great deal of light upon one of the outstanding geographical features of Western China, namely, its river system.

The journey which is to form the subject of his paper to us this evening was undertaken last summer, and in calling upon Professor Gregory to give us his paper I venture to congratulate him, upon your behalf, upon his recent safe return from that country.

Professor Gregory and Mr. C. J. Gregory then read the paper printed above, and a discussion followed.

Dr. EVANS: I am afraid I am scarcely qualified to speak about Western China, because I have not been nearer to it than Calcutta, which for all practical purposes is quite as far away as Bond Street. But as an old friend of Professor Gregory I have been intensely interested in the story that he has had to tell us to-night. I do not know whether I admire more his courage or the wonderful tact and patience and perseverance with which he met the difficulties he had to meet. There are few parts of the world in which one takes one's life in one's hand more deliberately than on the borders of India and China. The inhabitants, like other people, are good-hearted enough, but they are mostly agriculturists, and with an agriculturist the success of his crops comes before everything else. There are certain things that augur badly for crops, at any rate in uncivilized regions. One of those is the presence of foreigners at unsuitable times, and if you happen to venture that way in an unsuitable time, so much the worse for you.

I was also greatly pleased with all that Mr. Gregory, the son of the great geologist and explorer who has read the paper to-night, told us. I have never heard a more charming account of adventures in a strange land or one which showed a more sympathetic understanding of the good points of the people with whom he came into contact.

I suppose I ought to say something as to the great problems which Professor Gregory has placed before us, the problems of the structure of the world and the history of the changes that have taken place in the past. There are few problems that are more difficult than these. The world is a great palimpsest manuscript on which story after story has been written in the course of the ages, and it is very difficult indeed for us, at the present time, to interpret even the latest of those writings. All over the world we have a series of foldings and faults, crumplings and fractures, which have occurred at different times, and it is very hard to find any system amongst them. My own interpretation of these scars, the traces of past convulsions, in the history of the world is not quite identical with that of Professor Gregory. There are two tendencies, it seems to me, which we find, at any rate in the later changes in the Earth's crust. I say "later changes" because it is difficult for us to know anything very definite of those that occurred before the Carboniferous period. But in these later changes there appear, as I have said, to be two tendencies. In the first place, there are a series of foldings with an east-and-west direction, that is to say, for one reason or other the Earth tends to close like a Chinese lantern from north to south. Whether that is due to a movement from the equator towards

the poles resulting from the slowing down of the Earth's rotation or the contraction of the interior of the earth, or, as Wegener contends, to a movement ("Polflucht") from the poles towards the equator, I am not at present prepared to say.

In addition to that, as Professor Sollas told the Geological Society nearly twenty years ago, there is a kind of symmetry in the Earth's crust which has one pole in the centre of the Pacific and the other in the centre of Africa. This symmetry is in my opinion the expression of a general tendency for the great earth blocks of the Earth's crust to slide away from Africa towards the centre of the Pacific, and by the compression which results to form round the Pacific a great chain of foldings which is one of the most striking features of the Earth's surface. I would suggest that the various phenomena we have had described this evening are the result of the interference between these two series of foldings, those round the Pacific and the east-and-west foldings which are manifested better than in any other part of the world in the great ranges of the Himalayas and the Alps.

What are the causes of these various movements it would take us too long to discuss to-night, but I cannot resume my seat without heartily congratulating Professor Gregory on the information which he has brought us for the consideration of these questions from regions in which we still had so much to learn.

The PRESIDENT: Professor Gregory has placed before us a vivid picture of Western China. It certainly recalls to my mind the most vivid recollections of my own sojourn in that part of the world some fifteen years ago. I was much interested in Professor Gregory's description of his entry to the town of Tali-fu. Personally, when I was at Tali-fu I entered through the gateway and not over the wall, but Professor Gregory explained the reason why he found it necessary to enter by climbing over the wall. That recalled a similar state of affairs which I found in existence in another town in Western China, the town of Chung-king, some 1500 miles up the Yangtze from its mouth in the Pacific. On this occasion the gates at Chung-king were closed, not in order to keep out the evil spirits who brought the flood, but in order to keep out the evil spirits who prevented the flood from rising, because the country had been suffering from drought. The magistrate of the city was ordered to repair to the various temples and to pray for rain. He prayed in one of the temples on August 5 in the year 1906 and he prayed with prodigious effect. It began to rain, and a waterspout within twelve hours burst a little higher up the river. The result was disastrous. The river at Chung-king rose to the almost unprecedented height of 108 feet. Houses, coffins, corpses, and live freight on various forms of support were seen racing down the river and were watched in their mad career by the inhabitants on the city wall.

Then again the descriptive pictures which Professor Gregory gave us of those wonderful rivers, the Yangtze, the Mekong, and the Salween, brought back to my mind most vivid recollections of the time when I went across them. There is nothing more striking in the whole of that part of Asia than the regularity with which, day after day, if one is travelling from east to west, or west to east, one finds one has to drop two or three thousand feet to the bottom of a huge valley, and climb up again, say two, three, four or five thousand feet on the other side.

Professor Gregory has given us his view as to the cause of this peculiar formation. From what Dr. Evans said, I gather that there may be some differences of opinion amongst geologists as to the actual cause. But whatever may be the cause, from the point of view of the traveller who is interested in scenic effects rather than in the causes which produce them, the West of China

is certainly one of the most delightful and attractive countries that I have ever struck in any part of the world.

Professor Gregory also told us something about the internal discomfort—I forget exactly what the cause was—which he and his party suffered, or were threatened with suffering, in one part of the journey. That recalled a story of which I myself was the central figure in that very part of the world. I had just eaten breakfast one morning when my Chinese interpreter came to me and said, " Sir, may I speak ? " I said, " Yes, Mr. Chu, you may speak." " Sir, I hear very funny story." " Yes, Mr. Chu, let's have it." He went on, " Sir, they say that the people who eat eggs of this village suffer very terrible pain and sometimes die." I replied, " Mr. Chu, that would be a funnier story if it was not for the fact that I have just eaten three eggs myself ! " I am happy to say that the prophecies of ill effect from the eggs of that particular village were not, at any rate in my case, fulfilled. These stories probably arise fron the unhealthiness of some of the valley bottoms where fever, particularly malarial fever, is extremely prevalent. In fact, as we know from the stories told by Marco Polo himself in his great journey across Asia, many of these valleys were said, in those days at any rate, to be impassable by man for that very reason.

Nothing remains now except for me to express, on your behalf, your appreciation of Professor Gregory's admirable paper and of the most excellent postscript which was added to it by his son.

WEGENER'S HYPOTHESIS OF CONTINENTAL DRIFT

Philip Lake

Read at the Afternoon Meeting of the Society 22 January 1923.

WEGENER'S views are now so widely known that a very brief introduction will be sufficient. He imagines that the continental masses are patches of lighter rock floating and moving in a layer of denser rock, of unknown thickness ; and this denser rock forms the floor of the oceans. Following, with a slight alteration, the terminology of Suess he calls the lighter material the Sial and the denser layer the Sima. Suess's words are Sal and Sima, and there is no advantage in the change. Suess thinks, however, that the Sal is continuous, covering the globe completely, and this is a fundamental difference.

Wegener does not suppose the Sima to be actually liquid, but he believes it to be plastic enough to yield slowly under the strains to which it is subjected, much as a stick of sealing-wax supported at its ends will gradually bend without ever losing its apparent rigidity.

In this paper I shall not discuss the possibility of Wegener's conception. He does not profess to explain completely why the continents should move, but he claims to have proved conclusively that such movement has taken place. It is the evidence on which he relies, and more particularly the geological evidence, that I propose to examine.

us this afternoon. It certainly has raised an interesting question and has elicited interesting opinions. I am only expressing the feelings of the whole meeting when I venture to offer him, on your behalf, our most sincere thanks for the trouble which he has taken in drawing up his paper and coming and addressing us this afternoon.

EQUIPMENT FOR HIGH ALTITUDE MOUNTAINEERING, WITH SPECIAL REFERENCE TO CLIMBING MOUNT EVEREST

Captain G. Ingle Finch

Read at the Afternoon Meeting of the Society, 20 November 1922.

IN climbing Mount Everest, high altitude may be said to begin at 22,000 feet when the North Col is approached from the east. Although there is no sharp line of demarcation between what constitutes low and high altitudes, I select the above figure for the following reasons: Firstly, all the strongest and most physically fit members of the Expedition are of the opinion that at 21,000 feet (Camp No. 3) one's physical functions are practically unimpaired, and good sleep and recuperation from fatigue are possible; but at 23,000 feet (North Col), owing to the altitude, one's physical functions are impaired; sleep becomes fitful, in some individuals the appetite falls off, and there is a general loss of physical fitness. The conclusion may therefore be drawn that in the case of the most favoured individuals acclimatization to altitude ceases between 21,000 and 23,000 feet. Secondly, up to a height of 22,000 feet, snow and ice conditions approximate very closely to summer conditions in the Alps; above 22,000 feet, however, the state of the snow resembles that met with in mid-winter in the Alps. This high-altitude zone may be further divided into two sub-zones—the first from 22,000 feet (foot of the steep snow and ice slopes leading up to the North Col) to 23,000 feet, and the second from 23,000 feet onwards. The first zone is protected by the North Col from the prevailing westerly wind, whereas the second is fully exposed.

Equipment for First Zone.—Oxygen should be used from the foot of the North Col slopes onwards. No useful purpose is served by tiring oneself through not using oxygen, when, as we have seen, full recovery from fatigue is no longer possible at 23,000 feet.

Clothing somewhat warmer than that used in the Alps in summer is quite sufficient. A solar topee is advisable as protection against the sun, and Crookes' glasses of smoke-blue colour afford complete protection from glare without causing eyestrain and subsequent headache. It is also advisable to wear a veil or similar protection, and not to expose the hands to the rays of the sun. Sunburn is invariably followed by a condition of feverishness which cannot but impair one's fitness.

Equipment for Second Zone.—Above 23,000 feet conditions change radically. The wind is almost invariably blowing and the cold is intense. The degree of intensity of the latter is comparable with that met with at the Poles and, indeed, probably often exceeds it. Also, owing to the rarefied state of the atmosphere, cold is much more severe in its effects than would be the case at sea-level. A far greater volume of air is expelled from the lungs, and this air is saturated with moisture at blood heat and under a low pressure. A proportionately more rapid loss of animal heat is the result. The partial pressure of oxygen is so low that, unless the climber has recourse to a supply of oxygen carried by himself, his climbing efficiency is enormously lessened. It follows that the climbing equipment of the mountaineer in this second high altitude zone should include (1) a supply of oxygen; and (2) warm and windproof clothing and foot gear. (3) The use of oxygen increases the appetite, and due provision must be made for a sufficiency of suitable food and drink.

Oxygen Equipment.—The oxygen equipment should consist of an improved form of the apparatus, using cylinders of compressed oxygen, described by Mr. P. J. H. Unna in the *Alpine Journal*. Numerous other methods of supplying oxygen have been suggested, but these all fail in one or more respects.

In the Leonard Hill Bag oxygen is generated from sodium peroxide and water. Already at an altitude as low as 16,500 feet there is thrown up into the oxygen developed a fine spray (probably caustic soda solution) which settles so slowly that, even after standing for two hours, the oxygen is still unfit to be breathed. In addition, water is required for developing the oxygen, and at high altitudes water is almost too precious a commodity to be used for this purpose.

Mr. Harkness advocates the use of oil of garlic. He found from practical experience in the Andes (at an altitude of 16,000 feet) that the smelling of oil of garlic dispelled his symptoms of mountain sickness. He offered as explanation that oil of garlic contains much oxygen and emits this oxygen freely. Oil of garlic certainly does not do this, but it may possibly act in another way by stimulating normal involuntary breathing.

The Administration of Oxygen by Subcutaneous Injections.—I shall refrain from discussing the possible value of oxygen administered in this manner, but will content myself with merely pointing out what seem to me to be weaknesses in the proposed method of administration. Presumably such subcutaneous injections would be employed only at high altitudes, say, 25,000 feet or more, in the hope of thus dispensing with the heavy and bulky oxygen apparatus. At such altitudes, however, the climber must concentrate all his powers of resolution upon one object, namely, the getting to the top of Mount Everest. I think that the pushing of a needle into his skin and injecting a large volume of oxygen—it must be large to be of any use—would irritate him to such an extent as

to divert his mind from this main object. Furthermore, unless the man who operates upon himself is possessed of a certain amount of skill and is mentally still sufficiently alert in spite of the high altitude, he will run the risk of doing himself an injury. The method of administration also leads one to suppose that the needle should be left in position. Owing to the intensity of the cold, this would result in the formation of a considerable area of frost-bite all round the heat-conducting needle. Again, I believe it is suggested that the injection be made in the thigh ; with the needle in position and passing through or covered by clothes, laceration of the muscles while climbing would be almost inevitable. I do not know whether it would be possible for an extremely clumsy man to push the needle into a major vein. Should this occur, the results of injecting oxygen would be disastrous. There is one other point. I am not sure that we ought to ask even a climber to insert a needle into his skin when, in order to do so, he must, owing to the cold, push the needle through clothes that are bound to be septic and dirty, and so run the grave danger of infection.

With reference to the injection of oxygen under the skin, however, I would like to suggest that physiologists consider the advantage of occasionally flushing out the stale air surrounding the body by allowing a few litres of oxygen to flow from the apparatus into rubber tubes leading down inside the clothing, say, to as far as the knees.

Another suggestion was to take potassium chlorate. The oxygen of potassium chlorate is chemically very stable, and it is not absorbed by the blood, and for all the oxygen you would obtain by this means, you might just as well take sodium chloride.

Recently the proposal was made to me very earnestly indeed that hydrogen peroxide could be used. The method has this in its favour at first glance : the ratio of the oxygen to the total weight of the hydrogen peroxide is a very favourable one (about 16 to 34)—far more favourable than in our oxygen apparatus, which weighs about 35 lbs. to about 3·3 lbs. of oxygen actually available. The unfortunate thing about hydrogen peroxide however is that, although I believe it has been prepared pure, it is with reference to its products of decomposition a highly endothermic compound, and as such extremely dangerous and liable to explode. Further, the rate at which the oxygen would be given off by a commercial hydrogen peroxide, although controllable in the laboratory, would not be so on the slopes of Mount Everest.

The Effects of Tobacco.—Captain Geoffrey Bruce, Lance-Corporal Tejbir, and I arrived at an altitude of 25,500 feet and pitched camp about half-past two in the afternoon. From half-past two until seven o'clock the following evening (that is, for more than twenty-eight hours) we used no oxygen at all. Very fortunately, I had brought with me three packets containing in all thirty cigarettes. About half an hour after arriving in camp, I do not mind confessing that we felt a little bit miserable. We

had been exposed to a considerable degree of cold and wind, and warmth once lost does not, at that height, return very quickly to one's members. I also noticed in a very marked fashion that unless I kept my mind on the question of breathing, that is, made of breathing a voluntary process instead of the involuntary process which it ordinarily is, I suffered from lack of air and a consequent feeling of suffocation. By forcing my lungs to work faster than they would have done of their own accord, I would recover and again become normal. There is a physiological explanation of this phenomenon. The partial pressure of carbon dioxide in the blood falls below normal because it is washed out of the system owing to the enormous volume of air which one inhales in order to obtain a sufficient supply of oxygen. Carbon dioxide stimulates that nerve centre which controls one's involuntary breathing.

About 4 o'clock that afternoon I smoked a first cigarette, remembering how often in quite different situations the mere act of smoking had distracted the attention from unpleasant things. I was joined by Geoffrey Bruce and Tejbir, both of whom had been experiencing the annoying necessity of having to concentrate on breathing the whole time. After the first few deep inhalations of the smoke, this was no longer necessary, although at first we had to pant a little on account of the time during which the lighting of the cigarettes had interfered with our breathing. Evidently something in the cigarette smoke acted as a nerve stimulant in the place of the carbon dioxide in which the blood was deficient, and, making breathing once more an involuntary process, relieved us of the need for constantly keeping our minds fixed on the controlling of the lungs. The effect of a cigarette lasted for about three hours, so that by 5 o'clock the next afternoon our supply was consumed. At 7 o'clock, rather sorely craving a substitute, we had recourse to the oxygen apparatus. Instead of breathing the normal two litres per minute each, we contented ourselves with about half a litre between us. This amount not only sufficed to make us feel much more comfortable and less cold, but it also enabled us to obtain the first sleep which we had had at this great altitude.

It is not yet known what the stimulant contained in cigarette-smoke is. It is not likely to be carbon monoxide. I have carried out laboratory experiments, in which an intermittent current of air at a pressure of 380 mm. was drawn through a cigarette, lighted at the beginning of the experiment by means of an electrically heated platinum wire. The gases after washing through glass-wool moistened with dilute sulphuric acid were colorimetrically tested for presence of carbon monoxide on absorption through iodine pentoxide. The results were negative. Perhaps the stimulant is pyridine, which is present in comparatively large quantities in tobacco-smoke. Pyridine is frequently used in the laboratory for the extraction of certain constituents from coal, and it has been independently observed by several research workers that the slight traces of the pyridine in the air of the

laboratory have, for the first few days, a distinct stimulating effect upon respiration.

Morphia is another stimulant which has been suggested. I cannot speak with authority about morphia, but I should be very glad to have medical opinion as to the exact nature of its effect at high altitudes. It must always be borne in mind, however, that a man has no business to be at 23,000 feet on the slopes of Mount Everest unless he is feeling fit and practically immune at that height from the evil effects of high altitude.

Clothing.—I would recommend clothing on the following lines: One suit of thin silk underwear, followed by a suit of (1) light woollen underwear, (2) medium-weight woollen underwear, (3) heavy-weight woollen underwear, and a loosely fitting woollen sweater with trousers of the same material. In order to keep the abdomen completely unrestricted, nether garments should be supported by braces. Two-piece under garments are preferable to one piece, as they provide a double protecting layer round the abdomen. Over all should be worn a suit of warm and windproof clothing consisting of (beginning from the inside) a layer of thin flannel followed by a layer of duropreened light canvas, green in colour, another layer of light flannel, and a layer of transparent oiled silk of yellow colour. The coat should be made in blouse form with a hood, fur collar round neck to act as a brake upon the efflux of air from between the clothing and the body, a narrow fur band round the abdomen for the same reason, and likewise fur bands round the inside of the cuffs. Suitable tapes should be provided at the neck, round the waist and round the wrists, by means of which these openings can be comfortably closed. The trousers, fashioned on the same lines, should reach to the ankles and be provided with tapes for binding at the ankles and just below the knees (to prevent dragging on and hence impeding the action of the knees). Trousers should be supported by braces.

Gloves.—I wore one pair of thin woollen finger gloves, one pair of lambskin gloves, and one pair of duropreened canvas gauntlets with a lining of flannel. My hands kept warm, and I was able comfortably to manipulate the oxygen apparatus.

Headgear.—The R.N.A.S. pattern helmet is the most suitable form of headgear, with a chin piece covering the whole of the face up to the nose. Crookes' glasses, let into a mask lined with soft fur and large enough to cover the remaining exposed portion of the face, complete the headgear.

Footgear.—Leather is too good a heat-conductor, and reliance should not be placed upon it for warmth. The uppers of the boots should be of felt, strengthened where necessary to prevent stretching by sewn-on leather straps. The felt should be covered by duropreened canvas. Toe and heel caps must be hard and strong; the former should be high.

The sole should consist of thin leather, a layer of three-ply wood hinged in two sections at the instep, and a thin layer of felt. The boot should be large enough to accommodate in comfort two pairs of thick socks. As regards nailing, ten tricouni nails per boot would be sufficient. These should be fastened by screws passing through the leather sole and entering into, but not penetrating, the three-ply wood.

Short-length ankle putties will prevent ingress of snow into the boots. Climbing irons are unnecessary.

Food.—Altitude does not impair the appetite, at all events when oxygen is used. Food, together with the necessary fuel (Meta) for cooking, should be made up in 10-lb. parcels contained in three-ply wood cases and clearly marked " for high altitudes only." A light tin-opener, a box of matches (Swan wax vestas or equally reliable " strike everywhere " brand), and a supply of cigarettes should be included in each parcel. The greatest care must be taken in the selection and making up of the contents of these parcels in this country; the best organizer is likely to be somewhat below par when at the North Col.

Cameras should be of the roll-film type.

Aneroids.—I would suggest considering the advantages of the Pallin barometer. It is a zero instrument and light and robust.

Thermometer.—This should be graduated below zero only, and should be lighter, smaller, and better protected against rough handling than those with which we were supplied in 1922.

Rope.—There are no crevasses above the North Col. A light sash line, say 6 mm. or at the most 8 mm. diameter, is sufficient. Fifty feet should be allowed for two men.

Axes.—Light axes with long picks and short hafts are best. The axes should be soaked for a day or two at the base camp and then well rubbed with linseed or similar drying oil.

Before the paper the PRESIDENT said: This afternoon Captain Finch is to give us a paper on the use of oxygen and the apparatus required. He will also refer to the equipment necessary in high climbing.

Captain Finch then read the paper printed above, and a discussion followed.

Professor J. B. HALDANE: I unfortunately missed my way here and did not hear the first part of Captain Finch's paper on the oxygen apparatus, so I do not think I can say anything as to that beyond giving my own impressions as to the use of oxygen. I have for many years held that, although an unacclimatized person breathing only air would perish rapidly at the height of Mount Everest, there was on the existing evidence every reason to hope that, apart from the physical difficulties, men could with the help of acclimatization get to the top without oxygen, and that was the opinion I expressed last year. It is also expressed in the report we made on the Pike's Peak Expedition of 1911. I think that the most interesting scientific question in connection with any future expedition is whether you can get to the top without oxygen. If you can it throws much important light on the physiology of respiration. As to going to the top with oxygen, it would be easy with a sufficient supply.

Paul Bert's experiments of forty-five years ago indicated that one might go to over 40,000 feet with pure oxygen, even without acclimatization. The difficulty is to carry an oxygen supply which is sufficient, and until liquid oxygen can by hook or crook be supplied we are up against a proposition which presents some difficulties. I think it is very important to economize the use of oxygen as much as possible. In the experiments which Kellas and I made in steel chambers we used an apparatus which did not waste the oxygen, and we found that with one litre a minute at about 25,000 feet, even when we were not acclimatized, it made an extraordinary difference to the subject of the experiment during work. As to the effects of it, I can confirm Captain Finch in every respect. But my calculation was that a man who was thoroughly acclimatized at, say, 23,000 feet would want very little more oxygen to carry him to the top. Possibly one litre a minute would be sufficient. Dr. Kellas and I did not contemplate anything more than the weight of one cylinder. Kellas knew very well what a handicap weight is. The cylinder we used then was the same as was used by the Air Force and the Army Medical Department during the war, and I calculated we could make it last about six hours. We had little doubt you could get to the height contemplated by Kellas (25,500 feet) without oxygen, but we thought it was very desirable to have it in case anything went wrong with any one. I do not think I need say anything more as to oxygen. The whole question has been perfectly clear from the physiological point of view ever since Paul Bert investigated it.

As to other means of what may be called doping the person, I was very much interested in the account of the effects of garlic. If I were feeling mountain sick I think the least whiff of garlic would make me sick on the spot. You did not try it, I think ?

Captain FINCH : No, sir.

Professor HALDANE : But there may be people who like garlic so much as to feel no ill effects. I think the same may be said about cigarette-smoking. It may be that the large amount of carbon monoxide in the smoke has a favourable effect. Lorrain Smith and I found about twenty years ago that an animal exposed to very low barometric pressures was affected favourably by carbon monoxide. It had just the opposite effect to what we expected. Later on we discovered the theoretical explanation. On Pike's Peak, where we often administered carbon monoxide for experimental purposes, we never got headaches from the administration of it, whereas we suffered from headaches at sea-level. Dr. Douglas was very much struck with that. He nearly always used to get headaches lower down, but he got none on Pike's Peak. As to chlorate of potash, it was a ridiculous idea. It dates from the time when physiology was merely qualitative and not quantitative, and the same applies to injections of oxygen. It is very little you would get in by means of injections.

There is another thing which is likely to be most important at very high altitudes, and that is the administration of something which will produce what is called acidosis in the living body. In the experiments that Dr. Kellas, Dr. Kennaway, and I made, it was shown that until acclimatization occurs the body suffers from alkalosis, owing to the increase of breathing and excessive washing out of carbon dioxide from the blood ; and this is associated with mountain sickness. Acclimatization consists partly of the process by which the excess of alkali in the body is got rid of by the kidneys. Mountain sickness can probably be avoided to a great extent by hastening that process up. One way to hasten it is by administering ammonium chloride, which when taken in considerable quantities has a very peculiar effect, discovered by my son eighteen

months ago. The ammonia disappears in the body and hydrochloric acid is left and produces marked symptoms of acidosis, so that at ordinary atmospheric pressure the subject of the experiment begins to breathe far more deeply than usual. It seems probable that in the last push from a camp of 21,000 feet or higher, a little ammonium chloride would hasten the acclimatization at greater heights by getting rid of the alkalosis and so increasing the breathing. It was formerly supposed that there was a condition of acidosis at high altitudes and in cases of want of oxygen. That put people on the wrong track altogether.

It seems to me that the prospects of getting to the top now with all the experience and all the new facts that have been gathered in the last expedition are extraordinarily bright. I cannot judge of the tremendous physical difficulties that there are, but as far as the physiological difficulties are concerned the prospects seem very good. All the evidence and the new facts ascertained by this expedition are extraordinarily important and they are of the utmost physiological interest, particularly the fact that men could get to 27,000 feet with no oxygen at all.

Captain FINCH: The next point, and I do not seem to have made it clear, was the question of our mask. Instead of using the mask as originally described and figured by Mr. Unna, we inserted in the business end of the apparatus a T-piece, and on that T-piece we put a rubber bladder. The mouth of the T-piece went into the climber's mouth. Before exhaling he bit the tube. On re-inhaling he merely released the pressure of his teeth and the oxygen flowed into his mouth. It was a perfectly economical mask and after ten minutes' practice it could be used quite easily, not only waking but when in a state of semi-unconsciousness, on the dividing line between wakefulness and sleeping. I watched Captain Geoffrey Bruce. He would stop working his jaw and then simply content himself with breathing the oxygen as it flowed. The tube would sometimes slip out of his mouth, and he would grope round for the tube without properly waking up and put it back in his mouth almost unconsciously.

Mr. DOUGLAS W. FRESHFIELD: We have heard objection raised to the use of oxygen, but I think in this room we may dismiss that. Oxygen, after all, is only another form of stimulant. Its use can only be argued against logically by a Pussyfoot! Beyond this special point it appears to me that we ought to consider the general question of food or nourishment in ascending Mount Everest. I should like to ask Mr. Finch whether he thinks they were this year in all ways suitably provided. I was, twenty years ago, at a height of 20,000 feet near Mount Everest, on Kangchenjunga, and at camps at that height we found it possible to use self-cooking soup-tins. I have been told they would be useless at 23,000 feet, but I have no evidence that they were tested at that height. What makes me more doubtful about their not being serviceable is that when my friends Donkin and Fox were lost in 1888 in the Caucasus, we found their soup-tins after they had been for a whole year buried under snow and ice at a height of 14,000 feet, in perfectly good condition. We lit the spirit and cooked the food inside. Those soup-tins would be invaluable if available at 25,000 or 27,000 feet. Next we have heard a good deal about starvation. Did the climbers carry chocolates? In the mountains a long day can be done on a supply of chocolates and biscuits, and there is no food, *experto crede*, that is so digestible at great heights.

Then with regard to clothing. I am glad to hear what Mr. Finch has told us—that he believes the members of any future party may be effectually protected from frost-bite. It will be invaluable if you can provide footgear suitable

for climbing that will avoid this danger. Prevention is better than cure! But in case of need I can supply an interesting prescription for use in cases of frost-bite, one which proved effectual in the case of an Italian guide who had been dismissed uncured from the great Hospital at Milan. It is printed in an article by Mgr. Achille Ratti, who was a very eminent mountaineer thirty years ago, and who is now Pope Pius XI.

Captain FINCH: As to the question of shortness of food, I cannot speak with regard to Geoffrey Bruce, but I can speak for myself. Before going on to Mount Everest, and indeed many years ago, I had read a great deal about it and also about the travels of numerous explorers in the Himalayas, including Mr. Freshfield. And one thing that had been more or less firmly impressed upon me by these books was the impossibility of prolonged camping out at an altitude, I might almost say, in the neighbourhood of 23,000 feet; and certainly the idea of camping out for more than one night in succession at an altitude of 25,000 feet appeared impossible. When we went up to our highest camp it was with the fixed determination of getting to the top of Mount Everest, and then returning at once to the North Col without passing a second night up at 25,500 feet, because we thought that would be courting disaster. It was later experience that taught me that one can hold out for two, and possibly three or four, nights at that altitude. Because we had no idea of staying a second night we only took with us sufficient food for one day, and even then we took rather short rations because we had also had it impressed upon us that we could eat very little at that altitude. We had a fair quantity of sugary food in the shape of mint cake, and devoured every vestige of it. We also enjoyed ration biscuits. One of the effects of oxygen was to increase our appetite, so that all our food was disposed of in the course of the first night and the first half of the next day.

As to the question of cooking, I like the small flat tin in which those preparations are made up, but I do not like the little cooker underneath. We dispensed with that and took blocks of Meta which are wrapped up in silver foil, and thus saved carrying the heavier weight. That is the only way in which I can criticize those cookers; if you take off the small cooking stove and keep the tin without it, it is an improvement.

As to the footgear, there is absolutely no doubt about that question. I had with me footgear that was absolutely frost-proof, but unfortunately it was so large that I could almost turn round in it. It was really rather too large for climbing. It is, however, only a question of making that same kind of gear rather smaller and better fitting.

Dr. LONGSTAFF: I do not think there is really much for me to say. I had written some notes for the *Alpine Journal*, but I find that Captain Finch has said most of what I was going to say, and he has said nothing with which I do not generally agree. With reference to oxygen, Professor Haldane is the greatest authority in the world about it, and after what he has said there is very little for me to add. Therefore I think I had better speak simply as the doctor of the Expedition and put on record the evidence as it appeared to me. Of course I was a spectator, but a spectator often sees more of the game than any single player. Also it is much easier for a spectator to speak than for an actor to speak, because actors are so modest. I have come back finding that it is not universally realized that if those two attempts on Everest had not been made when they were, the Expedition would have returned to England having accomplished precisely nothing. I take great credit to myself for having urged from the earliest moment that I met any member of the climbing party that they should take the first possible opportunity of having a smack at the

mountain. But I also observed that the climbers were even cleverer than I, because they all very soon perceived that my remarks were merely the repetition of a platitude! I wish very strongly to take the opportunity of emphasizing the fact, because there has been a certain amount of criticism: Why didn't they wait until their arrangements were a little more advanced? Was not it rather precipitate? Was not it a pity to use up four men on the first attempt? No; it was exceedingly wise of General Bruce and Colonel Strutt to send four men on that first attempt.

There is one remark I should like to make as a spectator having no bias either for or against oxygen. With the twelve apparatus we took up, it took Captain Finch a couple of days' work on the Rongbuk Glacier to assemble sufficient parts to make up four complete apparatus. So that when you are sending oxygen apparatus you want to send a competent man along with it. There is no question about oxygen, no mystery; with oxygen there is nothing in the altitude to stop you getting up. The only difficulty is in carrying sufficient oxygen. Without oxygen we do not know whether it will be possible to get to 29,000 feet; but, on the other hand, we know no reason why it should not be possible.

I noticed that the frost-bites did very badly even at the base camp, that is 16,500 feet—more than half an atmosphere. They did very badly; they all went downhill. And then I noticed that the second party who had taken oxygen were not nearly so badly frost-bitten as the first party. That distinctly shows two things. It shows what a vicious circle is set up by frost-bite plus want of oxygen. It is obvious it is made worse by a lack of oxygen, and it showed that the latter was a protection against frost-bite. There is no doubt about that. What I am coming to is, from a medical point of view, what I should like to see done. I should like the climbers to use oxygen, but as little as possible; to go as high as possible without it. It will enable them to face, say, forty-eight hours in a blizzard. If a man can get a little oxygen during that time he can face those forty-eight hours at 26,000 feet or 27,000 feet with equanimity. If he has not oxygen he is extremely likely to get very badly frost-bitten. But against oxygen I should record that the general physical condition of the second party (using oxygen) was distinctly worse than that of the first party (no oxygen) on their arrival at the base camp and afterwards. The physiological explanation of the apparent paradox is simple. Unfortunately there is no actual proof that the second party would have been no more exhausted than the first party if neither had used oxygen.

Again, in presenting the evidence I must recall that the only member of the whole party who was fit to make a second attempt on the mountain was Somervell, and he was in the first party. He was only very superficially frost-bitten on the hands, but his general condition was extraordinarily good. Otherwise the first party were more frost-bitten than the second, although Captain Finch's feet did not escape, and Geoffrey Bruce had to be brought from Camp III. to halfway to Camp II. on a sledge because of superficial frost-bites on his feet

There is one other point I should like to make. I would like to say this as a climber, pure and simple: that the first attempt on Mount Everest was absolutely ruined; its chances were absolutely destroyed on the second day of the climb. Our dispositions envisaged a three days' climb; one day up to the North Col, where afterwards the avalanche fell; the second day from the North Col to over 26,000 feet; then on the third day the final climb. The first attempt was absolutely destroyed by bad weather on the second day's climb, so that they had to camp about noon at 25,000 feet, and lost their chance

of getting up. It was the same with Finch's attempt. Although he got to 25,500 feet, he intended to have got higher on the second day, and his chance was ruined by the fact that he was kept there a night and a day in very bad weather. They stayed up the second night, but of course that sort of experience is not the best preparation for your third day's climb. I venture to point out that the Committee of the Mount Everest Expedition were extremely fortunate in selecting climbers who, although they had lost all real chance of success on the second day, still in both cases went on and tried to the last. Both parties made marvellous records on the third day, and we are very lucky indeed that we had such men with us.

Major C. J. STEWART (Air Ministry): I am afraid, speaking from personal experience, I am only a baby in regard to altitude. My height record is 20,000 to 21,000 feet. I hope I am not misinterpreting the remarks that have been made, but from such experience as that I should not like to feel that anything was being put forward as to the ease of climbing with oxygen. The fact that oxygen was taken, to my mind, certainly does not in any way minimize the astonishing performance that has been put up and the tremendous size of the achievement. I have been at 21,000 feet without oxygen, and I will frankly confess, the idea of staying through a night at 25,000 feet with half a litre of oxygen is somewhat appalling.

There are one or two points which might be borne in mind in discussing the apparatus. One has to remember that the Air Ministry—and Mr. Eagar is here with me to-day—had a very short time (I think only three weeks from the beginning) to settle the design of the apparatus, and no little credit is due to the firm, Messrs. Siebe, Gorman & Co., who made the apparatus in that short time. I think their work, both in the willing way in which they threw themselves into it and the speed with which they got all the apparatus out, was a very great credit to them.

As to soldered joints, trouble has been experienced in that way. We have lately had some difficulty with soldered joints when they have been subjected to cold, although nothing like the cold we subject a 50–50 composition of solder to in liquid oxygen vessels. There, instead of having a temperature of something like —50° C. we go to something like —182° C., and vibration is not absent, when the containers are being used. In discussing the question of solder I may say the troubles we have experienced with certain solder joints were with those from the same source. I think the subject may be dismissed with Captain Finch's decision to use silver solder, which no doubt will be thoroughly well tested. It will be well to subject it to very low temperatures and vibration.

Professor Haldane made some reference to the use of liquid oxygen. While I think it would to a great extent minimize the bulk and weight of the apparatus I see little or no chance of such apparatus being used in an Everest climb. Owing to the time it takes to climb to the uppermost camp it would be quite impossible to carry stores of liquid up there; so it means a plant, and however small the plant is it is bound to give a good deal of trouble on account of temperature conditions, besides the trouble of taking up liquid fuel for the prime mover. So I can see no prospect of liquid oxygen being used in climbing Mount Everest. It is a difficult problem. In the Air Force where we climb to an altitude like that in a matter of minutes, getting to 20,000 or 21,000 feet is a comparatively rapid process, and there is no chance of acclimatization. Consequently at 20,000 feet if one has no oxygen one is panting very vigorously, and that, I may say, is the least troublesome of the symptoms.

There is one point I would like to make as to the cylinders. I do not know what arrangements are being made with regard to them, but this type of Air Force cylinder is getting on in years now. As they are only about $\frac{1}{16}$ inch thick, with the presence of rather damp oxygen inside—in the opinion of the makers there is, of course, no such thing as that, but the substance is not unknown—and weather conditions outside, that $\frac{1}{16}$ inch thick may be dangerously reduced. Steps are being taken by the Gas Cylinders Committee to produce rather better cylinders. I think the question ought to be gone into as to whether, if these new cylinders are not forthcoming in time for a future expedition, entirely new light cylinders of the kind used in the last expedition should not be made. If not, those that are used should be very seriously overhauled, because they are not suitable for indefinite use.

Another point I should like to make is this: that if the apparatus is going to be sent, as it must be of course, by sea and by rail to Mount Everest, then if it is going to be a long time on its way to the tropics and through the high temperature belt, some attention should be paid to the question of the rubber perishing. There may be trouble over that. It is not rare for us to get considerable trouble with the rubber tubing after its journey through India. If there is any information we can give on that when the time comes we shall be ready to do so.

There is some talk, as you know, by the Gas Cylinders Committee—Professor Haldane will smile at this—of producing cylinders which should be much more satisfactory and perhaps a shade lighter. I think it is not unwise to forecast that a cylinder considerably stronger than that at present in use, if properly selected, may be produced of a weight of about 5 lbs. 12 ozs. for containing something like 20 cubic feet of gas at 150 atmospheres. It could contain rather more if the pressure could be raised. The strength of the cylinders, if successful, will be considerably in excess of the strength of those now used. The Department of Scientific and Industrial Research, Gas Cylinders Committee, of which I am a member, will no doubt help as much as they can. The Committee has been in touch with the Mount Everest Committee. That, I think, is all I have to say on the matter so far, except to add that anything we can do to help you may feel quite sure we shall be only too pleased to do.

Captain FINCH: With reference to a suggestion by Dr. Longstaff, who said we should go as high as possible without oxygen and then use it in the smallest possible quantities: I say not. Both Mallory and myself—and I see that Mr. Mallory has put it in print—think that the limiting height for acclimatization is somewhere about 21,000 feet. I found it somewhere above 21,000 feet, but certainly below 23,000 feet. At 21,000 feet I can sleep my sixteen hours a day and enjoy my sleep. I also have a very healthy appetite indeed. At 23,000 feet there is a distinct falling-off in appetite, although it still remains good. I found, however, that instead of sleeping twelve hours or more out of the sixteen hours spent on my back, I only slept four, and Mr. Mallory and his party noticed much the same thing. So I think at somewhere between the 21,000 and 23,000 feet line is the limit at which we can hope to acclimatize. Climbing or doing anything at any altitude above that acclimatization limit will only mean that you will be gradually going downhill, becoming weaker and weaker, and if you persist in living long enough in that way, you will eventually die.

Dr. LONGSTAFF: I quite agree.

Captain FINCH: If you go on without oxygen as high as you can you will get higher and higher above your acclimatization level, but you will also get weaker and weaker. I think the point where oxygen should be used is the

point where acclimatization no longer occurs. Begin to use oxygen there in small doses. We used quantities of oxygen varying from 2½ litres a minute down to one litre while actually climbing. Going straight up and one of us carrying 60 lbs. and the other 50 lbs., and covering the ground at a pace equivalent to 1000 feet per hour and a half—that is approximately 1000 feet in elevation being gained for every one and a half hours' climbing—we used oxygen at the rate of 2½ litres per minute. But when we actually ceased climbing speedily upwards and began to traverse out across the mountain-side we economized our oxygen because we were not putting forth anything like the same effort as if we were climbing straight up. Then we used approximately only about a litre of oxygen per minute.

We had climbed to a point of 26,000 feet when Tejbir broke down. Then Geoffrey Bruce and I climbed on until we were driven off an easy ridge by the high wind, and in order to avoid it we traversed out across the face. It was on that almost level traverse where we hardly gained any height that we only used about one litre of oxygen per minute. I think one could carry on, for instance, on a future expedition approximately as follows: The best camping-ground, as we discovered later, is on the north ridge where there is room to pitch a tent and some protection from the wind. At a height of nearly 26,500 feet and thence onwards I should recommend a full dose of oxygen, 2½ litres up to the shoulder, which can be reached within an hour's climbing. From the shoulder I should recommend slower going with one litre of oxygen per hour, until we get to a difficult pitch and the final difficult slope up towards the summit. Over the difficult places where one is actually putting forth a big effort I should recommend taking the oxygen as fast as you can usefully cope with it.

Mr. DOUGLAS W. FRESHFIELD: What sort of ground was it on the other side of the ridge?

Captain FINCH: Bad ground; it resembles the Macugnaga slopes of Monte Rosa.

With reference to the points mentioned by Major Stewart, I am extremely glad he referred to the makers of the apparatus. It was quite an oversight on my part that I have not done so hitherto. Messrs. Siebe, Gorman's work was done under most difficult circumstances, and it was wonderfully well done. They are not to blame for the 50–50 solder failing. It is really remarkable that the apparatus, which was purely experimental and which had been designed and made in such a short space of time, worked as well as it did. I am very glad to hear about the new cylinders. I think with those new cylinders Everest will only have another clear year of freedom. There is no doubt about it now at all. The co-operation of Major Stewart and his staff was indispensable, and when I have said that there is nothing more to be said. We could not have got on without Major Stewart and Mr. Eagar's help, and we hope that their help will be available in the future—in fact, we shall be quite dependent upon them.

Lord EDWARD GLEICHEN reminded the lecturer that he had made some mention of ultra-violet rays, but nothing more had been said with regard to them.

Captain FINCH: We had so many layers of clothing that there was no risk of the skin being burned. The only portions of the skin that might have been exposed to the sun's rays were actually covered up. Thanks to Major Stewart, we were put in the way of getting good goggles. They were of the Flying Corps type, and covered up the whole of one's forehead; they also had flaps

of fur or leather which came down almost to the level of the tip of the nose. The glasses were Crookes' ultra-violet glass, which completely absorbed the ultra-violet rays. The design was criticized at first on the ground that there was not enough room for ventilation, but I stuck up for them on that point, saying that we should need no ventilation whatever at heights above 20,000. That was found to be the case. At heights below 17,000 feet the glasses fogged up because there is no possibility of air escaping freely from over the eyes behind them outwards; but at an altitude of 19,000 feet such a thing as the glasses fogging up was unknown, and the less moisture lost, the less your eyes will be irritated. One of the effects of doing experiments in a low-pressure chamber is the evaporation of moisture from the eyes, which produces a dry burning sensation on the cornea. The rest of the head and face was completely covered by a Flying Corps helmet. Under that was another light woollen helmet, and Geoffrey Bruce, in addition, wore a sun-proof cloth helmet over all his other head-gear.

Major STEWART asked whether Captain Finch had suffered any psychological effect from the wearing of Crookes' ultra-violet glasses. Did the blue light have a depressing effect?

Captain FINCH: We were not depressed in the least. In fact, the highest praise I can bestow upon the glasses is that we really hardly knew we were looking through glass at all.

The PRESIDENT: I am sure Captain Finch's address and the speeches which have followed it have added very much to our knowledge of the equipment which is necessary to make mountaineering at these great altitudes possible. We are all deeply indebted to Captain Finch, who has managed to find the time, in spite of a very heavy programme of other engagements, to come and give us this discourse. You will desire to express your appreciation of his having done so.

A NOTE ON BAFFIN LAND

From a letter of the Rev. J. Bilby, of the Missions to Seamen.

BETWEEN lat. 62° and 69° are three large lakes or inland seas, that to the north being the largest; they are connected with one another, and with the coasts by rivers which are in part tidal. These lakes and rivers are used annually by Eskimo hunters on their summer deer-hunting expeditions.

Of these lakes two only have been shown hitherto, that to the north called "Netselik"=place of seals, and that to the south called "Angmakjuak"=the great water. The central lake known to the natives as "Tesseyoakjuak"=the great lake, approximately 70 miles by 50 miles, is not known and not charted in the latest maps.

These lakes abound in fish and seals, and are the highways for the Eskimo entering the deer-hunting country.

The southern lake "Angmakjuak" contains a large island, seen for several miles, in shape like an iceberg, hence its native name "Pilkalooyoyarktok"=that which is like an iceberg.

The country surrounding these lakes is reported by the hunters to be

tribesmen in the Great War. They realized that the British were their friends. This too was realized by the Kurds, and we read of how one massacre was probably averted by a priest stating that King George would probably, by way of reprisals, kill an equal number of his Moslem subjects in India. This, the Kurd acknowledged, would be perfectly just. The Turks made high bids to secure the Assyrians, but when the Russians advanced on Van in 1915 they threw in their lot with them. Unfortunately, after relieving the Armenians at Van, the Russians retired to the Urmi district and left their allies to bear the full brunt of an attack by regular Turkish troops and Kurds. The badly armed Christians retreated to the uplands, where they were able to defend themselves during the summer, but when autumn came, their position was one of grave peril. Faced with the alternative of starvation or the sword, if they remained in their own country, they bravely broke through their encircling enemies to the west, where the blockading line was weak, as it was expected that they would make an attempt to the east.

For two years they maintained themselves, their flocks and families, in the Urmi district, and even raided their enemies with considerable success. Then came the disastrous collapse of the Russian army, and our allies were once again in sore peril. The British, under General Dunsterville, promised them help, but before this could be given panic seized upon them, and the whole tribe fled southwards, attacked by Turks, Kurds, and Persians, and suffering terrible losses of life and stock. But the tiny British force, with the Christian fighting men, drove off the pursuing hordes, the whole tribe being then organized into a column and withdrawn by easy stages to Hamadan and so to Bakuba in Mesopotamia. The tragedy of the flight recalls that of the Torgut Mongols, so dramatically described by De Quincey, but it was relieved by the splendid behaviour of the British and by their generosity to the refugees. The tribesmen have now returned to their mountain homes, but their future is doubtful. If these mountains remain under British protection all is well, but if the country is restored to Turkey their doom is certain. The " wild men " of Angora will not be content until they have destroyed all who are not of their own faith, oblivious of the fact that by this action they condemn themselves and their race to misery and poverty.

Doctor Wigram has kept his remarkable personality in the background, but it is clear that his knowledge of these fighting Christians and their neighbours was invaluable to the British. To the ordinary reader he has given a fund of valuable information, illustrated by the wide outlook and deep knowledge of his brother and himself, the whole illuminated by delightful stories, which prove incidentally that danger and hardships are the lot of residents in the " Cradle." The work is a classic and is unlikely to be superseded for many years to come. It remains to add that the illustrations are excellent, but inconveniently placed with regard to the text. The map, too, is hardly good enough. P. M. S.

The Sema Nagas.— J. H. Hutton, C.I.E. London: Macmillan & Co. 1921. *Maps and Illustrations. Price* 40*s. net.*

This work closely follows, in scope and arrangement, that by the same author on the Angami Nagas, reviewed in this *Journal* last March. Both these tribes belong to the group called by Mr. Hutton the Western Nagas, and they have traits in common which place their affinity beyond doubt. They show, on the other hand, material differences. Whatever may have been their place of origin, they reached the Naga Hills by far different routes, and in the

course of their migrations acquired a considerable admixture of foreign blood. The Sema, for instance, show some decidedly Bodo characteristics, a fact which supports the view that this tribe immigrated from the north or north-west, their assimilation with certain subdivisions of the Angami being a more recent process, due to pressure of later Naga arrivals from the south or east. Again, the Sema entered a tract on which they could not, in the primitive stage of their industries, multiply and live. They were compelled, therefore, to expand over fresh territory as they increased. But the Angami were not only skilled artisans, but met the pressure of population by intensive cultivation, through the aid of the elaborate system of terracing and irrigation which they apparently brought with them. Thus the Angami stand at the top of the economic scale among the Naga, and the Sema at nearly the bottom. Mr Hutton states, however, that this inferiority is gradually diminishing, and he has a good word for the capacity of the Sema for improvement. Bearing on this point is the fact that half the Naga Labour Corps in the War, of about 2000 men, were Sema. They saw service in France and were shipwrecked in the Mediterranean. One may wonder, with Professor Balfour in his Foreword, what will be the result of these strange experiences upon the Sema who have got safely back to their villages.

Books such as this, as Professor Balfour points out, are of permanent value in administration as in research, and those engaged in either of those pursuits will heartily endorse the Professor's personal tribute to the enthusiasm and industry of the author. J. A. B.

British North Borneo: an account of its History, Resources and Native Tribes.— Owen Rutter. London: Constable & Co. 1922. *Illustrations.* 21*s.*

Mr. Owen Rutter begins with an account of the geography and settlements of British North Borneo (may a zoologist be permitted to cavil at a pangolin being termed an "armadillo"? p. 14). His excellent description of the native population and their customs and folklore should be read in conjunction with the admirable book by Ivor H. N. Evans, 'Among Primitive Peoples in Borneo' (1922), which deals with the same area, and H. Ling Roth's 'The Natives of Sarawak and British North Borneo' (1896), should also be consulted.

Mr. Rutter gives a coherent statement of the native races which is very welcome. The brief early history of the area and the story of the beginnings and struggles of the British North Borneo Company make fascinating reading. The method of administration reads all right and doubtless is carried out in practice; naturally everything depends upon getting the right sort of official, of which the President and Directors are fully aware. It is to be hoped that the Administration runs not on the lines of European law or the Indian Penal Code, but as much as possible on those of customary native procedure. This is the practice in Sarawak, where it works very well. The more slowly progress is made the greater chance has it of being real, and not irksome to the natives. Mr. Rutter has been not only a Government official, but also a planter, and thus he is able to speak with knowledge on both subjects. He gives valuable suggestions about the development of the country and hints at mistakes, or errors of judgment, made by the British North Borneo Company; but it is very difficult for a governing body in London to have a full appreciation of the difficulties and possibilities of a country so far away. The failures of various plantation companies afford a lesson to others.

The author says, "This book is not written in the sense of an advertise-

REVIEWS

ASIA

Travels in Eastern Tibet.— Eric Teichman, C.I.E. Cambridge: University Press. 1922. *Map and Illustrations.* 25*s. net.*

THROUGH Eastern Tibet, or Kam, on the borders of the Chinese provinces of Szechuen and Yunnan and of the Kokonor country, lies the trade route from southern China to Tibet. At its door in the last sixty years many travellers have knocked. Some, like Cooper and Gill, have been turned away. Others more fortunate, such as Welby, Bower, Kozloff, Rockhill, and Tafel, have traversed it in haste and unwelcome, while De Rhins and Rijnhart have been murdered. To other difficulties have been added those of nature in the high mountain ranges which separate the great rivers Yalung, Yangtse, Mekong, and Salween, forming cañons thousands of feet deep.

Mr. Teichman had the good fortune to escape all other difficulties than those of nature. The fortunes of Tibet and China, of which a clear and concise history is given in the earlier chapters, had in 1918 conspired to require a mediator who would stay the advance of Tibet on Szechuen before territory had been seized which would provoke a permanent feud between the two countries, and Mr. Teichman, the British Consular Agent in western China, was detailed for the duty.

Starting from Tachienlu he found it necessary to make an immense détour in order to reach Chamdo, where the Tibetan commander-in-chief had his camp, without passing through the lines of the opposing armies. Following the main road to Lhasa by the line of the Yalung valley viâ Kanza as far as Nando, he then struck north into the Golok country and thence descended by a westerly route to Jyékundo on the Yangtse. There he came into the Tibetan lines and struck ground already traversed by Rockhill, Kozloff, Tafel, Bower, and others. But leaving the main road to Chamdo he turned west to Nagchen, apparently to trace the headwaters of the Mekong formed by the Dze Chu, the northern and eastern branch, and the Ngom Chu, composed of the waters of the Bar and Dje Chu, the two main streams uniting at Chamdo.

The journey to Chamdo had taken from March 1 to May 20, and on the latter part of the journey traces of the devastation due to Chinese armies were evident on all sides in villages ruined, farms burnt, and monasteries—and especially the magnificent monastery of Chamdo—absolutely destroyed.

At Chamdo the Tibetan troops under the Kalon Lama, the Tibetan commander-in-chief, were well organized and equipped, and he was practically assured of success if he advanced against the Szechuen forces, which received no support from the Mohammedans in the west nor the Yunnanese in the south, and little support from the Peking Government. But he readily entertained a proposal to stay his advance if the Szechuen authorities agreed to make peace, and he also allowed Chinese non-combatant prisoners to accompany Mr. Teichman to Batang, to which place he wished to carry this news.

On the road to Batang viâ Draya Jyambun, Markam Gartok, and Bum La many other refugees were picked up. Some of these went south to Yunnan. The others on arrival at Batang were mostly plundered by the Chinese soldiers.

As communications with the government of Szechuen were interrupted and its consent could not be obtained for some time, Mr. Teichman returned to Chamdo taking the Chinese general with him. On this occasion he travelled by a more direct route, ascending the valley of the Ong Chu, a tributary of the Yangtse, towards Draya Jyambun and thence onwards to Ipi La by a road to the north of his previous route.

At Chamdo the Kalon Lama had given orders for a cessation of hostilities pending receipt of news from Szechuen. But in the north-east the tension between Tibetan and Chinese forces in trenches only a few yards apart was such that Mr. Teichman started off for Rongbatse (near Kanza) to preserve peace if possible, visiting on the way Dege Gönchen, the famous monastery where Lamaist scriptures are printed.

After some tedious weeks of waiting for Szechuen's acceptance of the Kalon Lama's proposal, Mr. Teichman again returned to Chamdo to arrange the release of Chinese prisoners. Taking a new route across the Yangtse–Yalung divide, three passes of about 16,000 feet were traversed in quick succession. The Yangtse was crossed below Beyü. From Nadzong La (16,000 feet) he looked down on the Re- and Mar-Chu, which afterwards unite and flow to the Yangtse. Thence travelling to Gonjo Dzong and Draya Jyambun he made his way by the Me Chu valley to Chamdo.

A dispute between Tibetans and Chinese at Yenching carried the peacemaker off again, and taking a final leave of the Kalon Lama (of whom he writes, "I have learned by experience that a high Tibetan official never fails to carry out his promise") he travelled south, crossing the Riwoche river and following the Yu-chu valley to Di, above the point where the river makes its remarkable bend to join the Salween near Menkung. Two more days brought him to Yenching, and after settling the dispute he left for Batang.

At Batang the crowd of Chinese refugees which clung to him in each journey east was swollen larger than ever. But in the territory administered by China brigands also swarmed, and attacks on his party forced Mr. Teichman again into Tibetan country, where, travelling viâ Beyü to Kanze, he reached the main China–Tibet road and arrived safely at Tachienlu after eleven months' absence. In that time he had traversed Kam from north to south, had crossed and recrossed its rivers and ranges at different points, and had had a welcome in towns from which earlier travellers had been jealously excluded. With the exception of the main road from Jyékundo to Chamdo and Batang, the country was in the main new. Kozloff had travelled from Chamdo to Chunkor Gomba on the Yangtse, lat. 32° 29′, and had seen parts of Nagchen unvisited by Teichman. And Tafel had followed a route from Jyékundo to the Yalung, where his company was stoned in crossing the river. But with those exceptions and Mr. Coales's recent discoveries on the Yangtse, our knowledge of Kam would seem to be almost confined to the routes traversed by the author.

His knowledge of Chinese and Tibetan and the nature of his mission combined to place opportunities in his hands such as no other foreigner had enjoyed, and the book is full of notes on the government and relations of the different parts of eastern Tibet. While it throws into strong relief the ability of Tibetan leaders and the advance made by the country in military organization, it gives a pitiful picture of the condition into which western China has fallen under a republic.

Mr. Teichman appears never to have been acclimatized to high altitudes, though he seldom descended to 8000 feet, and it is curious that the Chinese refugees who encumbered his march were apparently able to cross ranges of 14,000–15,000 feet on foot without serious suffering.

Though little space is given to any account of the fauna, the tameness and abundance of animals in grasslands neighbouring the temples is referred to frequently. It must indeed be a strong religious scruple which secures sanctity to animal-life in a country where the main food consists of *tsamba*, *i.e.* barley, stale milk, and tea leaves, rubbed into a paste and occasionally supplemented with strips of dried turnips.

It is difficult to decide whether the political or the geographical element in the book is the more interesting. Perhaps it may suffice to say that those who have read Mr. Rockhill's books will welcome this volume as another in the same style and worthy to be classed with them. It has but one defect: the publishers have used the worst of papers for the route map.

W. R. C.

AFRICA

A Grammatical Guide . . . in the Ewe Dialect.— Prof. D. Westermann, translated by **C. D. Trotter.** London: Crown Agents for the Colonies. [1921.]

The name of the author of this little work, published apparently by the Gold Coast Government, is a sufficient guarantee of its value; it is made up of three pages on phonetics, sixteen on grammar, and sixty-three of vocabularies and texts. The key to the pronunciation is in part taken direct from the German, and, quite unnecessarily, a German illustration of the sound of *ng* is given; *dz* is said to be *d* followed by a soft *s*, but what is meant is an English *z*. The remarks on musical intonation, here called "inflexion," would have been far more intelligible with illustrations in musical notes. For the beginner it would have been a great boon to have word for word translations of the Ewe; "the scholars are noisy" appears however as "there is commotion among the scholars," and in the absence of an interpreter the meanings of the individual words is not to be guessed.

The Ewe dialect, or rather language, is of more than local interest, for it is nearly akin to the tongue of Benin; it is the Negro language of which we know more than of any other, within or without British dominions, and Westermann's larger works on it are models of exact learning. N. W. T.

Bantu Beliefs and Magic.— C. W. Hobley. London: H. F. & G. Witherby. 1922. 18*s. net.*

This book, containing a detailed account of the beliefs and ceremonies which characterize the religion and life of the Kikuyu and Kamba tribes of Kenya colony, is divided into three parts. The first deals with Natural Religion, in which the surprising prevalence of *tabu* will strike the reader. The longest chapter in the book devoted to "The Curse and its Manifestations" is extraordinarily interesting, and will be a revelation, even to the ethnologist. The second part, on Magic, contains much information regarding the smiths and magicians of these tribes. The third treats of tribal matters generally, as the councils, oaths, war and peace, legends, and dances, and includes an illuminating chapter on "Woman as a Factor in Tribal Organization."

In a penultimate chapter the author in a few wise and pregnant pages shows the practical application of his researches. It would be well if they could be read and digested by all legislators, officials, and missionaries, indeed by every thoughtful citizen of the Empire. Space will not permit even the briefest summary, but their gist may be gathered from the following passage: "The writer's main object has been to demonstrate the fact that the tribes under review possess a system of natural religion more elaborate than was hitherto suspected, and he must frankly admit that although living for some years in close touch with these natives, he had no idea of the extent and variety of the ceremonial connected with the tabu beliefs, sacrifices, and other cognate branches of their beliefs. The light which the inquiry has thrown on the complex nature of a native's life is somewhat of a revelation. It should serve as a warning to rash reformers who consider that so-called pagan heathendom

taking the road on to the downs east of the gap, and Captain Grant taking it straight to Ashtead to join the ideal alignment from Chichester to London. In this discussion the question which inevitably arises, but which no one as yet can settle, is whether the Romans in planning a road had surveying instruments approaching ours in precision. Captain Grant seems to assume they had, whereas Mr. Belloc's hypothesis is that on the whole their methods were rough and ready. Captain Grant's book, in its turn, is not free from minor errors.

S. E. W.

The English Village: the Origin and Decay of its Community: An Anthropological Interpretation.— Harold Peake. London: Benn Brothers. 1922. 15*s. net.*

To trace the character and life of the English village from prehistoric times to the present day, and to suggest an ideal village for the future, is the theme of this work. The author's imagination, stimulated by his anthropological studies, and the thorough knowledge, archæological and historical, of a countryside, enable him to sketch the conditions of rural life from the Bronze Age to the present time. That the descriptions of the earliest periods rest on meagre evidence he would probably be the first to admit, and the attribution of certain characteristics to Nordic or "Beaker" strain, though suggestive, can hardly be said to be demonstrated.

The village in Saxon, Norman, and Mediæval times, the rise and decay of the manor, the effects of the Agrarian Revolution and of Industrialism, are described in a sympathetic and interesting manner and should be found informing and valuable to every student of the social questions of the hour.

The suggestions for an ideal village, with which the book concludes, will probably appear almost utopian even to the most sanguine reformers, and to those who are most anxious to retain the people on the land. Yet there is nothing that seems beyond the capacity of sympathy, goodwill, and public spirit to realize.

The village of the future, if it is to play its full and proper part in our national life, must satisfy the social interests and desires of the people. It is the absence of such satisfying conditions that has made village life so deadening, and led to its abandonment by so many of the best sons of the soil. Let the village supply what the town can give in social life, and it may hold its own, with the added advantage of purer air and a healthier existence, to the benefit of the villagers and of England as a nation.

E. A. P.

ASIA

Lands of the Thunderbolt: Sikhim, Chumbi, and Bhutan.— The Earl of Ronaldshay. London: Constable & Co. 1923. Pp. xviii. and 268. *Map and Illustrations.* 16*s. net.*

This book deals with a region—Sikhim, Chumbi, and Bhutan—which for the grandeur of its scenery and the variety of its plant-life is unsurpassed by any in the world. And to these must be added the further interest of the sombre religion which the peoples who dwell there profess; while the writer, as Governor of Bengal, had for his summer residence a house situated in the very heart of the region he describes and from the grounds of which he could throw his eye over almost the whole. With such an inspiration to write, the wonder is that no previous Governor should have done what Lord Ronaldshay has done. At least we can hope that where he has led others may follow, for the interest of this wonderful region could never be exhausted.

The book is a narrative of travel, but it is also more. It is for a great

part a thoughtful, well-informed, and peculiarly sympathetic account of the particular form which Buddhism has taken among these strong-natured mountain peoples. This indeed is the chief value of the book; and from that point of view it is the most valuable that has so far been written. For Lord Ronaldshay sought and made opportunities for getting in touch with the leading lamas, and made full use of the opportunities he had created for himself. The result is that we get an insight into the inmost springs of the people's life. Other books have dealt more exhaustively with the detailed minutiæ of the ceremonials and creeds and of the lives of the saints. But none that the present writer knows has given us better the true spirit of the people. And it is this that all travellers and administrators must needs get hold of.

It is satisfactory to find that Lord Ronaldshay, whose experience of men is very varied, and whose opinion is therefore particularly well worth having, says that "there are among lamas and layman alike an attractive gentleness and kindliness of disposition, a dignified and courteous hospitality, and withal a cheerfulness and friendliness, which bear witness that the influence of an outstanding character and personality lives and works for good, unaffected by the flight of time."

There is not space for more than a reference to Lord Ronaldshay's account of his interviews with the leading lamas, but attention must also be drawn to the remarkably good photographs by the author himself of these lamas in their own surroundings. There is about them a certain rude strength which is decidedly impressive. And if the spirituality is not very refined, it is certainly there in considerable degree.

Of the journeys he describes perhaps the most interesting is that into Bhutan, and his descriptions, together with his fine photographs, leave us amazed at the wonders of Bhutanese architecture. Of the builders of one series of monastic edifices which seem to cling on to the very face of a precipice he says that they must be the most undaunted in the world. The riddle of the construction of these extraordinary buildings remains on a par with that of the pyramids at Gizeh. And he was overwhelmed with the immensity of the fort at Paro.

Another fascinating excursion he made was directed straight at Kangchenjunga itself. From his own headquarters at a height of 7000 feet above sea-level he could see this mighty mountain, 28,146 feet and only 40 miles distant, and he reached a pass only 7 miles from the summit. Standing there he reflected how easy it is to understand how such works of Nature impel man to worship. And later on he had a perhaps even more impressive sight, when from the Oma-la, 14,650 feet, he saw a panorama of snowy peaks covering an arc little short of 180 degrees, and extending from Mount Everest itself on the west through Kangchenjunga to the peaks of Bhutan.

Many other glorious views did he see and describe, and it is hard to refrain from referring to every single one. But enough has been said to indicate the richness of the ore this book contains, and readers must now dig for themselves. F. E. Y.

La Syrie.— Dr. George-Samné. Paris: Éditions Bossard. 1920. [1921 on cover.] Avec 30 photographies et 6 cartes hors texte. Pp. 729. 48 *fr.*

The intent of this ponderous volume, written when Syrian affairs were very much "in the melting pot," is obviously political and propagandist. It opens with a lengthy preface, dated August 1920, by Chekri Ganem, Président du