THE GEOGRAPHICAL JOURNAL

PUBLISHED UNDER THE AUTHORITY OF THE COUNCIL
EDITED BY THE SECRETARY AND THE JOINT EDITOR

VOL. XLIX.—JANUARY TO JUNE 1917

LONDON
THE ROYAL GEOGRAPHICAL SOCIETY
KENSINGTON GORE S.W. 7
EDWARD STANFORD, LTD. 12 LONG ACRE W.C. 2
1917

PRINTED BY
WILLIAM CLOWES AND SONS, LIMITED
LONDON AND BECCLES, ENGLAND.

CONTENTS

Authors are alone responsible for their respective statements.

No. 3. March 1917.

No. 6. June 1917.

The PRESIDENT: I am sure that you will be grateful if I now wind up the discussion. My remarks will be very brief. I listened with respect to Prof. Garwood's very luminous summary of the natural forces which have helped to make the Alps. He spoke of the work of the sub-glacial torrents. We have an excellent opportunity of observing that in the glacier that comes down below the Eiger close to the inn on the Little Scheideck. The glacier has retreated about half a mile, and we see in the ground it has abandoned smooth rocks, and in their middle a deep cleft, cut as if with a knife. The Lower Grindelwald glacier affords another excellent example of similar action, where the contrast between the work of ice and water is forcibly shown.

My friend Sir Martin Conway has been pleased to make sundry genial gibes; but I noticed that while he was talking of Hannibal and the Saracens the real point of his remarks was revealed by one word. He talked of the *low* passes I had been describing. Sir Martin Conway is, as we all know, a great mountaineer, and he naturally despises a pass that has not a glacier on the top of it.

Sir Henry Howorth has addressed a challenge to me to which I am thankful to say that I can give an amply sufficient reply. The task of writing the history of the Alpine Passes has been undertaken by the man in Europe who is most competent to do it, and that is Mr. Coolidge. He has begun with an article in the *English Historical Review* on the first Pass, the Col di Tenda. I understand he is going right through the Alps, and if he does the rest with the same marvellous industry and almost profligate detail he has bestowed on his first article, there will be nothing left for future writers to do. I think it would be a grave impertinence for anybody to try to rival him, and it is certainly far from my intention to make the attempt.

There is only one remark made by Sir Henry Howorth which I should like to qualify. There is no doubt that the passes which were used in early times were both the western and the eastern passes. I am quite ready to give precedence, in the number of peoples who went over them, to the eastern, but I believe that most of the Gauls came over the western. If Sir Henry Howorth refers to Livy he will find a very decisive statement that the Gauls came over the western passes. They were able to show Hannibal the way through the Alps, and they would not have been able to do so if they had not been in the habit of traversing them. I thank those who have taken part in this debate for so kindly enlivening our meeting.

A CONSIDERATION OF THE POSSIBILITY OF ASCENDING THE LOFTIER HIMALAYA

A. M. Kellas

Read at the Afternoon Meeting of the Society, 18 *May* 1916.

UNDER certain conditions mountaineering can be regarded as a branch of geographical exploration. Any one doubting this statement has merely to read a recent publication of the Indian Survey, describing the completion of the "Link connecting the Triangulations of India and Russia," to be convinced of its truth.

Surveys involving the triangulation of the great ranges of Asia and America, still far from complete, will require mountaineers to carry them out, using the term "mountaineer" in its truest and widest signification,

namely, that mountaineers are those who can ascend and find their way among mountains. If this fact had been grasped when the survey of the Himalaya was begun about seventy years ago, and surveyors specially trained as mountaineers, the maps of the mountain regions would have been more accurate and complete. Amateur geographers will probably, however, find the correction of the present maps of great interest, and the above statement is not intended either as complaint or protest.

Although, fortunately for our surveyors, it is not absolutely necessary to ascend mountains above 25,000 feet in triangulating the Himalaya, still, such ascents would be of scientific importance, and therefore a consideration of the difficulties involved in climbing the loftier summits comes within the purview of this Society. Geodetic problems, such as the exact determination of the effects of refraction on altitude calculations, might be solved, triangles with immense length of side directly measured, physiological problems of considerable interest worked out experimentally, and Science as a whole would undoubtedly benefit. If these reasons were deemed insufficient, one might bring forward the primeval axiom which subconsciously at least is in the soul of every geographical explorer: Man must conquer and investigate every spot on the Earth's surface. If the difficulties are carefully considered the conquest should be peaceful; but Nature in some of her aspects is adamantine, and even the most cautious explorer may suffer.

From the general point of view, the chief difficulties of Himalayan exploration might be summarized as due, firstly, to transport, and, secondly, to intrinsic difficulties of the mountain region.

Transport cannot be discussed in a paper of this type, but a few notes might prove useful. The actual difficulties vary with the region to be explored. As all tents, equipment, foodstuffs, etc., have generally to be carried 100 to 200 miles, the arrangement of carriage, or "bandobast" as it is termed, is of great importance in connection with the success of an expedition, especially if time be limited. All luggage will have to be carried by coolies, if ponies, mules, or yaks are not available, or the route too rough for animals. The experienced traveller will generally use animals for a portion of the journey, if procurable, in order to save time. After reaching the glaciers one has generally to depend upon coolie transport.

Of the different types of coolie, the writer has found the Bhutia Nepalese superior to all others he has employed. They are strong, good-natured if fairly treated, and as they are Buddhists there is no difficulty about special foodstuffs, a point strongly in their favour at high altitudes. The Lepcha and Kumaoni are of inferior physique, but the former makes an excellent coolie. The Kashmiri of the plains were not found reliable on the mountains, which was perhaps hardly to be expected; but the hillmen of North-West Kashmir can be trained, as Collie's account of mountaineering in the Nanga Parbat region shows and the author can confirm. The

Gahrwali is inferior to the Bhutia at high altitudes, because he is a Hindu, and there is far more difficulty with his food supply.

The writer has had no opportunity of travelling with the Gurkha and Balti, who are highly spoken of by those competent to form an opinion. A solitary traveller, anxious to do a little easy climbing, might find it worth his while to take a few carefully selected Bhutia Nepalese with him as personal servants to any mountain region. They can be engaged at Darjeeling.

The first difficulties in the mountain region would be among the glaciers leading to the peaks to be attempted. The Himalayan glaciers may be divided into two main types: (*a*) Great moraine-covered ice-streams, like the Zemu and Kangchenjunga Glaciers, with ice-cliffs and small tarns. The ice-cliffs have resulted from the opening out of the crevasses. The great glaciers of the Mount Everest region seem to be of this type, as the slide showing the north-east Chomo Langmo Glacier indicates. This glacier seems to be covered with limestone *débris*, which is of great geological interest. These glaciers are troublesome, but offer no serious difficulties with regard to transport. Roping is unnecessary. (*b*) The tributaries of this type, and sometimes their upper portions, are like the ordinary Alpine glaciers, and crevasses, icefalls, etc., are often difficult and dangerous for loaded coolies. Before the monsoon snows set in seriously one has to be particularly careful. Coolies often dislike roping, and may shirk it if not carefully looked after. A case in point, where a fatal accident nearly occurred, was emphasized in an earlier paper in the *Alpine Journal*.

After these preliminary notes, we now come to the consideration of the possibility of ascending the loftier peaks of the Himalaya, mountains over 25,000 feet in altitude, none of which have so far been climbed. We will consider the limiting case as a rule, and the problem might be stated as follows:—

Could a man in first-rate training ascend to the summit of Mount Everest (Tibetan Chomo Langmo), 29,141 feet above sea-level, without adventitious aids?

Colonel Burrard's corrected values are used for the loftier peaks, as 140 feet might require at very high altitudes an hour's climbing, which could easily mean the difference between success and failure.

The difficulties of ascending the higher Himalaya must be considered from two points of view: I. Physiological; II. Physical.

I. Physiological Difficulties.

The physiological difficulties are indubitably of a very high order, and depend upon deficiency of oxygen. The supply of oxygen varies directly with the barometric pressure. At sea-level the pressure of the atmosphere is balanced by a column of mercury 760 millimetres high, but at the top of Mount Everest the barometric pressure would be about 250 mm., and the oxygen supply would therefore be only one-third of that at sea-level.

KANGCHENJUNGA FROM A DISTANCE OF 9 MILES AT A HEIGHT OF 18,000 FEET ON A SOUTHERN SPUR OF THE JONGSONG PEAK, NEPAL

KAMET FROM NEAR THE SUMMIT OF DHANARAU MOUNTAIN, GARHWAL (18,500 FEET), EIGHT MILES TO THE NORTH-WEST

The body is kept alive by the process of respiration, during which oxygen taken up by the blood from the air in the ultimate ramifications of the lungs—the alveoli—passes with the blood to the tissues, effecting oxidation processes necessary during maintenance of life. Carbon dioxide is formed, and being transported by the blood to the lungs is exhaled.

How absolutely fundamental respiration is in maintaining life may be grasped when it is stated that unconsciousness would ensue in about three-quarters of a minute if an indifferent gas like pure nitrogen is breathed, the body being at rest. Death would follow in a few minutes unless oxygen were supplied.

One has to consider whether respiration near the summit of Mount Everest under about one-third of an atmosphere pressure will suffice to aërate the blood not only at rest, but while climbing. The problem might be attacked by the four following methods :—

I. By consideration of the physiological effects recorded during high balloon ascents.

II. By consideration of the results obtained in air-chambers at sub-atmospheric oxygen pressures.

III. By evaluation of observations and experiments of physiologists at sea-level and moderate altitudes—up to 15,000 feet.

IV. By consideration of the effects of minor Himalayan ascents up to the highest recorded, viz. 24,600 feet.

Space permits only of a consideration of the first three methods, as the fourth would involve a discussion of mountain sickness and the limits of acclimatization to high altitudes.

I. *Balloon Ascents.*—From our point of view two are of special importance, namely, that of Glaisher and Coxwell from Wolverhampton in 1862, and that of Tissandier and two companions (Crocé-Spinelli and Sivel) from Paris in 1875.

In Glaisher and Coxwell's ascent at 29,000 feet both men became paralyzed, and then Glaisher became insensible. Coxwell, unable to raise his hands, seized the valve-rope in his teeth, managing to open the valve before he in turn lost consciousness. Fortunately Coxwell's action gradually stopped the ascent of the balloon, thus undoubtedly saving their lives. Glaisher claimed that the balloon rose to 37,000 feet before beginning to descend. If so this would constitute a record ascent; but the estimation of height seems of doubtful accuracy.

Tissandier's ascent to 27,950 feet was not so fortunate. Although provided with oxygen the three men were paralyzed before they could raise the tubes of the oxygen reservoirs to their lips. Tissandier fainted at an altitude of 26,500 feet (approx.), and when he recovered consciousness his two companions were dead and the balloon was rapidly descending.

The conclusion from these balloon ascents must inevitably be that an ascent of Mount Everest without adventitious aids would be quite impossible if the physiological conditions of mountaineers and balloonists

are comparable. They are not comparable, however, as the balloonist has no opportunity of becoming acclimatized to high altitudes. As will be shown later, this fact is of fundamental importance.

In many more recent balloon ascents oxygen has been used with success. In 1898 Berson and Spencer ascended from London to 27,500 feet, and in 1901 Berson and Süring ascended from Berlin to about 35,500 feet, an actual barometric reading corresponding to 34,500 feet being made before both men, notwithstanding oxygen inhalations, became unconscious.

These ascents showed that oxygen was an immense help at high altitudes, and might suggest that the ascent of Mount Everest would be possible if air enriched with oxygen were breathed during the latter portion of the climb.

II. *Experiments in Air Chambers.*—Considering pressure alone it might at the outset be stated that considerable variations of pressure, *e.g.* increase up to four atmospheres pressure or diminution to a pressure of a fourth of an atmosphere hardly affect the body. Provided decompression is slow, one might say that moderate variations of pressure are innocuous. It is alteration of the available amount of oxygen which affects the body, and this alone need be considered. Two types of experiments are worth studying.

1. Experiments in which the oxygen percentage in the air breathed was *slowly* reduced. Rapid variations need not be discussed as they are inapplicable.

2. Experiments in which the pressure of the air breathed was diminished.

Both yield similar results.

1. *Slow Alteration of Percentage of Oxygen in the Air breathed.*—When the percentage of oxygen in the inspired air is slowly reduced below 20·96 per cent., the proportion present in air at sea-level, no effect is produced until the percentage is 12 to 14, and then the breathing becomes deeper (*i.e.* more air is taken into the lungs than normal), and at 10 per cent. cyanosis is evident, the lips, ears, etc., being blue. Haldane states that "marked symptoms of mental incapacity are also present. Simple observations or calculations become impossible." Consciousness is generally lost without a struggle when the percentage of oxygen in the air breathed falls to between 10 and 7 per cent.

2. Experiments in air-chambers where the atmospheric pressure was diminished gave exactly similar results. Mosso, for example, lowered the pressure in an air-chamber to 310 mm., corresponding to 24,500 feet at 15° C. "His mental faculties became blunted, he experienced difficulty in reading his watch, was twice unable to count his pulse, his handwriting altered and his memory weakened."

In considering the results of experiments in air-chambers Starling states that the lowest limit at which life is possible corresponds to an

oxygen tension in the alveoli of 27 to 30 mm., which is distinctly above that calculated for Mount Everest.

It follows, therefore, from experiments in air-chambers that the ascent of Mount Everest should be quite impossible without adventitious aids, agreeing with the observations of balloonists. Again however the conditions are not comparable, since the subject in an air chamber cannot become acclimatized to low oxygen pressures, whereas the mountaineer can.

Mixing oxygen with the air in the chamber gives significantly a different result. In air enriched with oxygen Paul Bert withstood successfully a pressure of 240 mm., which corresponds to nearly 32,000 feet. The best results were obtained with a mixture of oxygen and carbon dioxide. Aggazotti actually breathed such a mixture at a pressure of 120 mm. for some time. This pressure corresponds to approximately 50,000 feet above sea-level.

These experiments prove conclusively that air enriched with oxygen would easily maintain life during rest or moderate work at the summit of Mount Everest, where the pressure is, approximately, one-third of an atmosphere.

III. *Consideration of Observations and Experiments of Physiologists at Sea-level and Moderate Altitudes up to* 15,000 *feet.*—The work done by Haldane and by Barcroft and their respective coadjutors is of special importance. A very interesting series of observations on the incidence of mountain sickness was made by Haldane and his co-workers on the summit of Pike's Peak, Colorado, in 1911. Pike's Peak is one of the eastern Rocky Mountains near Denver, which has a cogwheel railway to its summit (14,109 feet), upon which there is a small hotel. The following notes on the effect of change of altitude on the visitors to the summit show that mountain sickness was of very frequent occurrence.

"Among the numerous visitors who came up by train and stayed only about three-quarters of an hour, the most marked and almost universal symptom was blueness of the lips, cheeks, etc., accompanied by great hyperpnœa (*i.e.* deep breathing) on exertion. As a rule there was no marked discomfort, but some persons became very miserable and faint, and actual fainting was observed occasionally, as well as vomiting. One press representative who came to 'interview' us became so alarmingly blue and faint that we gave him oxygen, which revived him at once, and immediately restored his colour and spirits. He continued all right for a few minutes, and then again became blue and faint, and was again revived by oxygen, after which he hurried into a descending train.

"Among those who walked up or came on donkeys, the symptoms were much more general and severe. The blueness was more marked, and nausea, vomiting, headache, and fainting were extremely common. Many persons walked or rode up during the night to see the sunrise, especially on Sunday morning, and the scene in the restaurant and on the platform

outside can only be likened to that on the deck or in the cabin of a cross-channel steamer during rough weather." And this occurred at 14,100 feet!

The description suggests that if any of the Himalayan giants in the far future are desecrated by a cogwheel railway, oxygen will have to be breathed continuously by the patrons when near the summit, otherwise none will get down alive. This may be a consolatory thought to some minds.

Haldane's party suffered somewhat on first arrival, but after a few days on the summit, blueness, headache, nausea, and lack of appetite vanished, and in about a week all felt quite well physically and mentally. With regard to the mental effect, it must be noted, however, that the brain seems particularly sensitive to a deficiency of oxygen. Many visitors were inclined to be unreasonable, the symptoms being similar to those of alcoholic poisoning, and a deputy-sheriff is therefore stationed at Summit House during the summer.

This psychic effect is apparently not confined to those unacclimatized to altitude. Miss Fitzgerald, one of Haldane's collaborators, who independently carried out observations at many high mining camps in Colorado, states that the nervousness of the people, both men and women, was very apparent, especially above 7000 feet, and adds: "The miners and others were fully conscious of the nervous tension, and attributed to this impulsive actions mentioned as common in mining communities at these altitudes." It might follow that some of the regrettable incidents with revolvers in the old days might belong to this category, but statistics and more extended observations are required. The Tibetans do not seem to be affected with nervousness.

The above account shows that mountain sickness is apparently something very real in the case of people unacclimatized to high altitudes when pressure is rapidly varied. In the Alps one rarely notices serious cases because of adaptation, and in the Himalaya, where as a rule the ascent to 15,000 feet is gradual and requires at least a week's travel, mountain sickness is exceptional even at high altitudes.

Paul Bert indicated, in 1878, that the cause of such mountain sickness was simply want of oxygen. He carried out numerous experiments with men and animals under different pressures, and using various mixtures of oxygen, nitrogen, and other gases. He showed that symptoms similar to mountain sickness were produced when the oxygen partial pressure of the mixture fell below a certain value. Bert's explanation has been challenged. Mosso maintained that many symptoms of mountain sickness depended on deficiency of carbon dioxide, which he termed "acapnia," and Kronecker suggested mechanical reasons. Recent experiments of Zuntz, Haldane, Barcroft, and their co-workers have clearly indicated that Bert was correct, and one might therefore state that *mountain sickness depends primarily upon deficient oxygen supply*. There may be many accessory factors, but the fundamental cause underlying all is *want of oxygen*.

As already stated, Haldane's party on Pike's Peak (14,109 feet) became completely acclimatized after about a week's residence on the summit, and the problem which really has to be solved in connection with Mount Everest might now be stated as follows: Is it possible to become sufficiently acclimatized to altitudes of 24,000 feet to 25,000 feet to enable one to climb to over 29,000 feet? This question can only be answered after a careful study of the scientific explanation of acclimatization to moderate altitudes which has been worked out by Barcroft and Haldane and their respective co-workers.

In order to be able to understand this explanation, one must, as a preliminary, study more closely what takes place during respiration. The process of respiration includes the formation of a compound of oxygen and hæmoglobin called oxy-hæmoglobin, which, being carried to the tissues, gives up its oxygen, thus maintaining life, which as previously mentioned depends on the continuity of a series of slow oxidation reactions. The two processes mentioned might be represented as a reversible chemical equation—

$$Hb + O_2 \rightleftarrows HbO_2$$

In the lungs, under an oxygen pressure which varies with the altitude, oxy-hæmoglobin is formed, and in the tissues, where the oxygen pressure is less, oxygen is given up to oxidizable substances.

It is obvious that a study of the pressure conditions under which hæmoglobin respectively takes up and gives off oxygen, might help one to understand the physiological difficulties of respiration at high altitudes.

Experiments were carried out by Hüfner with *hæmoglobin dissolved in water* at blood temperature (37° C.) and a varying pressure of oxygen, with the following result:—

TABLE I.

Pressure of oxygen in millimetres of mercury.	Percentage saturation of the hæmoglobin with oxygen.
10	50
20	71
30	81
40	87
50	90
60	92
70	93
80	94-5
90	95
100	96

To enable these values to be thoroughly understood, consider one pressure, *e.g.* 50 mm. If a large quantity of air containing oxygen of partial pressure 50 mm. is shaken with a small quantity of hæmoglobin dissolved in water, the hæmoglobin rapidly takes up oxygen until 90 per cent.

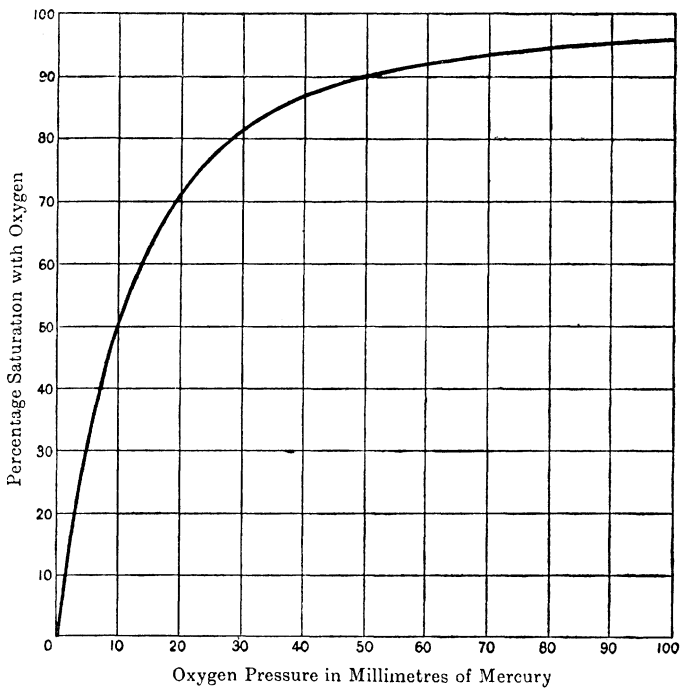
is saturated, *i.e.* there must be in the water 90 per cent. oxy-hæmoglobin and 10 per cent. hæmoglobin. If the oxygen pressure is increased, more oxygen will be taken up; but if diminished, oxygen is given up, *e.g.* if the pressure of the oxygen were diminished to 10 mm., oxygen would be given up until 50 per cent. of the hæmoglobin remained as oxy-hæmoglobin.

The connection between the hæmoglobin in water and the oxygen pressure is best represented, not by the above set of figures, but by a curve which shows graphically the relationship between the two inter-related qualities.

Plotting the pressure of oxygen in millimetres of mercury horizontally (along the abscissa) and the percentage saturation of hæmoglobin in water vertically (along the ordinate), one obtains what is termed the *dissociation curve of oxy-hæmoglobin in water.*

CURVE No. 1.

Dissociation Curve of Oxy-Hæmoglobin dissolved in Water at 37° C. (Blood Temperature)



This dissociation curve, worked out by Hüfner, somewhat puzzled physiologists, because even at comparatively low pressures the hæmoglobin is nearly saturated with oxygen. For example, the alveolar oxygen pressure in the lungs at the top of Mont Blanc (15,780 feet) should be nearly 50 mm., corresponding to 90 per cent. saturation, and at sea-level the oxygen pressure is about 100 mm., corresponding to a saturation of 96.

The trifling difference of 6 per cent. in saturation for an alteration of altitude of nearly 16,000 feet should not cause serious effects, and Bert's explanation that oxygen deficiency was the exciting cause of mountain sickness seemed unintelligible.

The difference was explained when it was discovered that the dissociation curve of hæmoglobin in blood is quite different from that of hæmoglobin in water. Many factors affect the action of oxygen on hæmoglobin, notably, (1) temperature, (2) presence of carbon dioxide (an acidic body), (3) presence of other acidic bodies like lactic acid, (4) presence of salts.

With regard to temperature, it is obviously only profitable to consider one temperature, viz. 37° C. (99° F.), the normal blood temperature.

The substances mentioned, carbon dioxide, other acidic substances, and salts are present in blood, and tend to flatten the dissociation curve of hæmoglobin. The normal dissociation curve of hæmoglobin in blood can be drawn from the following experimental data, the pressure of CO_2 being taken as 40 mm., the normal pressure at sea-level.

TABLE II.

Oxygen pressure in millimetres of mercury.	Percentage saturation of hæmoglobin in blood with oxygen.
10	10
20	32
30	57
40	74
50	84
60	90
70	92
80	93·5
90	95
100	96

These results can be expressed by a curve, the *dissociation curve of hæmoglobin in blood.* (See next page.)

This normal dissociation curve for hæmoglobin in blood is, as already remarked, flatter than that for hæmoglobin in water, with the result that the hæmoglobin is less saturated for any given pressure of oxygen. For example, the saturation of hæmoglobin in water with oxygen at 24 mm. oxygen pressure—the calculated approximate alveolar pressure for the top of Mount Everest—would be 74 per cent., whereas the saturation of hæmoglobin in blood with oxygen at the same pressure would be only about 40 per cent.

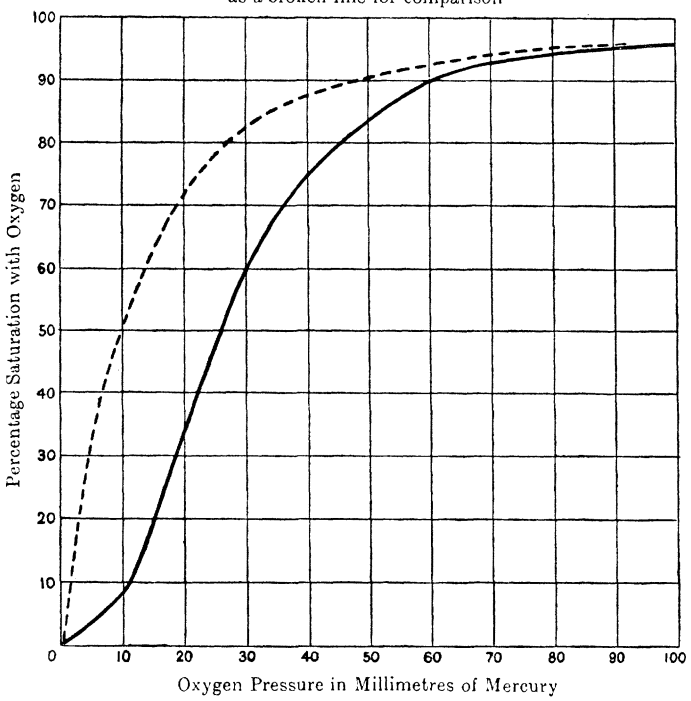
One of the main factors causing flattening of the dissociation curve is carbon dioxide, and as the quantity of this substance in blood considerably diminishes with altitude, one might suppose that the curve would steepen, and that the blood hæmoglobin would therefore be more easily saturated

with oxygen. Barcroft, however, proved by experiments carried out on the peak of Teneriffe, that although the carbon dioxide in the blood diminishes with altitude, yet the resting dissociation curve for any individual was identical with his curve at sea-level.

CURVE No. 2.

Dissociation Curve of Oxy-Hæmoglobin in Blood at 37° C. (Blood Temperature)

The Dissociation Curve of Oxy-Hæmoglobin in Water is given as a broken line for comparison



This surprising fact was confirmed by Haldane on Pike's Peak, and the explanation was found by Barcroft to depend upon an increased acidity (or rather diminished alkalinity) of the blood in such quantity as to exactly compensate for the loss of carbon dioxide, which itself is acidic in character.

This relationship between carbon dioxide and blood acidity (or diminished alkalinity) is of far more vital importance than might at first sight appear. *The automatic regulation of the process of respiration* at sea-level depends upon the quantity of carbon dioxide in the blood, the pressure of which is the same as that in the alveoli of the lungs. The carbon dioxide in the blood effects the regulation by acting directly on a nerve-tract called the "respiratory centre" in the medulla oblongata, nerves from which control the muscles of respiration. Normally, about

eighteen respirations occur in a minute with the body quiescent. If work is done, more carbon dioxide is produced, the respiratory centre is more powerfully stimulated, and one breathes more deeply and rapidly, thus supplying that necessary extra oxygen to the tissues.

If, while at rest, one breathes rapidly for about a minute—forced breathing—so as to wash the carbon dioxide out of the blood, the respiratory centre ceases to be stimulated, and breathing stops until sufficient carbon dioxide is formed to act as excitant.

At high altitudes, as mentioned, the quantity of carbon dioxide in the blood diminishes, but the acidity increases correspondingly. This acidity acts on the respiratory centre in the same way as carbon dioxide.

It follows from above that there seems to be less danger than might have been expected of a cessation of respiration on breathing rapidly for some time at high altitudes. Even if all the carbon dioxide were washed out of the blood, the respiratory centre might still be sufficiently stimulated by the increased acidity of the blood circulating through it. This is of primary importance, as the following example will show.

If a subject in an air-chamber were decompressed to 370 mm., correspondlng to 20,000 feet, his oxygen supply would be diminished to less than half. Suppose he then carried out forced breathing so as to try to get a larger quantity of oxygen through his lungs per minute than at sea-level, he would quickly wash the carbon dioxide out of his blood, the respiratory centre would cease to be excited, he would stop breathing, and would probably faint because of deficient oxygen supply to the brain.

Were it not for the increased acidosis of the blood after acclimatization to high altitudes, the danger of fainting after rapid breathing during climbing might be a most serious one for the mountaineer. A climber fainting above 25,000 feet would obviously be in grave danger.

We are now in a position to grasp the significance of the different factors conditioning true acclimatization to moderate altitudes.

These factors are four in number, and might be briefly discussed in the following order. The third factor is at present debateable :—

1. The oxygen pressure in the alveolar air rises.
2. The number of red blood-corpuscles and the quantity of hæmoglobin in the blood increase in due proportion to each other.
3. There may be actual secretion of oxygen by the lung epithelium, so that the arterial oxygen pressure can be raised above that in the alveoli.
4. The blood stream may circulate more rapidly during exercise at high altitudes than at sea-level.

1. *Increase of Oxygen Pressure in the Alveolar Air.*—The increase of pressure of oxygen is brought about by a diminution of the alkalinity of the blood, which means that its carrying power for carbon dioxide diminishes. On staying for a few days at a moderate elevation the pressure of the alveolar carbon dioxide diminishes in accord with this

diminished carrying capacity, and as the partial pressure of carbon dioxide sinks that of oxygen rises. The respiratory centre remains adequately stimulated because of the increased acidity of the blood, The gain of alveolar oxygen pressure is considerable, as shown by the following table :—

TABLE III.

	Alveolar pressure of oxygen.	
	Calculated for 40 mm. CO_2 as at sea-level.	Observed.
Sea-level	102 (approx.)	102
10,000 feet	59	65
15,000 feet	38	52

Considering the calculated and observed pressures at 15,000 feet, one notes the great advantage of the extra 14 mm. pressure of oxygen. On referring to the dissociation curve of hæmoglobin in blood one sees that at 52 mm. oxygen pressure the blood would be about 80 per cent. saturated with oxygen, whereas at 38 mm. pressure it would only be about 65 per cent. saturated.

As stated, this adaptation to altitude may take a few days to develop, so that any one ascending quickly from sea-level to 15,000 feet is physiologically at a great disadvantage, as his carbon dioxide alveolar pressure will be nearly the same as at sea-level (40 mm.), and his oxygen pressure about 38 mm. This factor is obviously of considerable importance in connection with adaptation on the higher Himalaya, and a table will be given later to show the relationship between altitude and calculated alveolar oxygen pressure after acclimatization.

2. *Increase of Red Corpuscles and Hæmoglobin.*—It is generally stated that an increase in the number of red corpuscles and hæmoglobin occurs at high altitudes, but the exact value of this multiplication is not so simply gauged as has been supposed, and much more work must be carried out before its exact significance is understood. The normal number of red corpuscles for man is about 5,000,000 per cubic millimetre at sea-level, and values up to over 8,000,000 have been recorded at different altitudes. A few typical determinations might be quoted :—

TABLE IV.

	Metres.	Feet.	Red corpuscles.
Sea-level	0	0	5,000,000 (approx.)
Zurich	412	1,352	5,752,000
Davos Platz ...	1560	5,118	6,551,000
Pike's Peak	4300	14,109	7,000,000 (approx.)
Andes	4392	14,410	8,000,000
Taghdumbash Pamir	5548	18,203	8,320,000

These values seem easy of interpretation. To use a simile of Barcroft's, the number of "ships" available for carrying their precious cargo of oxygen to the tissues is increased, more oxygen cargoes will therefore be despatched in a given time from the lungs, and this may compensate for a diminution in weight of each freight carried.

If, however, the number of corpuscles increases quickly simultaneously with a rapid alteration in altitude, it is almost certain that the blood merely concentrates itself by transudation of part of its plasma (in which the corpuscles float) through the capillaries; this would of course mean an increase in the number of corpuscles per cubic millimetre.

In 1908 the writer carried out a series of experiments in London and Silvaplana which seemed suggestive. His average corpuscular value in London was approx. 5,400,000. During the journey of about thirty hours' duration (which meant rail to St. Moritz and then drive of 4 miles) his red corpuscular value rose to approx. 6,200,000, *i.e.* there was an increase of about 800,000 corpuscles per cubic mm. during a rise of about 6000 feet. One would imagine that it would be difficult to devise anything less stimulating to the corpuscle-manufacturing mechanism than a long railway journey, so that most probably concentration of the blood occurred. The same phenomenon has been observed by other observers and balloonists.

In the case of Haldane's party on Pike's Peak the results for different individuals varied greatly, but there was a distinct gradual increase in each case. The variation was from 115 to 154, taking 100 as normal hæmoglobin value for sea-level.

It is assumed that this slow increase probably represents abnormal production of new corpuscles, or slower destruction of old corpuscles than usual.

Some observers regard this alteration of corpuscular and hæmoglobin value as the chief adaptation to high altitudes, and it is undoubtedly important. Hingston, who was engaged in survey work on the Pamir ranges, states that a carrier of his who seemed inadaptable to high altitudes had a blood count of only 5,760,000 at 13,300 feet, whereas the rest of the party had a value of about 7,000,000. It is worth noting in this connection, however, that two of Haldane's party during nearly a month on Pike's Peak (14,109 feet) had lower average values than that which Hingston considered inadequate, namely, 5,530,000 and 5,240,000 respectively, although both were in excellent health. It is just worth mentioning also that the author at a camp at 20,000 feet had a blood count of only 6,500,000, and on ascending Pawhunri (23,180 feet) and again taking his blood count a few hours after return to this camp it was only 7,200,000. Probably diet and exercise may affect matters, and more work must be carried out.

Some physiologists have asserted that it would be impossible to carry out accurate blood-corpuscle estimations at high altitudes, and this is of

interest in connection with the psychic adaptation to the loftier Himalaya. One physiologist put the matter as follows :—

"During two successive years, Mr. Dent, Dr. Slater, and myself studied this question of polycythæmia in the Alps. We are of opinion that the counting of blood-corpuscles at high levels requires an amount of attention which no one can give when at a level of anything over 10,000 feet. Sustained mental work is out of the question at this level, and is performed with difficulty in Europe at a level of even 6000 feet. This statement we are certain would be confirmed by those who have experienced the cold and discomfort, together with the nausea and other slight symptoms of 'mal de montagne' which affects most people in some degree."

This is merely quoted to show that even first-rate observers may be misled by want of acclimatization. Probably blood counts could be made at upwards of 23,000 feet by one acclimatized to high altitudes. There was certainly no serious physiological difficulty involved in carrying out determinations at 20,000 feet, with the exception of overcoming the very distinct disinclination for serious mental work which attacks all above 18,000 feet, due to the mountain lassitude of high altitudes. This agrees with the report of Haldane's party, which states that after a few days at 14,100 feet "mental work seemed quite as easy as at sea-level."

3. *Secretion of Oxygen by the Alveolar Epithelium.*—Two theories have been proposed to explain the passage of oxygen from the alveoli of the lungs to the blood through the epithelium and capillary walls. One theory supposes that the physical process of diffusion is sufficient to explain the transference, but the other postulates that under certain conditions, *e.g.* high altitudes, the cells of the lung epithelium secrete oxygen from the alveoli and pass it on to the blood in the capillaries. According to the first theory the oxygen pressure in the alveoli would always be greater than the arterial oxygen pressures; but according to the second the arterial oxygen pressure might be higher or lower than the alveolar.

Haldane's party on Pike's Peak found that the arterial oxygen pressure in acclimatized subjects was invariably far greater than the alveolar pressure (35 mm. above or more), whereas in new-comers it was about the same, and they regard the secretory action of the lung epithelium to be one of the most important means of adaptation to high altitudes. If secretion actually occurs, then the value of the process to the climber might be very great; but Krogh and other physiologists oppose the theory, so that further confirmation is required.

This problem of oxygen diffusion and secretion is intimately bound up with the quantity of oxygen required by the body per minute at rest and during exercise. The results of different observers vary somewhat, but one may assume that the body requires during rest a volume of 230 to 270 c.c. measured at 0° C. and 760 mm. pressure, during moderate work 1200 to 2000 c.c., and during hard work 2500 to 3500 c.c. of oxygen per minute.

The following results of experiments made by Zuntz indicates the relationship between the oxygen required at sea-level and on Monte Rosa during rest and doing easy work on a glacier.

TABLE V.

	Oxygen required per minute.
Sea-level at rest, fasting	233 cub. c.
Monte Rosa do.	260 ,,
Ascending glacier on Monte Rosa ...	1329 ,,

Assuming that the quantity of oxygen required per minute during slow climbing near the top of Mount Everest was from about 1200 to 1500 c.c. per minute (a moderate computation), the question arises as to whether this quantity of oxygen could diffuse at the low alveolar pressure of 24 mm. Haldane and Barcroft seem to consider it impossible, but Krogh would say that it could diffuse. As the volume of a gas varies inversely with its pressure, the actual volume of oxygen measured at the barometric pressure of the top of Mount Everest which would have to diffuse would be about $1500 \times 3 = 4500$ c.c.

If only 1000 c.c. (measured 0° C. and 760 mm.) could pass the dividing septum, then the rate of climbing would be very slow; and if only 750 c.c. were available the rate of climbing might be less than 300 feet per hour.

In this connection one must point out that the actual quantity of oxygen used in doing efficient work depends on the training of the individual. The trained man requires far less oxygen than the untrained during an ascent because his muscular co-ordinations are arranged for maximum economy. Hueppe worked out a series of determinations, using town dwellers and an Alpine porter as subjects, with the result that the efficiency of the porter as regards work performed was about 100 per cent. above that of the untrained man.

4. *More Rapid Circulation of the Blood at High Altitudes during Moderate Exercise.*—After acclimatization on Pike's Peak the pulse rate at rest was only slightly raised in the case of three observers, and was actually diminished in the fourth case. On moderate exercise the pulse rate rose to a much greater extent than at sea-level. This would be beneficial.

General Conclusions from Physiological Data.—There is no doubt that (*a*) the rise of alveolar oxygen pressure, (*b*) the diminution in the alveolar carbon dioxide pressure, and corresponding increase in acidity of the blood, and (*c*) the increase in the quantity of hæmoglobin and red corpuscles are of great value in promoting acclimatization. If confirmed the secretion of oxygen by the lung epithelium will doubtless be further studied and might yield useful information.

As indicated above, however, much more work must be done at high

altitudes before exact evaluation of the different factors conditioning acclimatization can be made.

One might, however, work out the essentials of the problem under consideration in another way. If one could determine the relative strain under which the body has to undergo adaptation at different altitudes, the approximate difficulties in connection with an advance above 25,000 feet can be computed. The strain can be gauged by considering the relative capacities for saturation of the blood at different heights under the respective alveolar pressures which would obtain after acclimatization. These can be probably calculated within 2 or 3 mm. from a curve for the variation of carbon dioxide with altitude worked out by Miss Fitzgerald, and are given in the following table for a few well-known mountains:—

TABLE VI.

	Height.		Barometric pressure. 0° C.	Barometric pressure. 15° C.	Alveolar Oxygen press.
	Feet.	Metres.	Mm.	Mm.	Mm.
Mount Everest	29,141	8882	251·0	266·9	23·6
Kangchenjunga	28,225	8603	259·9	275·8	25·0
Nanga Parbat	26,620	8114	276·3	292·2	27·8
Kamet	25,447	7756	288·9	304·7	29·4
Aconcagua	23,080	7035	316·1	331·8	33·5
Mount McKinley and Jonsong La	20,300	6187	351·3	366·6	39·2
Kilimanjaro	19,321	5889	364·7	379·7	41·2
Mount Elbruz	18,465	5628	376·4	391·2	43·3
Mont Blanc	15,785	4811	417·2	431·0	49·5
Aorangi (Mount Cook) ...	12,349	3764	475·3	487·8	58·9
Gorner Grat	10,290	3136	514·0	524·0	65·0
Mount Kosciusco ...	7,328	2236	575·0	584·0	73·5
Rigi	5,905	1800	606·0	613·0	78·4
Ben Nevis	4,406	1343	642·0	649·0	83·6
Scafell Pike	3,210	978·4	673·0	677·0	88·7
Sea-level	0	0	760·0	760·0	102·5

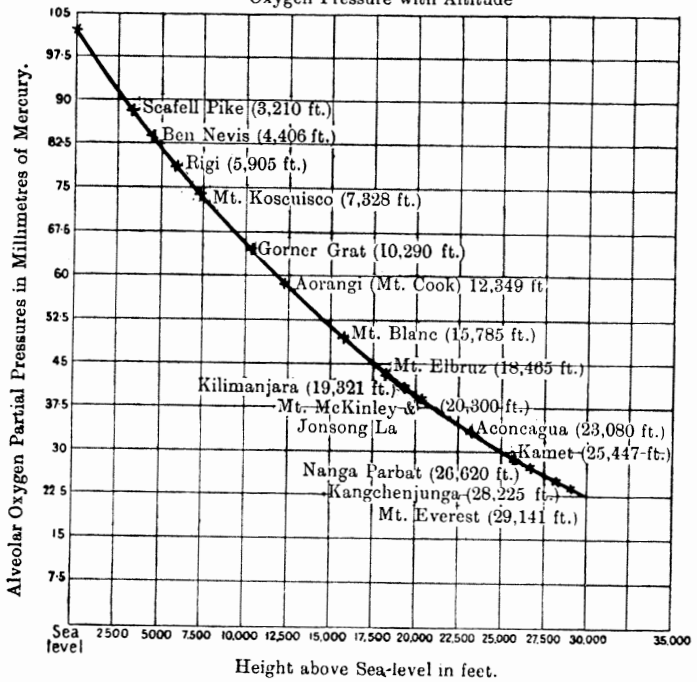
This table shows that while the oxygen in the atmosphere diminishes to one-third at the top of Mount Everest, the available oxygen, as indicated by the alveolar oxygen pressure (23·6 mm.), diminishes to less than a fourth of that at sea-level (102·5 mm. approx.). This, of course, tells heavily against the climber. The relationship of altitude to alveolar oxygen pressure is clearly seen in curve No. 3.

The relative capabilities of the different alveolar oxygen pressures at the heights mentioned to saturate the blood is well indicated by plotting the heights of the mountains on the dissociation curve of oxy-hæmoglobin in blood already given. (Curve 4.)

This curve is very suggestive. It shows that the strain on the climber is nearly negligible up to 10,000 feet and at about 15,000 feet becomes appreciable, but one must pass above 20,000 feet before the steepening of the curve indicated that the mountaineer will have to adapt himself carefully to his aërial environment. At 23,000 feet the curve is getting much steeper,

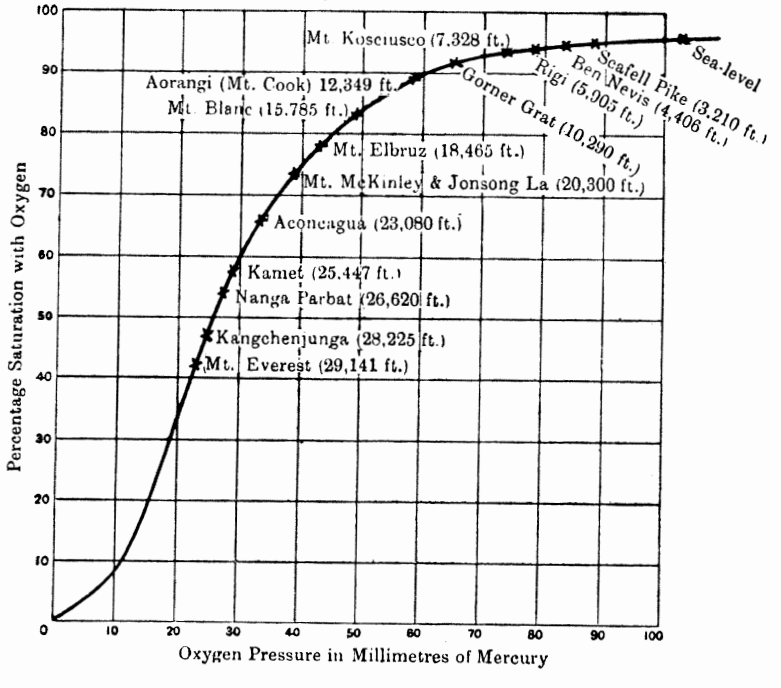
CURVE No. 3.

Curve showing the variation of Alveolar Oxygen Pressure with Altitude



CURVE No. 4.

Dissociation Curve of Oxy-Hæmoglobin in Blood with the heights of a few notable mountains plotted so as to show the saturation of the Blood with Oxygen corresponding to the alveolar oxygen pressures at their summits.



and the climber will obviously be put on his mettle above 25,000 feet, for the curve then attains its steepest. Every 1000 feet still higher must mean considerably increased difficulty, and the climber near the summit of Mount Everest will probably be on his last reserves in the way of acclimatization and strength.

Before drawing final conclusions from all the data summarized above the physical difficulties must be discussed. The mountaineering obstacles are usually of considerable magnitude, and in a few cases seem insuperable, but there are notable exceptions.

II. Physical Difficulties.

The physical obstructions might be classed as those due first of all to weather conditions, and secondly to the intrinsic rock and snow difficulties of the mountains.

Himalayan Weather.—The weather among the southern Himalayan ranges is notoriously bad during the monsoon, which may extend from the middle of June to the middle of September, that is to say, during practically the whole summer, but further north towards the Tibetan border may be much ameliorated owing to the intervening ranges precipitating the aqueous vapour. Above 20,000 feet on the southern ranges there is usually a fall of snow every day.

Mount Everest (29,141 feet) and Kangchenjunga (28,295 feet) would hardly be accessible during the monsoon, but could probably be attempted during the latter half of April, May, and the first half of June. The latter half of September and the first half of October would also be a good time for ascents.

The wind is a weather factor which may be of great moment to the climber. If not too strong and of moderate temperature—not much below 0° C.—it is helpful in raising the alveolar oxygen pressure as already mentioned.

A point of considerable interest, which does not seem to have been mentioned before, is that the strength of the wind for any given velocity is greatly diminished above 20,000 feet, as one might expect from the general equation for kinetic energy of moving bodies, $f = \frac{1}{2} mv^2$, that is, the force or kinetic energy of the moving body is equal to half its mass multiplied by the square of its velocity. It follows from this that the lifting or striking power of a tornado of 100 miles an hour would be reduced by 66·7 per cent. at the top of Mount Everest.

The writer has repeatedly had occasion to observe this difference of wind pressures. On the Grampians, when the wind roars past one's ears at a velocity of about 70 or 80 miles an hour, one finds great difficulty in pushing against it. Above 20,000 feet one has frequently found it comparatively easy to force one's way forward against a wind of nearly similar velocity. To gauge the velocity is difficult, but the general statement is certainly correct.

There is, however, one serious difficulty in connection with wind, namely, the low temperature sometimes met with. An intensely cold north or north-east wind might drive one down to avoid frostbite of hands and feet.

The snow and rock difficulties vary greatly, and might be best illustrated by consideration of the possibility of ascent of a few of the chief peaks, but space unfortunately only allows of a few brief notes.

Many of the most magnificent mountains of all present such physical difficulties that climbers will probably await attacking them until the effects of altitude are better understood. K_2 (28,253 feet), Makalu (27,790 feet), the Gasherbrum Peaks (I. 26,470 feet, II. 26,360 feet, III. 26,090 feet, IV. 26,000 feet), the Masherbrum Mountains (E. 25,660 feet, W. 25,610 feet), Nanda Devi (25,645 feet), Rakaposhi (25,550 feet), Boiohagurdoanasur or Hurza Kunzi (I. 25,370 feet, II. 25,118 feet, III. 25,050 feet), and Jannu or Jano (25,294 feet) are all difficult.

Many of these peaks seem impervious to direct assault, and if on close investigation that were found to be the case, they may be attacked in some future decade by aeroplane or airship. They will certainly be ascended. At present climbing by airship would probably be regarded as an unwarranted innovation by all true mountaineers.

Of the peaks which look possible of ascent Kāmet, Nanga Parbat, Kangchenjunga, and Mount Everest are of special interest.

Kamet (25,447 feet) is at present the most interesting of the peaks between 25,000 and 26,000 feet, because it is the most accessible of all, and is admirably adapted for carrying out acclimatization experiments. Lying back on the Tibetan border behind the main chain in the Zaskar Range, it is not so much affected in the rainy season as peaks like Mount Everest or Kangchenjunga, which bear the full brunt of the monsoon. It could therefore be attacked with distinct hope of success between May and October inclusive.

Nanga Parbat (26,620 feet) is one of the most fascinating summits of the main range. Mummery, in 1894, carried out the only difficult climb yet effected in the Himalaya, ascending rock ridges of the north face to about 21,000 feet. After examination from a spur of the adjacent Ganals Peak in 1913, the writer came to the conclusion that the north arête is practicable.

Kangchenjunga (28,295 feet) is in some ways the grandest mountain mass on the surface of the planet. Mr. Freshfield made the first near circuit of the mountain in 1900, and examined the eastern and western faces with regard to the possibility of climbing them. Regarding the magnificent eastern face, the finest ridge I have ever seen, he describes it as "a broad line of cliffs of terrific steepness which appeared hopelessly inaccessible to any direct attack." The only chance would be along the north-eastern arête, of which he writes as follows: "The right-hand buttress is a marvel of mountain architecture; it springs from a low mass

as pedestal of splintered granite, and flies up in an ice arête of a length and steepness which defy Alpine comparison." The western face is also difficult.

The south face presents a practicable but dangerous route of ascent. During an attempt from this direction in 1905 four men lost their lives, being swept away by an avalanche. The height attained was about 21,000 feet.

Mount Everest or Chomo Langmo (29,141 feet).—As the latter name was obtained by Colonel Bruce and the writer from quite different sources, its claims may be worth consideration at a later date. A pass to the north-east of the mountain, about 18,500 feet high, leading to Kharta near the Arun River, is called Langma La. The mountain may be assailable from the north-east or north.

While the limited scope of this paper hardly allows of the deduction of categorical conclusions, yet it is highly probable from the data cited that a man in first-rate training, acclimatized to maximum possible altitude, could make the ascent of Mount Everest without adventitious aids, provided that the physical difficulties above 25,000 feet are not prohibitive. A supply of sodium peroxide (Na_2O_2) to provide oxygen as an occasional refreshment would be of great value. It is intended to discuss the incidence and causes of mountain sickness, as well as the limits of acclimatization, and the possible rate of ascent above 25,000 feet, in an extended paper.

The author would be grateful for any practical unpublished information directly bearing upon the physiological effects of high altitudes, and in particular abnormal mental or physical effects observed by airmen above 20,000 feet.

The author has pleasure in expressing his obligations to Dr. Carl Browning, Director of the Bland Sutton Institute of Pathology, for kindly reading and criticizing the manuscript.

Before the paper the PRESIDENT said : The Poles having both been reached it is obvious that the next object of importance on the Earth's surface to be attacked by adventurers is the highest mountain in the world. There are, perhaps I should not say unfortunately, a good many difficulties in the way of reaching it. In the first place you have to deal with a Government which has up to the present time forbidden you to approach within 100 miles of the mountain's base. In the next place the mountain itself is probably—though of this we have no sufficient evidence—of considerable difficulty ; and there is thirdly the main obstacle, the effect of the rarity of the air at great heights on the human frame. As you know, the greatest heights reached at present are 24,600 feet by the Duke of the Abruzzi's party and 24,000 feet by some young Norwegians on Kabru, one of the mountains nearest Darjeeling.

Dr. Kellas, who is going to lecture to us this afternoon, will deal with this question of the effect on the human frame of high altitudes, and there is no one in Europe who can deal with it with greater authority or greater practical knowledge. He is a mountaineer himself ; he has gone to the Himalaya several times, always to the Sikkim frontier. There, without Alpine guides, himself the only European in the party, Dr. Kellas, with a few hillmen whom he has trained

to climb on snow and ice, has reached several summits of between 22,000 and 23,000 feet. He therefore adds practical experience to the scientific knowledge of an eminent chemist competent to deal with the medical side of the problem.

(*Dr. Kellas then read the paper printed above and a discussion followed.*)

Lieut. C. MEADE : In travelling in the Garwhal Himalaya at high altitudes, I have always found the sun peculiarly formidable. My coolies were all accustomed to living above 11,000 feet, but at heights above 20,000 feet I used to forbid them taking siestas in the open. I believe that exposure to the sun's rays at such a height is an important factor in causing mountain sickness.

The PRESIDENT : I should like to ask Dr. Kellas one or two questions. He told us about the unfortunate experience of the people who went up Pike's Peak by train. There is a similar ascent made by railroad in Switzerland up to the Jungfrau Plateau—11,300 feet. I do not know whether he has any statistics of what the effect on passengers in those trains has been. I recollect when there was a serious project, happily brought to naught, of making a railroad or lift up through the middle of the Matterhorn. It was proposed that caves should be excavated on the summit, and one of the caves was to be for a resident doctor who was to attend on distressed or collapsed tourists when they arrived on the top ! It is not usual for healthy people to suffer at the height of 11,000 feet unless they are brought up suddenly from sea-level or from relatively low altitudes. On the top of Mont Blanc (15,700 feet) many climbers suffer little or no inconvenience.

On one occasion when a hut was being built on the summit the workmen who lodged in a lower hut at a height of 14,300 feet used to run up the last ridge at as good a pace as you or I might run up Primrose Hill. I found it hard work, but still possible to keep up with them. One of the puzzling things in mountain sickness is the way in which the symptoms vary, not only with different individuals—some people, as in the case of sea-sickness, suffering far more than others—but vary on different mountains and on the same mountain on different days. For example, the first ascent to the top of Elbruz, 18,500 feet, in the Caucasus, was made by an English party in very good training ; none of us suffered at all. The summit being a crater with a rim to it, we ran about on the rim ; while the next party, who were equally good mountaineers and in equally good training, suffered severely. The only explanation I can offer is the difference between the weather on the two days ; on the first day there was a very high wind. That may possibly have increased the supply of oxygen.

Dr. Kellas has indicated the right line of research and practical experiment. He has also enforced a lesson that may be useful, and possibly even save lives : that is that climbing in the Himalaya is not to be lightly undertaken in the spirit of certain travellers who have boasted of running up them in their shoes, but is a task which requires careful preparation beforehand and a readiness to profit by previous experiences. I believe—I do not suppose I shall live to see it—that the highest mountains will be climbed, and I hope climbers will not lose time about it, else they may find themselves anticipated by airmen.

I do not know that I can add anything to the very careful deductions we have had from the chemistry of the human frame, but would ask Dr. Kellas if there is anything he would like to add now, and I am sure you will wish me particularly to thank him for the very fine set of photographs he has shown us, which will give you some idea of the great variety, the enormous majesty, and of course the very great difficulty, in many cases, of the Himalayan Mountains.

But among so many there must be a few easy ones on which experiments may be made by those who are testing the rarity-of-the-air problem.

Dr. KELLAS: First with regard to the effect of the sun mentioned by Lieut. Meade: there is no question that above 20,000 feet the sun's glare is terrific, and it is most inadvisable to think of sleeping in the exposed open. The effect must depend upon certain specific rays, probably ultra-violet rays, but perhaps also others which are filtered off lower down. I could not give any more definite reason, but I have noticed, when camping with thin tents on snow above 20,000 feet, that one has to cover the tents with opaque material to keep the sun's rays out, otherwise they are almost uninhabitable, especially if the air is stagnant.

With regard to the President's remarks about the apparently different effects of altitude on the first and second parties which ascended Mount Elbruz, the point he mentioned as being different on the two days was certainly one cause. Wind has a considerable effect on the breathing when climbing at altitudes over 20,000 feet, and is also important at lower elevations. I have noticed repeatedly that a high wind helps one greatly. There are various reasons which might be adduced: In the first place, when there is a breeze the exhaled air is carried away and none of it is re-inhaled. Secondly, air is packed into one's lungs by the breeze. This aids in the pressure, driving oxygen into the tissue between the capillaries and the alveoli of the lungs.

The PRESIDENT: In the early ascents of Mont Blanc in the eighteenth century, when they went up the great valley they always complained of the aridity and the stagnation of the air up at 12,000 or 13,000 feet in this hollow in the mountain; it seemed to cease when they got on to the ridges.

Dr KELLAS: One reason usually given as an explanation is that snow takes up more oxygen than nitrogen. One would not expect much effect unless the air were very stagnant, but there might be other reasons, such as reverberation of the sun's rays from the snow. Both could be investigated experimentally.

HAKLUYT AND MULCASTER

Prof. Foster Watson

HAKLUYT, it has been asserted, cannot be included in the highest rank of the great men of literature. Judged by his literary style no doubt this is true, as it would be true of Roger Ascham, of Thomas Fuller, or of Samuel Pepys. Still, such writers as these belong to a class which has a greatness of its own, not always reached by those who surpass them in the dignity of the highest literary style. They are men who draw towards them the affections of their readers on account of their personality, which finds expression in their work. Style and matter become united, for the concrete subject-matter is of high human interest, and the style is determined by the mode of expression which the personality finds inevitable for spontaneity and completeness of utterance.

Hakluyt's absorbing passion is that of patriotism—devotion to England. England, for him, is identified with the old Viking spirit, adventure on the sea, which in itself is sufficient to absorb all a man's thoughts. But Hakluyt, with the love of romance at sea as deep-set as that of Cervantes on land,

country is mineral. Nickel is the most important metal, and that is being developed to a very large extent. Almost every hillside in the serpentine districts is scarred by surface mines of nickel, and in a few places there are chromium mines; the smaller hillsides are also scarred by the remains of cobalt-mines. Cobalt up to a few years ago was very much exploited in rather a curious way. A great proportion of the cobalt which reached civilized countries had been mined by convicts who had escaped into the wild interior districts of the island. Cobalt mining is a one-man job. One can take pick and shovel and dig cobalt, wash it in a stream, bring it down to the coast and trade it against money or provisions. Very frequently, of course, a trader, after having received the cobalt was tempted by the thirty francs offered by the Government for each escaped convict who was captured. The trader used to hire a number of lusty natives at a franc a head to come and knock the convict over. They knocked him over and got their franc each, and the trader got the cobalt and the balance of the thirty francs. Cobalt is now very much less mined than it was, for the recently discovered argentiferous cobalt ore is not only more rich than Caledonian cobalt, but also contains a quantity of silver which is valuable as a by-product. As to the agricultural prospects, the country is very arid and needs extensive fertilization and irrigation; one cannot produce there good crops of any kind without those expensive processes. As to forestry, there are a great number of big and valuable trees, but they grow mostly on country which is so exceedingly precipitous—the hillsides are often practically at the angle of rest—that exploiting these forests is a matter of difficulty. They are being exploited, yet it is not at a great profit. On the whole the mineral wealth of the country is by far the most important, and I think there is a great future for the country in that direction from the European point of view. I must thank the Master of Downing and Dr. Rendle for the kind words they have spoken, and for their interesting remarks on the botany of the country. It was the Botany of New Caledonia which first attracted me, and I think I had the ambition to go there three years before I actually went. It was very largely owing to the kind offices of the Master of Downing, Prof. Seward, that the money was got together which enabled Mr. Montague and myself to go to New Caledonia. I have not mentioned Mr. Montague so much as I should have. We lived and worked together for about nine months in all, and I found him a most able and trusty companion.

THE KANSU MARCHES OF TIBET

Reginald Farrer

Read at the Meeting of the Society, 20 *November* 1916. *The map illustrating Mr. Teichman's paper in 'Geogr. Journ.' December* 1916 *will serve for this paper also.*

IN the grey and weeping darkness of 5 March 1914, my little expedition left Peking for the Tibetan Borders. I take the opportunity of these long and dull preliminary stretches over ground so well known to apologize to this Society for the meanness of its scope and the irrelevance of its results. I went purely on a voyage of botanical exploration; and

where a party consists of two men only, they have all their work cut out to attend to their own particular job, without energy or time left over to divagate into other interests. Therefore I will compendiously refer you for precise geographical information to the Russian explorers who alone had previously traversed some of the ground I covered. Potanin and Beresovski have the first word on Chagola, Satani, and Siku, while far up in the north Prjevalsky revealed to us Tien Tang and Chebson and the gaunt mountains along the Ta-Tung Ho. They wrote, however, years since, and though the face of these immemorial Alps will hardly change, yet that lonely land is so far away and so hard to come at that probably there will be members of this Society who may enjoy even an amateur's fresh presentment of its features, failing any immediate chance of going there themselves.

My aim was to make straight across country, by Sianfu and Feng-siangfu, towards the vague limits of Kansu where the mountain ranges of Tibet sink abruptly down into the rolling loess fells that are Western China. In parallel chains they come sweeping south-eastwards from the Roof of the World where all the rivers of Asia have their frozen cradle; and their alternating barriers make up the Tibetan March, that wildest and least understood of lands, which with such brazen blandness appears on maps in the colours of China; yet is in reality an absolutely lawless and independent chaos of alpine kingdoms and peoples, owning as little allegiance to Lhasa on the one hand as to Peking on the other. No writ runs current there, of Emperor, President, or Sovereign Pontiff; there are no plain boundaries, no government to replace the ancient authority of China which made travel so smooth and comfortable a business in all parts of the Empire. In fact, all the Western Marches of China, from the Mekong to the Da-tung, are not properly to be called China at all, and only vaguely and for the sake of a name even to be called Tibet. Official Tibet, the Tibet which a European recognizes under that word, is merely that deep curving trench behind the Himalaya where the Sovereign Buddha has his seat in Lhasa. The vast eastern fringe of that high table which is the centre of Asia is a continuous and complicated No-Man's Land, hundreds of miles in depth and thousands in length, extending in a labyrinthine belt all up Western Yunnan, Szechwan, and Kansu, till it dies away at last towards the northerly deserts that bound Shin-Jan.

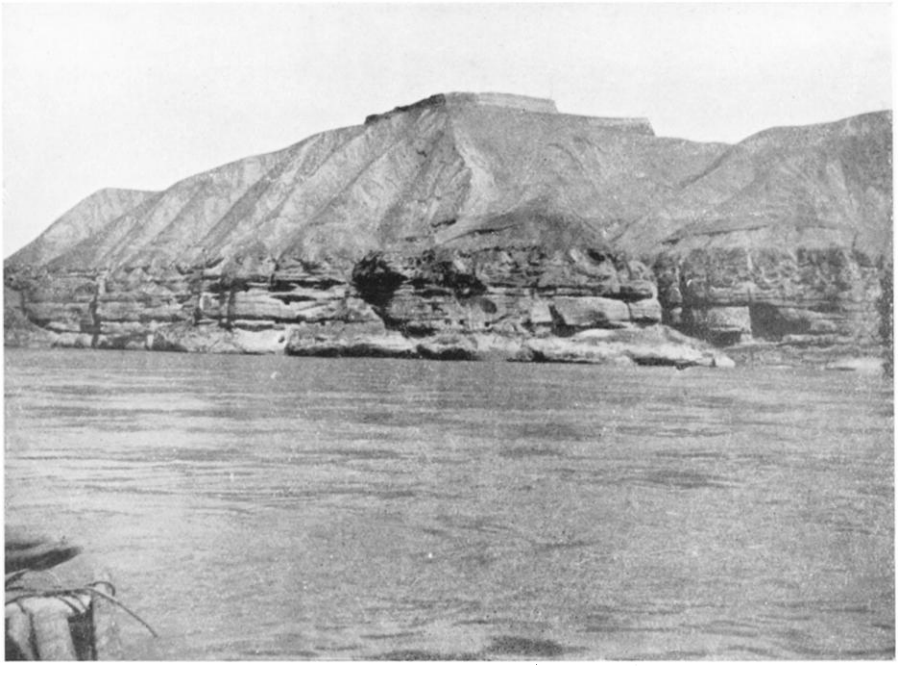
Somewhere in this uncharted wilderness, somewhere out in the vagueness that is still Kansu on the maps, there lurked a mountain or a range called Chagola, crossed by Potanin, and offering hopes of an alpine flora hardly less rich than those of the Yunnan-Szechwan Alps, quite virgin, and incomparably more likely to suit our climate than the tender children of the southerly mountain systems of China. In pursuit, therefore, of the elusive Chagola did I bend my steps towards the uncertain western borders of Kansu.

I was not alone in my quest; before leaving England I had met

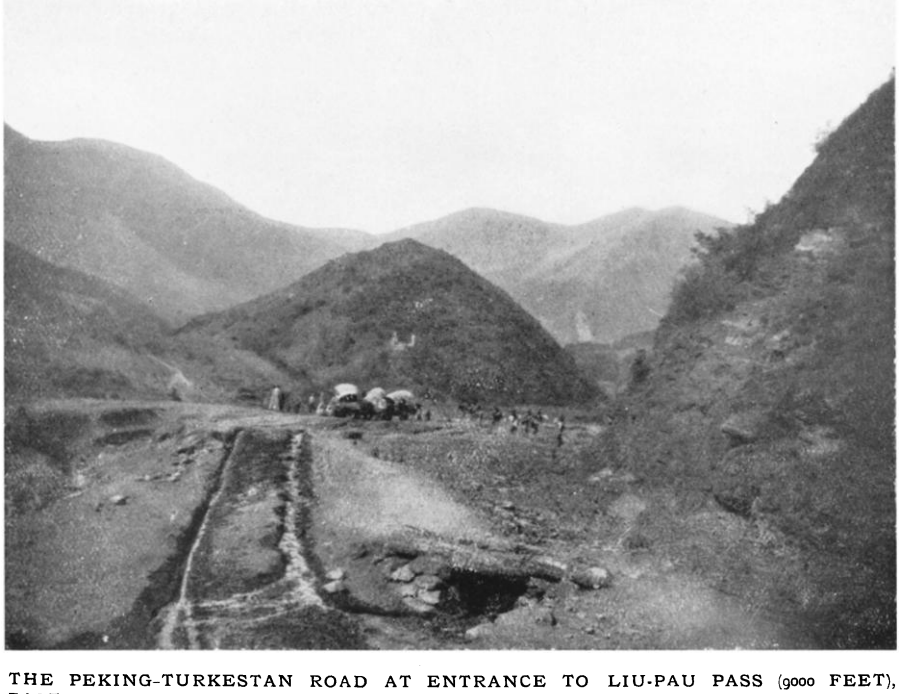
Mr. William Purdom, formerly of Kew, who had already for some three seasons collected seeds in Northern China for Sir H. Veitch. Him I asked immediately if he would join my venture for the mere fun of it; and that he consented I consider one of the greatest good fortunes of my plan. Quite apart from his knowledge of the ropes, which made him virtually the impresario of the expedition, I owe him further a special and undischargeable debt for his untiring courage, cheerfulness, contrivance, and friendliness, which consistently made the roughest moments of the expedition smooth, and the smoother ones pleasant as a picnic. Of two men, thus juxtaposed at sheer hazard for two whole years in the close intimacy of such travel, it is not invariably that so satisfactory a tale can be told; or that they emerge from the test of such comradeship even better friends than they went in. Therefore do I want to lay special stress here on my extreme good fortune in my companion.

Apart from ourselves the party consisted only of three Chinese servants—rough peasant lads from Shansi, uncontaminated by the slightest taint of Western civilization, and therefore to be fully relied on in the perilous and rough-and-tumble life of the Border, whither lily-handed "boys" from the coast towns could never be induced to follow one in the first place, and whence in the second, if they did they would immediately strike work and flee on the first word of difficulty. Besides these, of course, there was the ragged scarecrow of a soldier or two whom each governor of a walled city sends along with you as your escort into the jurisdiction of the next, and who, however useless for purposes of defence, does indeed most effectually represent the immemorial majesty of the Chinese Empire, and thereby secures you unvarying consideration throughout the length and breadth of this law-abiding land. And then there was also the mule-caravan of some ten pack-beasts, with half a dozen owners in attendance.

In point of fact it is very much better, when venturing among the uncertain tempers of the March, to be a small party, like mine, capable of travelling more quickly and lightly and unnoticeably than if one had an armed troop of Cossacks or Sikhs—quite sure sooner or later to provoke an explosion in some Tibetan village with their exactions, or in some Chinese one by the repellent darkness of their skins—a notorious bugbear to the Chinese, which has already been responsible for at least two of those Border tragedies that so instantaneously flare up. Indeed, a very small, lightly-armed party can go quietly where a bigger one could not penetrate; and this consideration is of special importance to a horticultural botanist, who not only has to work his district during flower-time, but also to return there later for seed, which incessant alternation of activities accounts, of course, for the comparatively small amount of ground one is able to traverse in a season. Even the mule train is a most inconvenient necessity, more especially as, in default of any banking facilities in the interior, one has to carry the entire supply of silver required for



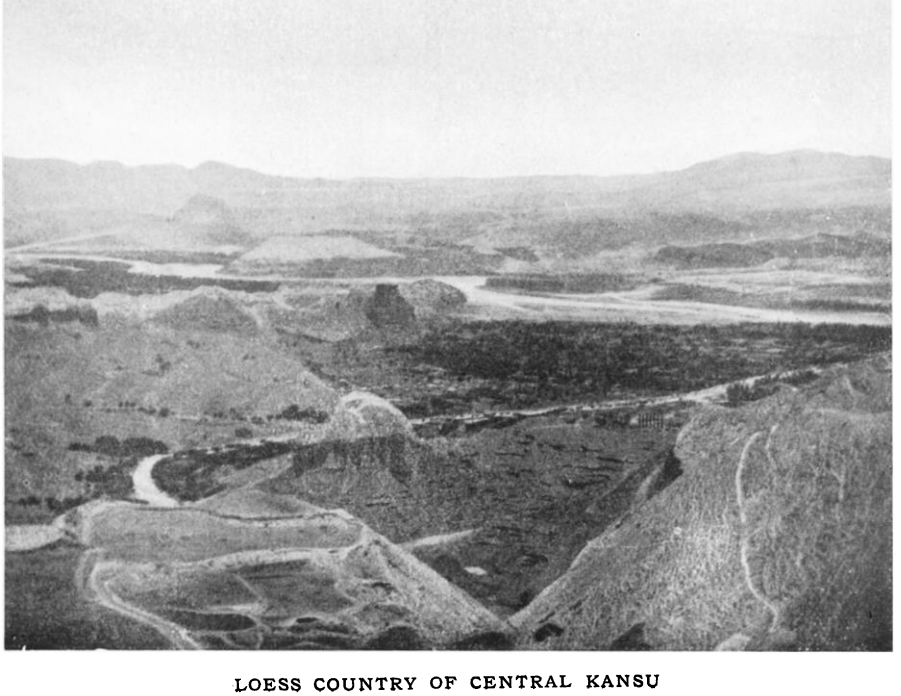
GORGE OF THE YELLOW RIVER BETWEEN LAN-CHOU FU AND CHUNG-WEI HSIEN



THE PEKING-TURKESTAN ROAD AT ENTRANCE TO LIU-PAU PASS (9000 FEET), EASTERN KANSU

Note: The photographs on this and the following page are by Mr. Eric Teichman, and were intended for his paper on "Routes in Kansu," 'Geogr. Journ.,' December 1916, *but owing to an accident could not be then included.*

KOKO NOR STEPPE NEAR YUNG-AN, FOUR DAYS NORTH OF SI-NING FU (10–11,000 FEET)



LOESS COUNTRY OF CENTRAL KANSU

the expedition, in the form of boat-shaped clods of metal, inconceivably cumbrous to convey, and the mark of every brigand hope along the road.

From this point of view the time of my expedition was singularly ill-chosen. Even in Peking rumour raged round the White Wolf insurrection in Honan, and by the time we reached Sian matters were in such a condition that the capital of Shensi was virtually in a state of siege, quailing before the terrible daily advance of the Wolves northward out of Honan into Shensi round the eastern spurs of the Tsinling. The troops were unpaid and disloyal, the generals no better than the Wolves, and all the robber villages beneath the shadow of Tai-bei Shan were stirring with sympathetic disaffection. It was only after a very anxious period of doubt that we were at last allowed to leave the city for the west, hurrying for the opportunity before the gates of Sian should be finally closed against the invader. Conscious of the black storm driving up over Shensi from behind us, we scudded thankfully westward across the open face of the province toward the remote security of the March. It never entered anybody's head that meanwhile yet another army of Wolves might be moving up to meet us in Kansu, round by the western spurs of the Tsinling out of Hupeh. But in the mean time what was remarkable as we went was the breathless and sullen atmosphere of gathering storm that lay tense on all the towns of Shensi as we passed. It was with a pang of real relief that we crossed the wooded heights of the Kuan Shan and descended into the freer air and genial hospitality of Kansu.

We arrived on April 11 in the ci-devant Imperial city of Tsinchow Kan, from which alone the itinerary becomes worthy of comment. For here all main roads were left, and we embarked on a wild and little-trodden cross-country track of some nine days towards the ill-famed city of Kaichow Kan secluded impregnably behind gorges that debouch on the Blackwater River. For the first week the scenery is still typically that of South Kansu, composed of rounded high undulations of loess downland, tilled in terraces to their tops, and wholly treeless except where little orchard stretches lie along the fell-side in a cloudy blur of blossom; or where the loess-built villages, so neat and clean, nestle into a vivid emerald vapour of weeping willow and young poplar. Gradually, however, the down-masses grow bolder and barer and higher; day by day one traverses more open passes, with further views out over higher and wilder ranges in the west, as one winds along the rounded wind-blown brows. Clouds lay persistently low along the snow-clad ranges of Tibet, but the flowers told the changing tale as by degrees the loess seemed like fading to its end; the wolds were sheeted in the blue of *Iris ensata*, and in the grave-coppices edelweiss in swathes of silvery stars stood up from the blazing azure firmament of Lithospermum. For I will not spare you appropriate hints as to the *raison d'être* of my journey; unlike real travellers, so preoccupied with theodolites and other high thoughts that never would you get any notion

from their learned pages that earth produces anything but rocks and rivers and bones.

But now the country reserved for us a characteristic surprise. It has often been remarked in what Saharan troughs of arid heat, beneath towering and alpine ranges, the big rivers of the Tibetan highland tear their way down into China. As it is with the Mekong, the Salween, the Huang Ho, and the Ta Ho that only a foreigner calls the Yang-dz'jang, so it is with the Blackwater (the Hei-shui Chiang), Kaichow Kan is reached through a terrible defile of rugged blasted mountains, and immediately you enter a territory of fierce heat and drought which gives you no notion of the Tibetan snows so close at hand. In the midst flows the turbid and warship-coloured flood of the Blackwater, and on either side roll crumpled ranges of fell like titanic slag-clumps burnt and seared and lifeless, a tumble of dull ochre-coloured deadness, except where laborious starvation has somewhere scraped a few faint terraces of tillage across some comparatively amenable flank, or dark coal-like strata lie across the rugged convolutions of the fell like shadows of cloud.

Had we foreknown our fate, Siku and its mountains are only three days' journey Westward up the Blackwater from Kaichow Kan. But in Kaichow Kan there was trouble and much unrest, characteristic of this remote place. We did not know that the malcontents of Kaichow Kan had invited the intervention of the Wolf, and were even now awaiting his arrival. Meanwhile we got our first news of Chagola, though even then nobody knew more of it than that it lay somewhere away west of Wenhsien Kan in the south and was a bad place, where the peasantry had a way of building up their visitors in damp bonfires.

To Wenhsien Kan, accordingly, we now bent our steps, and for three days descended the astonishing gorges of the Blackwater by which Kaichow Kan is so securely defended from all approach out of the south. They are of a strange and sinister splendour, of a withering heat and a burnt dark ugliness that suggests an approach to hell. Deep between black walls and buttresses of precipice the perilous track goes climbing along the sheer faces; far overhead rise close on either side huge lifeless crags on which occasional mica-smears give a delusive look of moisture to their arid altitudes, where the only sign of life is an asphodel, itself like the ghost of a corpse-candle, aspiring in millions of diaphanous pale flames from all the sombre walls of the gorges. At points of special peril Our Lady of Mercy, from her tiny shrine pecked into the living rock, keeps guard at the difficult turns of the buttress; and in the grottoes of the precipice the stranger-dead of the district lie poised in their huge coffins at auspicious angles, with boulders on their lids to keep away the leopards. But here and there are little bays below where one can ride over the silken blackness of the silt to where villages sit sunning themselves in a boscage of poplar and persimmon and pomegranate, amid the pervasive entrancing scent of Melia.

On the fourth day, however, one diverges westward across the river (by an elaborate suspension bridge) and proceeds up a converging valley of cooler moorland aspect, with clear becks filling its bottom, towards that high wooded down called Wind-hill Pass (Fêng Shan Ling), across which we now cut towards the valley of the Whitewater (the Pai-shui Chiang), missing its confluence with the Blackwater a few miles further south at Pikow; nor did we then know what else we were so narrowly missing. In a grove of green at the foot of the ascent lies that delectable hamlet Lao-yeh Miao, and on the far side of the pass, deep down amid ranges as torrid and bare as those of Kaichow-Kan, one comes unexpectedly on the yet lovelier city of Wenhsien Kan, clouded with secular acacias down its streets, and throned on the Whitewater, whose tide, alone among its compatriots, is blue and clear as beryls.

And here we did at length learn that Chagola was now no more than four days' journey out in the west. But the more definite the news the worse it was; and so terrible was the reputation of the place that the courteous and kindly old governor of Wenhsien Kan, responsible on his head for our safety, implored us with tears in his eyes to desist from our project of visiting it. For Chagola is pure Tibetan, outside the sway of China, and itself an outlying fragment of a Tibetan principality whose seat and sovereignty are some ten days northward, at Jo-ni, so that the natural lawlessness of the Chagolese is handsomely improved by neglect. Finally it was only by characteristically Chinese diplomacies that we were allowed to proceed. We might go westward, it was decided; but as to any precise objective no questions were to be asked, and no answers volunteered.

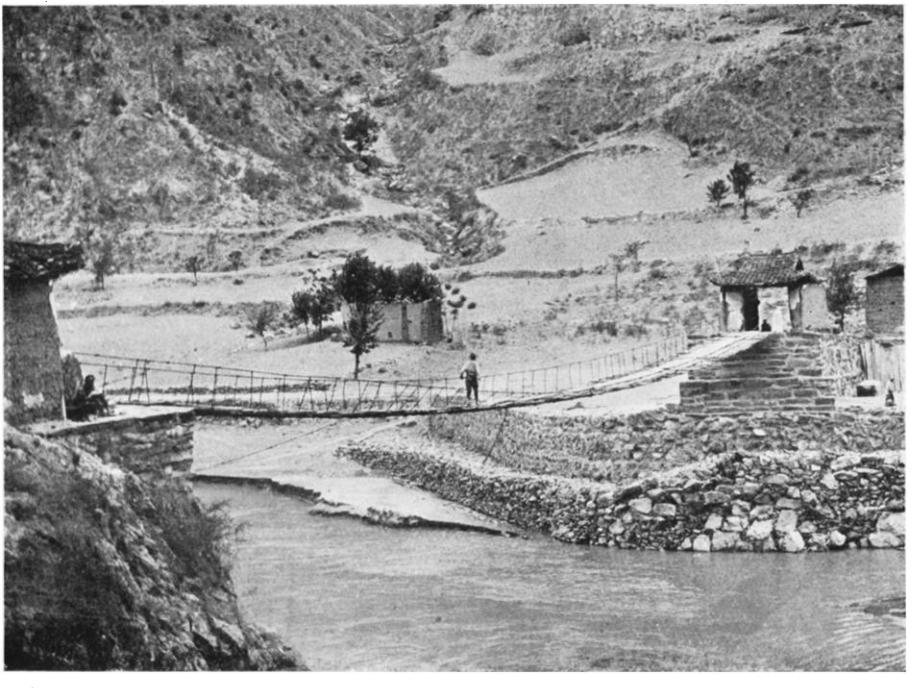
For three days the journey ran in a torrid valley, and on the second the beautiful waters of the Pai-shui Chiang deserted us, fetching their curve from a bold sweep out of the south, away down in Szechwan in a country so promisingly high, of forested mountains veiled in storm and streaked with snow, that this desertion was doubly bitter. Our own way ran meanwhile straight up the alpine-shingled valley of the Tung-lu Ho (East Road River) in a region more dreary, bare, and desolate than is easy to convey. Indeed, we heard that for three years no nourishing rain had fallen there, and that half the inhabitants had faded out by starvation. Yet now the Alps were obviously drawing near, and occasionally high points veiled in forest would appear on the right over the sad and shapeless sterile hills of the lowland, all of an Arabian brown deadness. And then, on the third day, riding under a little village gateway at the end of the stage, I looked up, and there, throned and haloed in their ranks, smiled down the Buddhas and Bodhisattvas of Tibet.

"Two-looks" (Ti-êrh-k'an), despite its Chinese name, is the first Tibetan village, and now almost at once you ascend away out of the valley-bed into a right-hand fold of the hills; and there above you, towering immeasurably high, impends immediately the vast wall of Chagoling.

The track zigzags furiously up and up the open side of the mountain, and behind, as the lesser hills dive down into insignificance, there unfolds over them, away into the uttermost distance, the stupefying panorama of the Szechwan March, in range over range of arrogant mountain masses, culminating in those immortal snows which dominate Sungpan. But even more wonderful, because more immediate, is what you see from the crest of the pass itself, at 10,500 feet, with snow still lying dense along the col on May 6.

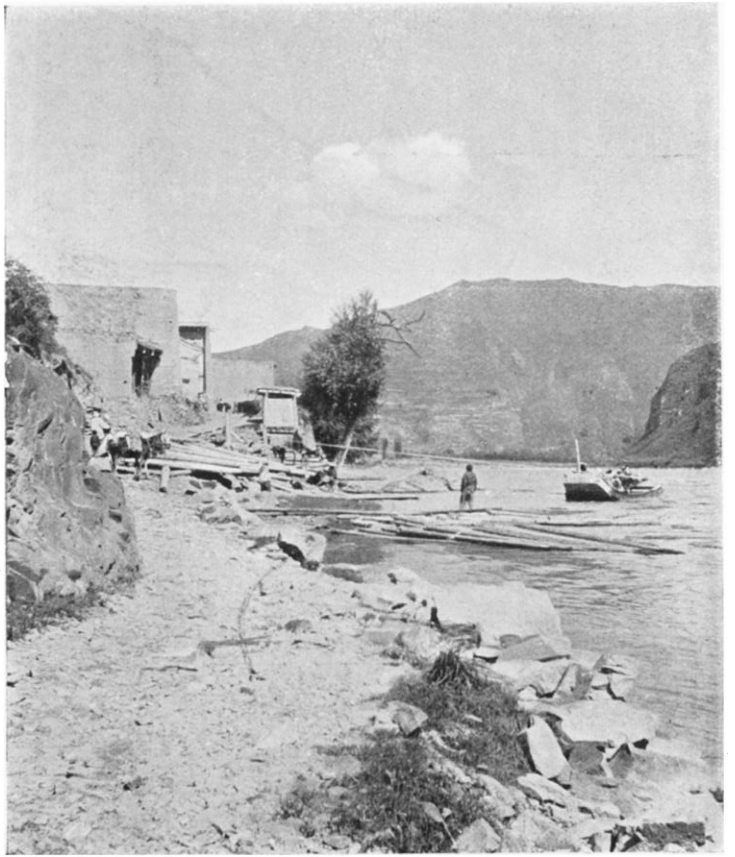
The southernmost corner of the Kansu March is very easy to grasp geographically at a glance from Chagoling. Its features are the two gigantic mountain ranges that sweep down parallel to each other south-eastwards out of Tibet, and are separated by an auriferous red-soiled ridge of some 9000 to 10,000 feet, between which and the further range the Blackwater cuts its eastward course. Chagoling is a pass over the dying easterly end of the first of these two ranges, and overhead on the right, as you look northward, impends the leonine naked mass of Chagola itself, some 1500 feet higher, and seeming from here a very considerable eminence, but from the Red Range opposite revealed to be the merest insignificant hummock, the last effort of this chain to assert itself; and a very feeble effort indeed by comparison with the magnificence of the main range, which from the pass you see extending westward on your left, compilation behind compilation of dolomitic castellations, glistening with lingering ice and snow, and seeming like a fleet of titanic bergs immobile over the ruffled sea of the lowlier ranges round their base. From your feet the pass drops immeasurably far, through the dense forest of fir and rhododendron in which its cold northerly slope is vested (so unlike the bare baked moorland of its southern wall); steep and far, in fold over fold of woodland it sinks through belts of the red birch, to where the Satani-Ho, hurrying round the last end of the range to meet the Whitewater, brawls like the Findhorn in ice-grey torrents deep among the white boulders of its bed. On the far side the view mounts over the laps and shelves of the red upland, to the serrated outline of the Red Range; and then, abruptly, high over this as Chagoling over the lowlier fells, the view is closed by the stark wall of the Stone Mountains (the Min Shan or Pei-ling), now in its final stages of decrepitude, to match the decrepitude of the Satani chain at Chagola. Yet it is none the less a most majestic parapet still of some 12,000 feet, breaking into the supremely splendid 14,000 odd feet of Thundercrown, full in the middle of the view, with another huge dim castle behind it, and then, after a break, the renewal of the range in a long succession of dolomites ranging away and away into Tibet, in answer to the long-ranging line of their Satani rivals. The intervening Red Range is once more partially China, though with isolated outcrops of Tibetan principalities; while on its further side, among the very roots of Thundercrown, China has established her last westerly outpost in the little walled town of Siku—the City of Western Defence—raised to that rank

THE CARAVAN BAGGAGE AT A COUNTRY INN

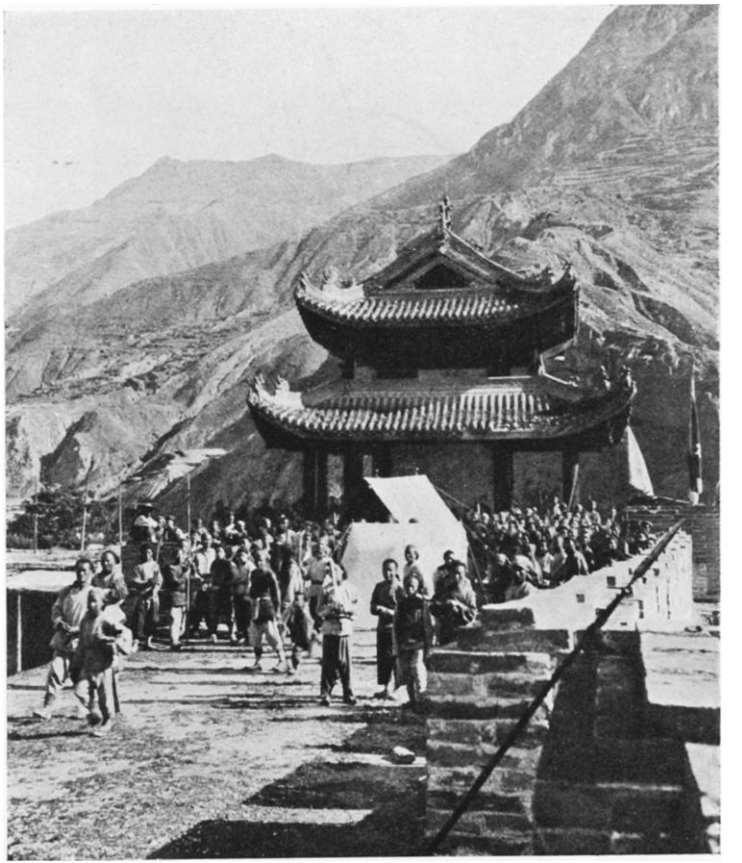


BRIDGE OVER THE BLACKWATER THREE DAYS SOUTH OF KIAI CHOW, WHERE TRACK TO WENHSIEN DIVERGES

Photographs by Mr. Reginald Farrer



JO-NI FERRY



THE DEFENCE OF SIKU

and girt with its noble new wall during that outburst of Imperialist activity all up the Marches which signalized the second reign of the Grand Dowager.

Away beyond the Stone Mountains again up in the north there is yet another strip from this parallel fringe of Alps that makes the March of Tibet; but this is very much feebler, lower in altitude, and not penetrating further east into China than the district above Jo-ni, where Monk Mountain and Lotus Mountain (Lama Ling and Lien Hua Shan, of some 11,000 feet) keep guard over the two passes that give access from the south to Lanchowfu. And after these there are no more Alps, only a drear chaos of crumpled loess fells, arid and lifeless, until at last, ascending into the far north above the Huang Ho, you meet the Ta-tung river and the southerly apex of that other descending sweep of the K'un-lun that curves round the northern arc of the Tibetan highland and breaks into the Tien Shan, the Ala Shan and the Altai. But this is a very different country from the southern March of Kansu, different dull igneous mountains, and the dull different flora of the north, so jejune after the lush wealth that ascends all up the Chinese March from Yunnan, and lingers even in the chillier heights of Kansu-Tibet.

To history, though, and not geography, belong my proceedings of the next two months. Chago gave us as bad a welcome as its character promised, when at length we reached the little village out on the spur of the lower fell, with its monastery standing conspicuous on the final eminence. The place is pure Tibetan, with a characteristic hatred of China and her friends. Characteristic, too, are the words' 'Chago" and "Chagoling," being obviously a Chinese transcharacterization of some Tibetan name of wholly different meaning. Be this as it may, we had not long to wait in Chago before meeting proofs of that prevalent ecclesiastic jealousy which, holding all gold of this auriferous country as the monopoly of the Church, is anxious to restrain by ghostly terrors any incursion of its own parishioners up into those grim Alpine fastnesses where gold and its guardian gods notoriously have their home; and therefore is, *à fortiori*, doubly and trebly opposed to any such excursion by foreign strangers, of whom (say what they may about flower-hunting and other such patent pretences) not the holiest saint in his cell is such a fool as to believe that any mortal man can possibly be such a fool as to come so far and climb so high for any purpose less reasonable than the discovery of gold. Following on which, as they too well know, would assuredly ensue the slow invasion of missionaries and drink and guns, and punitive expeditions, and all the other delightful results of what is called European civilization.

Accordingly the Prior of Chago received us very coldly, and his visit of ceremony resolved itself into an exhaustive catechism as to our objects in coming. It was plain that not one word of our answers did he believe; however, he melted gradually into politeness, and departed at last with smiles, leaving us gratified at our success, and quite unsuspicious of the

fact that the artless prelate had gone out immediately to issue orders that all our throats were to be slit in the night, provided the exploit could be achieved quietly and without indecent fuss. We did not lend ourselves, however, to this seductive scheme; and after even more drastic steps on the part of his reverence's parishioners had failed, we concluded that considerations of health recommended an early departure from an atmosphere so electric with religious zeal.

Hastily we removed down and across the beck up on to the secondary lap of the Red Range opposite, where nestles the Chinese village of Gâhota. Here we found news of yet another village, Tibetan by race, but loyal to China, some ten miles west up the valley, in full command of those glorious 18,000-feet Alps of which our departure from Chago had led us to despair. To Satani we accordingly proceeded, and found no less hearty a Tibetan welcome than Beresowsky when he wintered there in the eighties. It is a very poor but very friendly little place. We settled into a crumbling lonely cloister just outside the village, and were addressing ourselves to the summer's work when the double-edged sword of ill news came shearing through all our plans; for over the hills now filtered the latest news of China.

Not a week after we had slipped aside over the Border from the Blackwater, the White Wolf army had swept up unopposed by those same gorges into Kansu. And now all the walled cities of the southern province were laid waste in fire and blood, and even Lanchow sat quavering in terror behind locked gates; while on the passes in between the Mohammedan troops on guard left it still uncertain whether they would stay faithful to their trust or join forces with the Wolves. But our own case was even more immediately urgent. Our expeditions into the hills had, it seemed, engendered storms of hail and thunder in the hearts of the outraged mountain spirits, and these, passing away down the valley, had wrecked the harvest prospects of Chago; that simple and pious peasantry had accordingly sent out the Fiery Cross among all the Tibetan villages and monasteries and principalities of those parts, and an army of 3000 strong was now advancing up the valley, quite determined this time to wipe us out definitely, fuss or no fuss. For so tiny a party as ours the case was extreme, and not even the undeviating devotion of Satani could be of much avail. Before us lay that impassable barrier of 18,000-feet mountains; on the east the country was blocked by the approaching crusade; out in the west lay only that terrible wild land of the Black Tepos where no stranger can venture and live; while from the north (whither devious tracks over the Red Range might bring us to Siku) we heard that the city was actually in the hands of the Wolves, a smoking stack of ruin, running blood, with its mandarin and half its population slain.

I pass over the subsequent developments of the problem. Ultimately, in a grey dawn, with the inhabitants bearing our goods, we made our escape

successfully from Satani, and over the hills to Siku, preferring the least certain of all the perils offered us by fate. The country was in a buzzing stupor of panic, what with the Wolves and the Chagolese: but when we arrived once more at the Blackwater, and had achieved the 10 miles or so of blazing valley and defile at the top of which Siku lies impregnably ensconced in the deep roots of Thundercrown, tucked into a sunny bay of the sun-flogged fells about the Blackwater, and at the end of a cul-de-sac beyond which lies only Tibet, not 6 miles further up the valley, we found that though the walls were crowded and the place hysterical with excitement, the Wolf had not after all thought it worth his while to diverge so far for a prey so poor, and had swept on immediately northward to the ghastly sack of Minchow and Taochow. Siku shared this luck with only two other towns of South Kansu, Wenhsien Kan and Hsi-ho, both of them, it was held, mysteriously blessed in our having passed through. Accordingly we were received with open arms in Siku, alike by the people and by these two charming gentlemen, Mr. Pung and Great Lord Jang, their military and civil governors, who, amid all the turmoils of the Wolf incursion, had been further harried into white hairs by repeated letters from the viceroy, warning them of my party gone lost over the border, and on peril of their heads to be sought out and sedulously safeguarded.

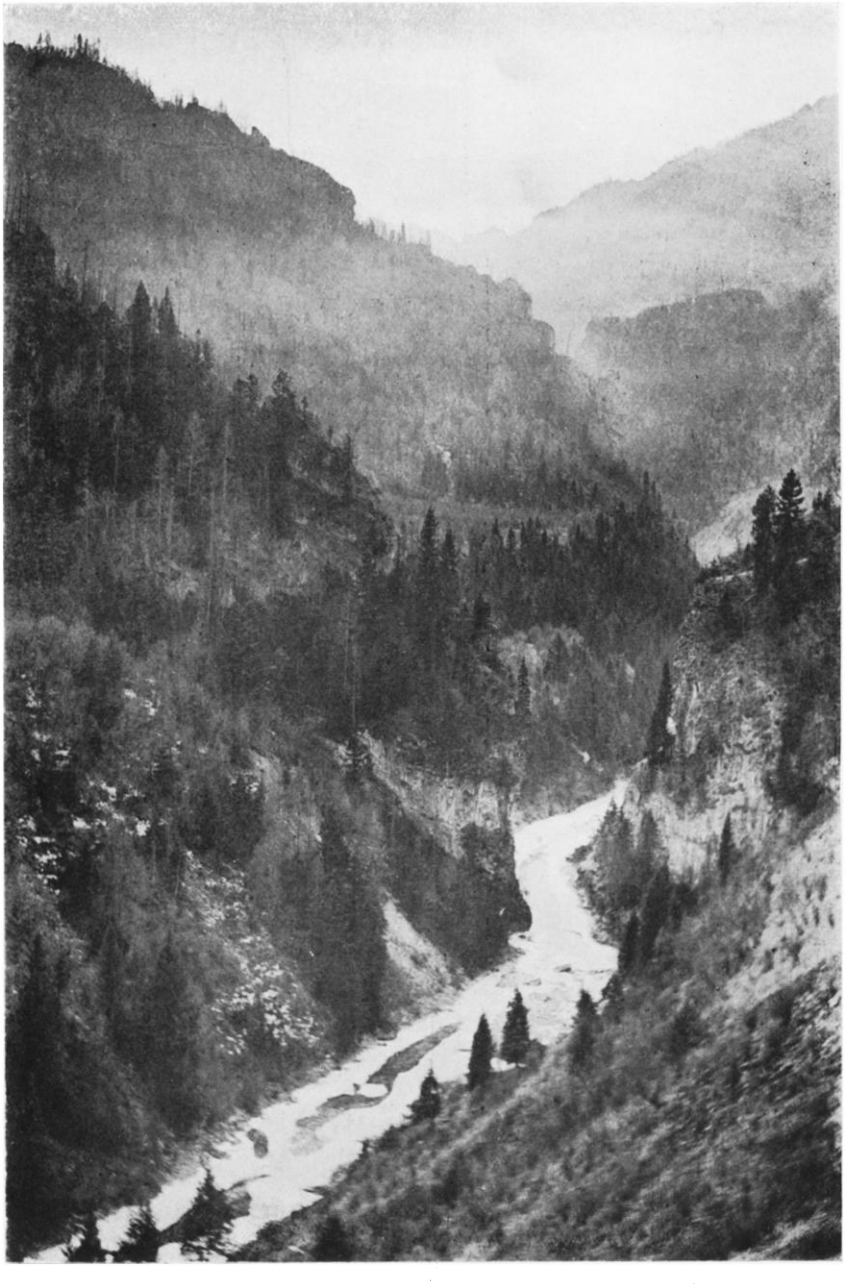
Siku is among the pleasant spots of Earth, and though we now lived through more troublous times, what with Tibetan invasions and Homeric sieges, I shall keep a sigh in my heart all my life long for that sheltered haven, so warm, so simple and so sunny, the northernmost lingering point of palm and fig and rice. Siku sits enclosed above the river in a big V-shaped delta of high loess downs. They are bare and brown, browsed over by laborious goats for any sprout of greyish-green that may push. Behind Siku they rise in a high wall, the top of which is an undulating shelf perhaps a mile deep, where villages nestle among the stony fields they have reclaimed. And then abruptly towers up from this the stark spine of the Min Shan Ridge, with the complicated and enormous magnificence of Thundercrown (Lei-ko'rh-Shan) immediately dominating Siku. Thus in some eight hours you can ascend straight from the Saharan heats and sun-trodden rocks of the river-valley, thirsty as Aden, at some 4500, straight up and up through ascending belts of vegetation, sub-alpine, alpine, and high alpine, until you emerge upon the gaunt stone-slides of the summits themselves, at some 13,000–14,000 feet, above reach of any vegetation now at all, except the galaxied golden hassocks of *Potentilla biflora* humped upon the naked shingle, or the azure maces of *Meconopsis Prattii* standing sturdily up in bristling thorny spires of poppies blue as a frosty dawn.

This last easterly tailing off of the Min Shan is, however, curiously waterless, and offers the characteristic phenomenon of the mountain limestone almost more startlingly than I have ever seen it elsewhere. The ridge, being, as I say, a single spine, is narrow and very steep. Its flanks on the southern face are torn and ravinated by a system of gigantic gorges

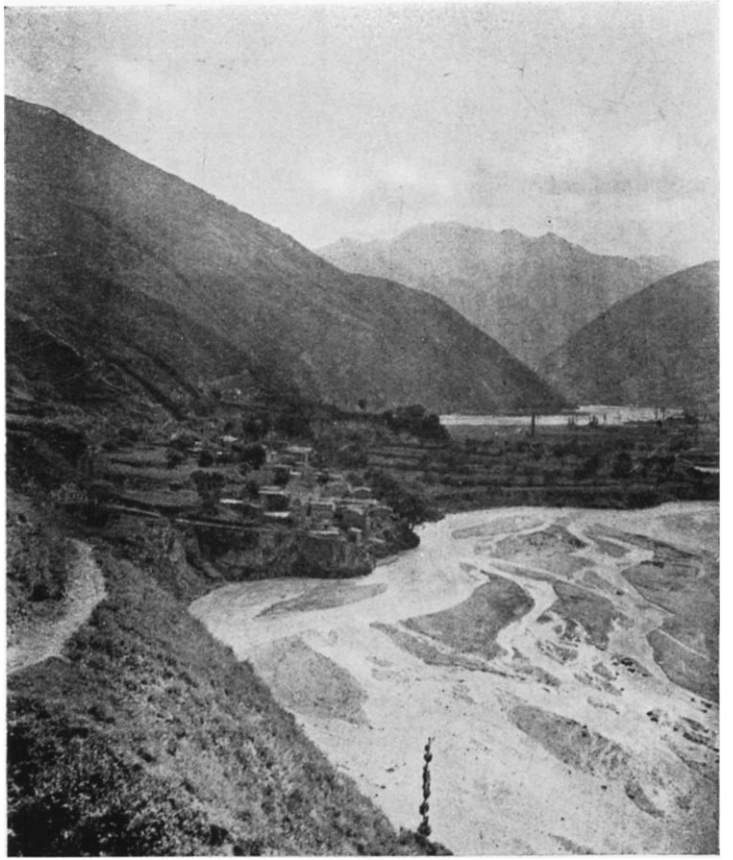
that in the gigantic scale of the mountain seem mere wrinkles and frownings and corrugations in its folds. Many of these have gone bone-dry within the memory of recent centuries, while of those two supreme and splendid ravines that converge at the top of the delta above Siku and have once made it one white-shingled river-expanse, neither now holds a continuous watercourse, but the becks sink and reappear, sink and reappear, like flying Arethusa or the rills that thread the limestone pedestal of Ingleborough. In fact, after all the snows are melted, aloft on the Crown of Thunder, it is never safe to expect water on those heights in summer, except in certain secret caches among the church-big boulders where the musk-deer haunt and the beautiful bushy-tailed wolves. But the waters have their revenge on the limestone that has so swallowed them; for far down in the very roots of Thundercrown they leap once more to the light of day amid the willow groves of Siku itself, in fountains and runnels as diamond-clear as those that gush from other dolomites far across the world.

Siku is a wicked little place; the last outpost of China, the refuge of outlaws, ne'er-do-wells, criminals, and all who have made their homes too hot to hold them. A dour and doubtful race, accordingly, are its inhabitants, looking on the stranger with no friendly eye. Had it not been for our luck in being able to serve the city during its siege, we could never have fared so well; as it was, we found the wicked ones at least simple and passive and curious. Other travellers have not always had such success there, and Potanin himself has left behind a sinister reputation. He stole the moon. This luminary, it seems, had a sort of villegiatura in a stone outside the east gate, where she was frequently to be found at home, until Potanin had left the place, after which she was never seen there again. No conclusion could be plainer than that Potanin had stolen her; unless the more charitable construction be adopted that Selene was so smitten with his charms as to have made herself a willing partner in an elopement. However, the Sikuese still deplore this rape, and not even her persistent official appearance in the heavens can console them for the loss of that special intimacy they had previously enjoyed.

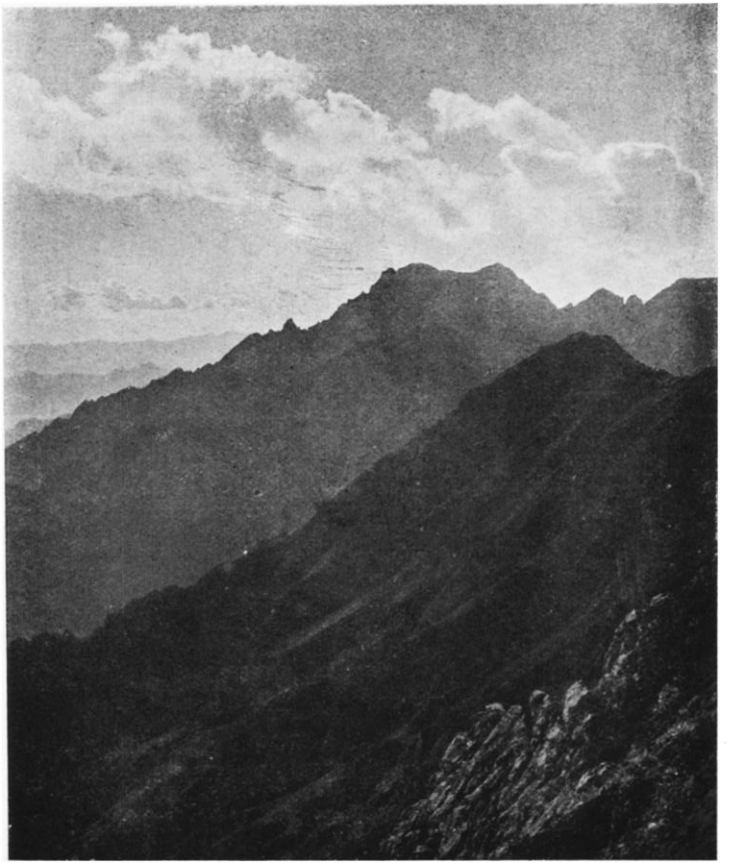
It was not till July 6 that I sadly quitted Siku for the north. The delta and all the adjacent fields were now cleared of corn and flooded for the rice, which is the second of the three annual crops they produce. Down the blazing stony valley of the Blackwater one proceeds south-eastwards for some 20 odd miles, till suddenly to one's astonishment a big river joins the Blackwater at right angles from the north, having cut its way deep in a succession of gorges through the last fading vertebræ of the Min Shan Ridge. This is Southerly River (the Nan Ho), sole exception to the rule by which all waters born on the northern flanks of the Min Shan flow away northward ultimately to join the Huang Ho, while all those of the southern drive southwards, to find their ultimate Nirvana in the Yangtse Chiang. Up the gorges of the Nan Ho proceeds the northward



GORGES ABOVE ARDJE'I



ON THE NAN HO BETWEEN KWANTING AND TAN CHANG LOOKING SOUTH TOWARDS THE GORGES OF THUNDERCROWN



ON THUNDERCROWN, FROM THE RED SHALE HEIGHT OF THE GREAT RIDGE

road, and as soon as you have emerged from them you find yourself once more in the typical scenery of South Kansu, eventless undulating high downs, clothed in scrub and less cultivated than are the fells further east, in parts more civilized.

Here we were following straight up the track of the Wolves, dispersed now a month since by movements of the Mohammedan troops in the north, on Lotus Mountain, and yet further dissipated in retreat by the fruitful prayers of the Abbey of Jo-ni. It was rather terrible to travel through the blackened wreckage of those quiet Kansu villages that had asked so little of life but to be let alone. However, the track was now once more beginning to revive in traffic, and the destruction was not so complete as I had feared. On the fourth day the scenery abruptly changes. Behind and about Tan-shang, with the Tibetan palace of its prince Ma T'u-ssŭ dominating the little town from its acropolis, there ranges a convolution of small bright red fells, the headquarters from which, in many converging runnels, the Nan Ho collects its muddy tide. And as soon as you have crossed to the north of this you have changed from Chinese scenery to what I must call typical Northern Tibetan—a country not of rolling brown fells, high tillage, comfortable valleys, but one of enormous open green downs unscarred by the plough, of broad river-vales, and a general extraordinary sense of space and expansion, and of being in a shallow green saucer near the top of the world, with a limitless blue sky pressing close on you like a lid. The culmination of this impression is reached at Minchow, where once more you meet a river (the Tao Ho) born of the Tibetan highlands, now quite close again on the west; but itself a typical walled city of North China, harried and wrecked by the Wolves (who ran up its walls "like rats" over their sword-hilts), yet filled with a feeling of primeval calm, encircled all about with dish-covery emerald green fells that seemed of no height at all, yet made one feel as if they were pillaring the sky.

From Minchow the westward way follows the course of the Tao Ho, round its endless bays. Some 60 li up is the bridge over on to the Chinese bank (for from this point the river makes for once a definite boundary between the Empire and the Pontificate, here represented by the Tibetan principality of Jo-ni). However, the Wolves had destroyed the bridge and its village in their advance on Taochow, and we had to continue our journey up the Tibetan side. Nor had the Wolves had the best of the bargain either. In arrogance of heart they had cut their road behind them and swept on up to Taochow. Here, on the theory that as the town had never yet been taken it never would be, the whole population of the countryside had so crowded inside the walls that there was barely standing room in the streets. Hardly a living thing escaped. Infuriated by resistance the Wolves swept Old Taochow from end to end, leaving but one house standing in all that thriving Chinese city, and that one only by accident escaped the conflagration. Of the inhabitants, not only was no

human being left alive out of some 10,000, but the Wolves deliberately destroyed every creature that had breath, from the cattle and horses down to the dogs and cats, till the kennels and the gates were stacked so high with indiscriminate carrion that for many weeks after no one could bear to be within miles to windward of Taochow. As for the Mohammedan population, this shut itself inside its mosque, set fire to the whole, and so gloriously perished.

This ultimate tragedy seems to have stirred the Mohammedan troops that had long been doubtfully guarding the approaches to Lanchowfu on Lotus Mountain and Monk Mountain. On the first rumour of their movement the Wolves, caught and helpless in a cul-de-sac, rose up in an instant and scattered and fled, so precipitately that their very food was left warm in the pots. And now where was the bridge that would have let them safely back on to the southward road? But now, too, came the moment for the Abbey of Jo-ni, that had long been sitting in terror of sack. Night and day the monks made invocations, and the five Living Buddhas on their thrones lifted up their hands: with the result that the Wolves, compelled to make a huge raft to cross the river, found it turn over beneath them in midmost of the central whirlpool, and were swept down to death by hundreds, hardly a man of that particular batch escaping, while the rest went dissipated miserably in the inhospitable mountains, in certainty of slaughter wherever they were found.

This is all strictly irrelevant, unless you want not only the stage but the scenes that were played on it in 1914. The stage in its effects is more and more northerly as you advance round the bays of the Tao Ho, under steep and steeper impending serrations of hill, growing wilder and wilder, till at length, long before you reach the rope ferry that conveys you over on to the Chinese side of the river again, their flanks and crests are all clothed in scant scrub of barberry, willow, and alder, while in the shingle beds of the Tao Ho lie impenetrable brakes of willow and Buddleia, where the leopards have their favourite haunt. It is a bleak unfriendly land, and at some 8000 feet the 11,000-feet mountains all around you look like a bare 3000. An impression of arid cold pervades it, and its capital seems the culmination of this impression. For Jo-ni is a crumbling little miserable place, huddled inside a miserable wall, and tucked into the folds of a huge fell-system of open bare loess whose summits are crowned with obo or chortens. It lies infelicitously on the Chinese side of the river, which puts its prince and its princely abbey in the power of China, though all their sway lies southward across the Tao Ho in Tibet, the forested luxuriance of whose northerly slopes stands opposite Jo-ni in enviable contrast. The prince, however, is a wealthy young man (and of devious designs), and his newly decorated palace in Chinese style shares with the gorgeous temple of the earth-wizards the distinction of being the cynosure of Jo-ni. It is higher up, on a shelf of the hill above, girt by a wall of its own, and a city in itself, that the younger cult has its seat. For this is

the princely abbey, founded long since to be an appanage for the cadets of the royal line. Jo-ni Abbey stands out accordingly at least the equal of Gumbum and Labrang in eminence, and in some ways even superior in prestige. For Jo-ni is the only foundation outside Urga and Lhasa that has the rights of the printing-press: Jo-ni owns no diocesan authority nearer than the Dalai Lama himself, and the relations of Jo-ni, indeed, with the Potala have always been singularly close: outside the south gate you may see a little mud house in which was born that eminent saint who was regent of Tibet during the flight of the Sovereign Holiness before the British invasion; and it is always on the cards that one of those tiny naked urchins tumbling in the street may attain to the highest places of the Church.

Meanwhile the abbacy is in commission, no cadet having been born to the princely house since the last prince-abbot died, more than a hundred years ago; the dominant personalities in the abbey are the five Living Buddhas for which the place is illustrious. Once there were six, but now the sixth lives in a gilded palace away high up across the river in a forested fold of the Tibetan hills, where he lives a life of dowagerhood, and unravels the darkness of the future to the admiration of all who come to him from the wide skirts of Tibet. The Living Buddhas, though of supreme sanctity and authority, seem to stand outside the official hierarchy of the abbeys, though no foundation, if it can help it, will be without one or more of these eminences in residence. Only in very exceptional circumstances, and on a special summons of the Holy Being, can a foreigner hope to interview a Living Buddha. I count myself fortunate in having had an audience of the Sacred Body of Nalang, most eminent of the five in Jo-ni.

In one of the side streets of the abbey His Holiness has his house, and in his upper floor, panelled in pitch pine, His Holiness sits cross-legged on his dais, beneath the dimness of his paper-latticed window, radiating a suffused glamour of gold from the soft golden silk of his swathings. I found the Sacred Body all that was learned and courteous: his life resolves itself into meditation, study of the Scriptures, perpetual ecclesiastical correspondence with other eminences of the Church, and occasional participation in the stately mystery-plays that even missionaries have now left off calling "devil-dances." He was especially interested to hear that I had made pilgrimage to the Atamasthana, the Eight Sacred Places of Ceylon (Singhâla is a name almost without meaning to the lower ranks of the Tibetan Brotherhood), and on learning that I possess leaves from the Holy Tree of Anuradhapura was so moved that when I was going, he actually rose up from his throne and escorted me to the door, an unheard-of violation, I was told, of the cast-iron etiquette by which every act and posture of a Living Buddha is governed.

Times were still, however, heavily troubled. In the panic of the threatened invasion the abbey lay shuttered and silent, its long streets

empty, its treasure-houses and churches locked, most of the monks and several of the Buddhas gone away for change of air into the inviolate security of the heights across the river. And now from the wildernesses of that wild land the wicked Black Tepos began to make their own profit of the general disturbance, and came in such fierce raids down from beyond their own regions away through that strange gap in the Min Shan which is called the Stone Gate, that the Prince bent all his energies to prevent us from going southwards into the wilderness of those Alpine ranges that intervene for some 50 miles from Jo-ni between the Tao Ho and the Min Shan. However, at last we managed the expedition, by dint of many diplomacies. Even so it was only on condition of having an escort, composed of some forty sacking-clad Tibetans, of every age between six and sixty, armed with their prehistoric arquebuses on long prongs that stuck forward above each bearer's head like the antennæ of some monstrous insect. With these, in a lone valley far up in that desolate land, we made our armed camp within a laager of boughs; and tales and singings and laughter went on all night long beside the watch-fires, enough to have attracted every Tepo within miles.

None, however, came: and one could have spared the added excitement of their expectation after a summer already so rife with incident that for three months one had never been able to feel certain about the integrity of one's throat from dark to dawn. It was towards the last blackness on the edge of dawn, indeed, that expectation of the Tepos waxed highest: they have the habit of choosing that special moment for attack, coming creeping up on their bellies against you silently, like cats—a strange race, so dusky as to be almost negroid in colouring, dwarfish, altogether evil, and with such deformed skulls as add to their demoniac reputation. Only once did I see a black Tepo (to be carefully distinguished from the comparatively harmless white Tepo), and then it was from afar. For he was very, very dead, on the shingles of the Tao River into which their burial customs cast them; and the faithful collie at his side, whom I at first supposed to be guarding the corpse, I discovered ultimately to be eating it.

The Tibetan valleys between the Tao Ho and the Stone Mountains are wholly desolate. This is a land which, within a few miles of the river, becomes quite uninhabited; gradually even the high alpine steadings cease, and the valleys become a green void, silent and lifeless, stretching away into the feet of the Stone Mountains. These for a long time you do not even see; the landscape is a monotonous panorama of regular crumples and corrugations of ranges, without eminence or salient feature, uniformly green with lush grass on the southerly face of their every slope and fold, and as uniformly dark with forest on every fold and slope of their northern, till the view from any ridge has the strangest box-pleated effect of light and dark. But gradually limestone reappears, and eminences more massive; and from these at last bursts upon you the full splendour of the main Min Shan, stretching across the horizon in huge *chevaux de frise* like

tortured flames, recalling on their far vaster and more savage scale that other Dolomitic wall that one sees from Klobenstein or the Rittnerhorn. Into their vast gaunt splendour one could not hope to penetrate without far more of a caravan and far ampler provision than I could provide. My own work was done in the ranges within 15 or 20 miles of their base. Like all the other ranges of the Kansu March they keep no perpetual snow (for which, until you reach Ta-tung, an elevation of at least 20,000 feet seems necessary), but they brew their weather in the same way that has earned Thundercrown its name, starting the morning in flawless serenity, and developing by midday frowns that break into blinding storms of fury between four and six in the afternoon: after which—on Thundercrown at least—radiant smiles return again, except during the last fortnight in September, when the mountain sulks in a leaden ha'ar of cloud from week's end to week's end, preparatory to the first snowfall, that then yields to a blazing St. Martin's summer, before the final winter comes white upon all those Alps in the end of October.

I pretermit the tale of my return to Siku, of our combined return to Satani, and of Purdom's adventure after Dipelta seed to the woods of Chago itself, effectually disguised as a villainous-looking Chinese coolie. For panting time toils in vain after my topics, and your patience is now racing with me northward on my way to Lanchowfu. Thither, when the end of the autumn had sealed all those desolate hills in death, we proceeded for the winter season from Jo-ni up over the bare brown fells to the half-burned city of New Taochow; and thence yet higher up over the last of the big passes which culminates overhead on your right in the mass of many-petalled Lotus Mountain, about whose hem in winter the willow forest sweeps in a smooth vesture of gold, in every shade from amber to orange. After this it is good-bye for the year to the Alps. Far, far down at the northern base of Lotus Mountain the track at last rejoins the violently northward-bending Tao Ho, now dwindled from its muddy summer tide to a stream of purest emerald and aquamarine. And after this you are in China again, but in China of the north: drifting dreamily day by day up the wide flat vale of the river, hedged in along the far distance with a long flat-topped line of ochre-coloured bluffs, opaline in the transfiguring radiance of that cloudless northern winter, and quite extraordinarily Nilotic in effect. But, after quitting Ti-tao, the track leaves the Tao Ho, to make a short cut of three days over what must surely be among the most God-forgotten and lifeless stretch of country even in the dying wildernesses of North Kansu—an interminable Golgotha of pale hills and flats and hummocks, all of a soil so bitter and blasted that it seems no green thing could ever push. Finally one climbs the steep ascent of another Kuan Shan (Official Mountain being a usual name for any eminence giving access to capital or province) and on the further side descends long and painfully and far, towards yet further wildernesses of crumpled and Egyptian-looking ochre-coloured fells, till at last you turn a corner and

suddenly find yourself in all the roar and bustle of the Northern Capital, with the Yellow River flowing by beneath that hideous iron bridge which it is the one object of such rare foreigners as penetrate to Lanchowfu to go out and see and praise and photograph.

So ends the first half of my exploit. I had meant to give you the full tale of both seasons; but time and space alike failing me (when I remember how much I have to remember, and how little, outside my own walks, of any value to report), perhaps it is better that I should take this more garrulous course, of leading you on a breathless personally conducted tour along these tracks that I know so well, and in spirit travel again so often. For the personally conducted have always one advantage over the conductor: their feet are not perpetually bound to the paths they have trodden. Let all the wise beware: travel only between the covers of a book, or in the limits of a lecture. Once let Asia lay her hold on you, and you will never know peace again. Asia, ugly, desolate, tedious, difficult, and dangerous, has a call more insidious than Odysseus ever heard, more compelling than any coloured placard of Alp or Dolomite. And never, once captured, can your soul get free, amid the clamorous follies and futilities of Western life, from the deepening hunger that will always gnaw you for those wild and lonely lands, for that vast and vocal silence which everlastingly fills the remote high heart of Asia, so old, so weary, and so wise.

Before the paper the PRESIDENT said: The paper which Mr. Farrer is to read to us to-night is on a district of which we know very little; in fact, a good deal of it, I believe, had never been traversed by a European. It lies in the province of Kansu, in territory as to which there is some uncertainty whether it is part of Tibet or of China. European travellers have been near it. One of our Gold Medallists, Sir Aurel Stein, approached it from the west in 1906–8; the Russian traveller, Colonel Kozloff, was there in 1908; and we have published recently some notes on the country by Mr. Teichman. But these travellers scarcely touched the particular district of which Mr. Farrer is to speak, "The Kansu Marches of Tibet." Mr. Farrer is a great authority on gardens and botany, and his principal object in his travels is the collection of rare and new plants. If he did not always climb to the tops of the mountains, he went as far as the flowers. He had the good fortune to have a most capable and energetic companion in Mr. Purdom, who knows a great deal of China.

(*Mr. Reginald Farrer then read the paper printed above and a discussion followed.*)

The PRESIDENT: We have here Mr. Wilton, one of our Consuls in South China, who, I dare say, can give us further information about this remote region.

Mr. WILTON: I am sorry to say I have not been to the Marches of Kansu except to-night, but I have thoroughly enjoyed the excellent and delightful lecture to which we have listened. The lecturer's statements about Tibet are also exceedingly interesting. There is only one point to which I would like to take exception, where he says "that there is some doubt among the Chinese about the frontier between Kansu and Tibet." From my own experience there is no doubt at all in the Chinese mind as to this and other frontiers,

because they always claim the whole of any disputed part. The extraordinarily fine description the lecturer gave of the icy ranges of Tibet has been listened to by us all with very great enjoyment. It certainly recalled to me my experiences with the Younghusband Mission, and I can confirm the truthfulness of the lecturer's description.

Lord BRYCE: I have been no nearer to Kansu than the Great Wall north-west of Peking on the one side, on the north, and on the other side, to the south, the magnificent gorges of the river which after Mr. Farrer's warnings I must not venture to mispronounce. The country which the lecturer has described, and which he so clearly and interestingly brought before us by the photographs, is very different in character from the part of Western China which one reached in the gorges of the great river, and so different that I do not think that anything I could say from what I saw there would throw any light upon the country which Mr. Farrer traversed with so much courage and enterprise. However, I do feel inclined to ask two or three questions regarding the natural features of the province of Kansu. Would Mr. Farrer tell us what the heights of these mountains are, and whether, as he has spoken of snow, there is anywhere such a reserve of perpetual snow as to produce any glaciers descending into the upper valleys? Will he tell us what was the general type of the flora he was investigating? Is it similar to the flora of Western Siberia on the mountains of the Altai; and what affinities has it to the flora of Northern Europe? Or is there a completely different type belonging to Eastern Asia? In the Altai and even on the mountains north of Peking along the Great Wall, I noticed that the genera and sometimes even the species of Northern Europe appeared. Is there any sharp ethnological difference between the Chinese and Tibetans, or do the people along the borders of China and Tibet generally blend into one another and speak dialects which show some resemblance to each other? I have heard before to-night, what Mr. Farrer's modesty prevented him from telling us, that he has made not a few valuable botanical discoveries, and has brought home a number of seeds of handsome flowers and shrubs, some—perhaps many—of which are likely to stand our climate and adorn our gardens. I congratulate him upon the success of his difficult expedition, and join in the expression of our thanks to him for the pleasure he has given us.

Mr. REGINALD FARRER: As to the heights, I think one is always rather in difficulty. I took with me an elaborate and expensive aneroid. My experience of aneroids (which is borne out by the mistrust I read between the lines of learned works) is that they are somewhat unreliable. But judging by previous records, the height of Siku is reckoned by the Russians at 6600 feet, and I reckon therefore upon the height of Thundercrown as being between 14,000 and 15,000, say 14,200 feet; the Stone Mountains rather higher, reaching to about 15,000 feet; the Satani Alps range up to 18,000 feet. With regard to the snow-level, apparently this—always a variable point—is, up in the borders of Tibet, very high. None of these ranges has any permanent snow, except in the unsunned couloirs. They are built in such a way as to give no facilities for the accumulation of snow. The only permanent snow I saw in the first year was that on the heights above Sung-pan, far down in Szechwan. As I say, 18,000 feet was no doubt the limit of the mountain heights about Satani. With regard to the type of flora, you get two or three interesting developments. You get where I was in the first year a meeting-point between the flora that descends round Northern Europe and Asia, and extends down the eastern fringes of Tibet until it joins with the ascending flora from the Himalayan

side; and by the time you reach Szechwan the flora is purely southern and Himalayan, and only, I think, on the Tao-jo border of Kansu do you get a representative mixture of the two. It was remarkable in my first year that one found a mixture of the southern flora predominating; in the second year, in the higher, colder, bleaker Alps further up in the north, one had the northern flora, very much more limited, with fewer new species and altogether less interesting. With regard to the ethnological difference, I think nothing could be plainer; not only the difference between the Chinese inhabitants and the countless tribes called Tibetan, but also between the Chinese and Mohammedan inhabitants of the province. I had not the time to go into the ethnological difference between race and race, but the Tibetans as a family are, of course, entirely unmistakably different from the Chinese. Instead of being a small-boned, intellectual, refined, pale race, they are a large, very big-boned, very big-headed and round-skulled race, quite evidently, I should say, of a wholly different blood from the Chinese, with whom they neither marry nor are given in marriage, but live on terms of the strictest mutual intolerance, loathing and despising each other, and killing each other whenever it is possible to do so without fuss.

The PRESIDENT: I am sure you will wish me to wind up the evening by moving a hearty vote of thanks to Mr. Farrer for his paper. We seldom have a traveller here who has a story to tell more full of adventure, or who is able to tell it in so vivid, eloquent, and dramatic a manner. It appears to me that for those who are in search of adventure when the war is over—and time will come when we shall again be in search of adventure—there is no place in the world which can offer more variety of peril than the backlands of China towards Tibet. To start with, there is at your back the White Wolf; when you get up into the mountains you meet with monks who are ready to murder without the slightest provocation. I was interested in hearing from Mr. Farrer that the Church owns all the gold in Tibet. The fact of there being gold in Tibet made an impression on one of our statesmen which, I believe, was partly the cause of the Indian border being so rigidly closed to all travellers. Lord Morley had it on his mind that there might be a rush into Tibet like the rush into Alaska. We shall all hope that Mr. Farrer will put his adventures into a book, where he will be able to give us more pictures of the wonderful flowers—pictures which will give them in their natural colours, the only thing one missed to night. I do not know whether you noticed in one of those slides that it showed the wonderful defensive protection, the prickles that were arranged all around the delicate blossoms. In the Himalayan flora we find plants protected by fluffy coats against the cold. What is the enemy against which these delicate creatures arm themselves?

NATURAL DIVISIONS OF ENGLAND

C. B. Fawcett, B.Litt., M.Sc.

Map following p. 160.

THE steady persistence of the Irish demand for Home Rule, together with the existence and growth of strong national sentiments in Scotland and Wales and a growing tendency towards a similar demand in those countries, was a prominent fact of public life in Britain before the

Deutsche Erde, 1905, p. 205). We note an uncandid dealing with the Slavs, whereby the Čechs, Slovaks, and Slovenes are left white with the Magyars as "other races" (sonstige Völker), and their relation with other Slavonic peoples south and east is unrepresented. The line of division between the Bulgars and the Serbo-Croats is not in accordance with the political spheres of Bulgaria and Serbia as defined by the secret treaty of 1912.

We are greatly indebted to our correspondent in Berne, and hope to receive the succeeding numbers of this instructive series of "peace maps."

REVIEWS

ASIA

A Historical Geography of the British Dependencies.— Vol. 7, India. Part I. (History). **P. E. Roberts.** Oxford: Clarendon Press. 1916. *Sketch-maps.* 6*s.* 6*d.*

THE geography of India is not combined in this work with the history, but is to be dealt with in a separate volume. Only a brief summary of the leading surface features of the country is here prefixed, without which the history would be difficult to appreciate. On broad lines it fulfils its purpose. It might have been pointed out, however, that the mountain barrier could be, and probably was, turned from the west, before the comparatively modern desiccation of Mekran and Seistan took place. Then again it cannot be said that until modern times the Ganges delta was the gate of India from the sea, unless the period before the Portuguese settlements be ignored. The history is that of India as a British Dependency, so previous events are treated cursorily. In the account of the earlier transactions of the various trading companies which settled along the coasts a commendably full use is made of the records of the British East India Company, now available, thanks to the indefatigable researches of Mr. W. Foster. The next section of the volume is occupied with a fairly comprehensive account of the Anglo-French struggles for supremacy in Southern India, and the rest is concerned with what happened after the course of events had assumed a more definitely political character. Before this, the history being that of a number of separate and isolated settlements, the narrative has to sway from one side of India to the other, but from the time of Clive the sequence is, as usual, that of the term of office of the successive heads of British Indian administration. A considerable portion of this section is devoted to the "purple patches" of controversy which arose in the latter half of the eighteenth century, upon which much fresh light has been thrown within the last twenty-five years or so. The case on both sides is fairly set forth, and the judgment of the author is, on the whole, impartial. The more accurate results of modern investigation, however, have against them the literary brilliance of Burke and Macaulay, whose damnatory verdicts will long continue to warp the judgment of the more youthful students of the rise of British rule in India. The later narrative follows the usual lines, with the incorporation of some useful information upon special points culled from recent biography. There is a good index. J. A. B.

Provincial Geographies of India—The Panjab, North-West Frontier Province and Kashmir.— **Sir James Douie, M.A., K.C.S.I.** Cambridge University Press. 1916. *Maps and Illustrations.* 6*s. net.*

Every part of India has its special interest, and none more markedly than the region described in this volume. The height and breadth of the mountain

rampart on the north, the depth and volume of "Abu Sindh," or Father Indus, on the west, and the desert on the south, leave only the upper Jamna basin open for free intercourse with its neighbours, and it is here that the Panjab merges almost imperceptibly into a more typical India. From the opposite direction wave after wave of foreign irruption across the Lower Indus or by the Kabul Passes have left their traces upon the character and religion, and also to a certain extent upon the blood of the population. Here, accordingly, problems have to be solved which do not arise in other Indian provinces. Border tribes have had to be controlled; a martial people, in arms against the British less than seventy years ago, have had to be conciliated, and mighty rivers harnessed for the fertilization of vast tracts of land otherwise unproductive. It is fitting, therefore, to place the description of the Province and its surrounding States in the hands of one who has been associated with the administration, from the charge of a district to that of the Province, for thirty-five years, and is consequently intimate alike with the highways and byways of the whole country and with the life of its inhabitants. This familiarity and the sympathy bred of it is apparent throughout the work, and where the subject is highly technical, as in the case of geology and numismatics—the latter being of unusual importance in the Panjab—the author has enlisted the help of well-known experts. The result is a mine of trustworthy information, especially to those who refer to it upon some definite point. On the other hand, a thorough knowledge of the subject in all its details and difficulties tends occasionally towards an elaboration of its subdivisions somewhat confusing to one whose object is to obtain a general view of the conditions as a whole. The form, in fact, is more that of a Gazetteer than a geographical study, and the work would be improved by a closer co-ordination of the physical features with the history and life of the people upon whom they react, and by whom they have been adapted to current needs. It may be suggested, too, as tending in the same direction, that the geographical unity of the three tracts, to which, as well as to their political unity, attention is directed by the editor, would be best demonstrated by the inclusion of all three in a single map; or, at least, that in the otherwise adequate maps of each division appended to the volume the adjacent territories should be indicated. It may be noted in passing that in more than one place in the text there is a transposition, probably typographical, of east and west: also, in treating of rivers as tortuous as some of those described, it is safer to locate places or natural features in reference to them by the bank, rather than by the point of the compass. The work is copiously provided with illustrations which have the signal merit of being really illustrative. J. A. B.

AMERICA

The Conquest of Virginia. The Forest Primeval. An Account, based on original documents, of the Indians in that portion of the continent in which was established the first English colony in America.— By **Conway Whittle Sams, B.L.** New York: G. P. Putnam's Sons. 1916. *Maps and Illustrations.* 18*s. net.*

In calling his book 'The Conquest of Virginia' Mr. Sams wishes to emphasize the fact that Virginia was not colonized by Englishmen without a struggle with the original possessors of the land. But the title is misleading, not only because he gives no account of the conquest, but also because in a military sense the word "conquest" does not convey a correct idea of the course and outcome of Indian warfare in Virginia. Captain John Smith did in fact propose to the Virginia Company a regular campaign against the Indians

as the best method of procedure, but his suggestion was not followed. Desultory fighting and raiding, bargaining and persuasion, and the retreat of the Indians before the advancing settlers continued. The substance of Mr. Sams' book is a description of the manners, customs, and institutions of the Indian tribes in Virginia, made up of extracts from early writers, such as Hariot, Spelman, Smith, and Strachey. He arranges all this matter well, with many interesting illustrations, and it is good to have the available information about the Indian peoples brought together in this way. In his last chapter he gives a useful classification and separate account of the various tribes and nations. But the material wanted more digestion to become history.

E. A. B.

GENERAL

Intercourse between India and the Western World from the Earliest Times to the Fall of Rome.— H. G. Rawlinson, M.A., I.E.S. Cambridge: University Press. 1916. *7s. 6d. net.*

Prof. Rawlinson has examined a large and important question of general history—the early relations between India and the Western World. The materials available for such a study, so far as the classical literatures are concerned, are not very extensive and do not point to any close connection between East and West in ancient times. Neither Greek nor Roman influence seems to have gone very far in Asia, nor conversely did Indian and other Eastern civilizations contribute much to the formation of European life. East and West lived their separate lives. Though Indian soldiers accompanied Xerxes' army and passed through Thermopylæ (and thus fought in Europe more than two thousand years ago), Greece and India seem to have been almost entirely ignorant of each other. There was trade, of course, but over such long routes it carried little mutual influence. Herodotus, in fact, seems to supply the first description of India by a Western writer. There was a "close and friendly intercourse" between the Maurya dynasty and the Syrian kings, and to that we owe Megasthenes' account of the Maurya empire, without which we should know little of India at that time. When the Roman Empire was extended eastwards the trade in luxurious products seems to have been very considerable. Yet it is astonishing that Strabo, who had travelled in Armenia and up the Nile, seems to have been able to get little first-hand information about India. In the middle of the first century A.D. there were improvements in navigation which brought India within two months' journey of Alexandria, and Pliny the Elder was able to write a fuller story. Yet what stands out from this study of a thousand years of history is how little India and the West had to do with one another. Prof. Rawlinson tells us that India learnt of Greece in the art of coinage and the science of astronomy and in little else, while "of the great civilization of ancient India, its philosophy and religion, Greece knew —and cared—nothing." Further research may work out more fully the details of the relations between India and the ancient world; but Prof. Rawlinson's valuable and original work seems to establish the main fact of their almost completely separate development. So much does the exchange of ideas depend on economic progress.

E. A. B.

Naval and Military Geography of the British Empire.— Vaughan Cornish. London: H. Rees. 1916. *Maps. 3s. 6d. net.*

It is not often that one meets with so much useful information of a theoretical rather than statistical character packed within so small a space as

The Geographical Journal

Vol. XLIX No. 6 June 1917

GEOGRAPHICAL WORK IN INDIA FOR THIS SOCIETY

Lieut.-Colonel Sir Francis Younghusband, K.C.S.I., K.C.I.E.

Read at the Meeting of the Society, 9 March 1917.

THE curiosity to know something of what is beyond their own immediate neighbourhood is a characteristic of most men—certainly of most Englishmen. If there is a range of hills in the distance they want to go and find out what it is like; and when they have come up to the hills they want to get to the top and see what is on the other side. The thirst for knowledge of the Earth's surface is the foundation of all geographical science. Geography is fundamentally a knowledge of the natural features of the globe. But the more we know about them the more we find there is to know; and the keener becomes our pursuit of geographical knowledge, the more exact and detailed knowledge do we require. We want to know this Earth in every part—even the remotest—even the north and south poles, the summits of the highest mountains, or the heart of the sternest desert. We want to know whether the country is flat or hilly, desert or covered with vegetation, thickly or sparsely inhabited, and the climate, whether it is hot or cold, dry or wet. Then as we come into detail we want to know the precise height of the hills or mountains, the length and breadth and depth of the rivers, the extent of the desert and forest and cultivation, the passability of the mountains, rivers, deserts, and forests, the disposition and character of the inhabitants, and the limits of the territory occupied by groups of people. Moreover, we seek not only exact knowledge of the natural features of the Earth and of whatever moves upon it, but of the relation of the different items of knowledge to one another—as for instance the effect of a high range of mountains upon the rainfall of countries which lie beyond it and of the rainfall upon the mountains. And we want to get all the various branches of our knowledge co-ordinated into a whole so as to show how the various features of the Earth's surface act upon the mobile elements—the atmosphere, the waters, and plant, animal, and human life. Especially, and as a culmination of our geographical science, do we seek knowledge of the way in which the cardinal natural features affect the character, the movements, and the distribution of men, and

either form barriers to the intercourse of peoples with one another, or on the other hand tend to promote that intercourse. And besides noting the effect of the fixed features upon the mobile elements we want also to note the effect of the mobile elements upon the fixed—or, relatively speaking, fixed features.

If this be what we mean by geographical science a geographer could hardly hope for a finer field for his activities than India and the immediately surrounding countries present. Here we have every form of natural feature and in its most impressive aspect. We have the highest mountains in the world; some of the greatest rivers; the vastest deserts; the hottest, the dryest, and the wettest climates, and atmospheric movements on the most stupendous scale; we have immense forests, both tropical and temperate; animal and plant life in extraordinary variety and no less varied forms of human life. And we can see in one splendid example the interaction between a natural feature and Earth's mobile elements; we can see the Himalaya Mountains arresting and condensing the moisture which the monsoon currents bear from the Indian Ocean and the Bay of Bengal, depositing it in the form of rain to the extent of over 600 inches in the year at one place on the near side and leaving scarcely any to fall on the far side. As a result we can see great and numerous rivers flowing down the near side and spreading their fertilizing influence over the plains below, and can see the mountains covered with the richest and most varied vegetation while the far side is almost entirely desert. We can note, too, the way in which such a stupendous feature restricts the movements and modifies the distribution of human beings. For if there were no Himalaya the stronger, more industrious and intelligent Chinese and Mongols would have overrun India; whereas through all the centuries the two or three hundred million Indians have been effectively barricaded off from the three or four hundred million Chinese. Further we can note the way in which the mobile elements act upon the firm natural features, and can see the rainfall washing away the mountain-side, causing landslips and sometimes the collapse of whole mountain-sides, and carrying rich deposits to the plains below. We can note the forests holding up the mountain-sides, retaining much of the rain at the time of its heaviest fall and giving it a chance to percolate gradually to irrigate the plains below at the times when water is most wanted, when the rains have ceased and the dry season has set in. We can note, too, the effect of animal life—of goats, for instance, how they feed on the young sapling and so destroy the fresh forest growth, denude the mountain-sides, expose them to the full effect of torrential rainfall, and cause them to be washed away. Finally, we can note the work of man, how the improvident have cut and burnt down forests and thereby altered the whole characteristic of large tracts of land; how the provident have carefully planted new forests and held up the soil; how men have dammed up the waters here and led them into

channels there; how they have cut roads and railways along and over the mountains, bridged rivers and turned them to their use. We can, in fact, see man very very slowly, but without a pause, and at an increasing rate as the years go by, proceeding to the conquest of even so mighty a natural feature as the Himalaya. We see the mobile elements of the world obtaining the mastery over the fixed.

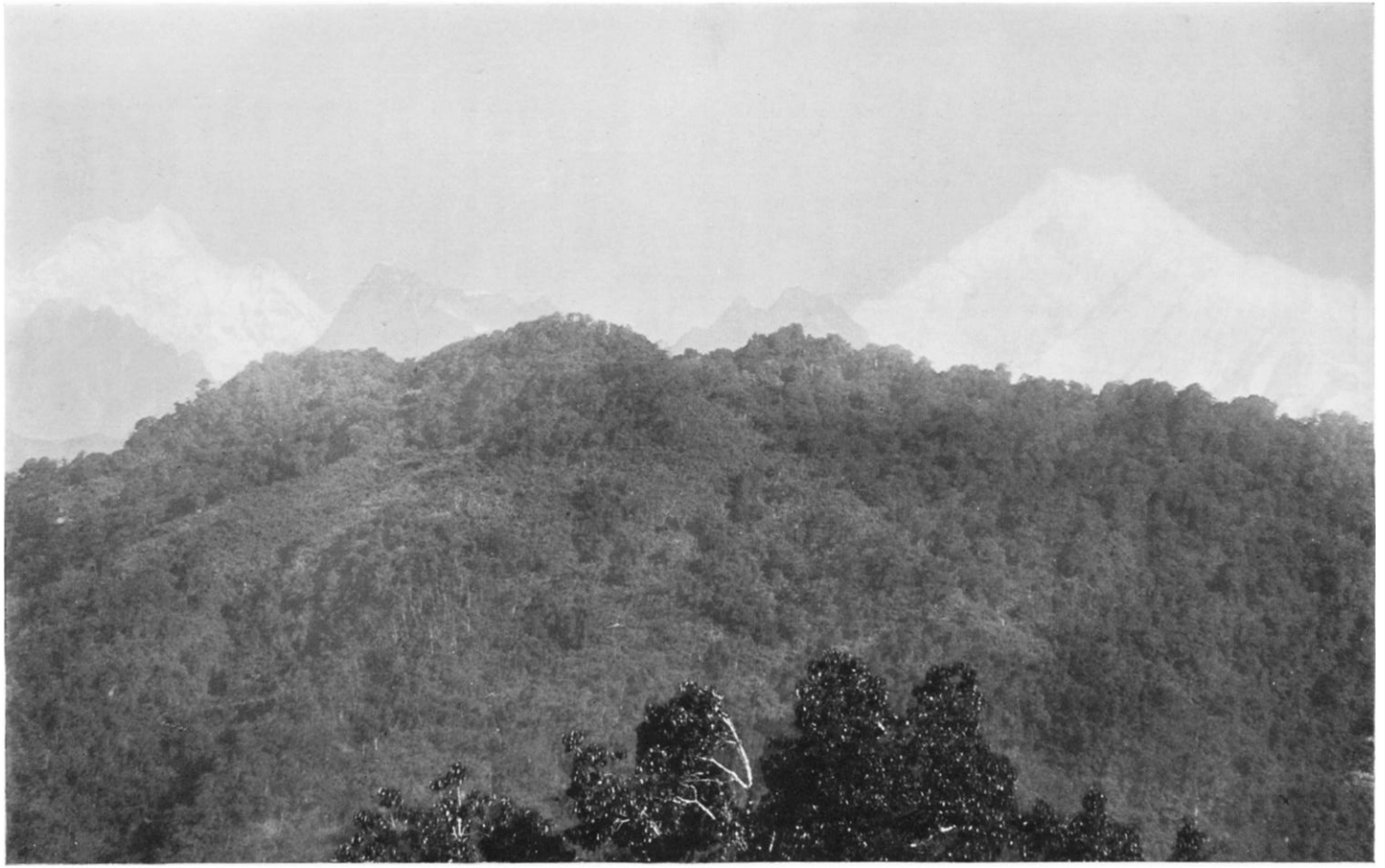
India therefore offers the finest opportunity for geographical enterprise; and like innumerable other officers stationed in India, I was early attracted to the Himalaya. One clear cold-weather morning, from out the dead level plain on which I was encamped I saw emerging a long grey-blue form against the sky, and was told that these were the "hills." They were only the outer spurs of the Himalaya and did not rise above 7000 feet. But in their dim mysterious outline they exercised a strange fascination. For one thing they pointed upward: they raised one's hopes above the monotonous level of the plain. There was a suggestion, too, of all kinds of marvels in mountain scenery hidden deep within that dreamy haze—majestic snowy peaks, awe-inspiring precipices, dark mountain gorges, rushing torrents: all the many joys that great mountains can afford.

Some time after I had my first experience of actual travel in the outer fringes of the Himalaya. The adjutant of my regiment had informed me that if I cared to apply for it the Colonel would give me two months' leave. I jumped at the opportunity, made my first plunge into the mountains, and so took my first footsteps in the pursuit of geography. And they were literally footsteps, for from the railway station at the base of the hills I walked the whole way on a round of several hundred miles, proceeding thus on foot chiefly from motives of economy, but partly because walking was easy for me then, and I was able once to walk 40 miles between 3 a.m. and 5 p.m. Starting from the foothills and starting on foot I was able to appreciate all the attractions of the Himalaya as they gradually unfolded themselves: first the pleasure of rising from the stuffy heat of the plain into the clear exhilarating air of the hills; then the joy of shady forests and fresh rushing streams; and at last the sight of real snow-clad mountains towering above me close at hand. And the further I progressed the keener became the attraction of the mountains. I wanted to get right up on to that snowy range, to get over it and see what was beyond. These peaks I saw were only 15,000 feet or so in height; but books and maps showed me that there were 20,000-feet peaks at the back. I wanted to see them too. Then there was a terrible pass over the higher range at the back; I wanted to gauge its terrors and see at first hand what a difficult pass was like. At length I came to the deep valley of the Sutlej, the river which comes down from Tibet, cutting its way clean through the great range of snowy peaks I saw before me—the main axis of the Himalaya. I wanted to follow up the river through the forests, through the gorges, and over one spur after another until I had

passed right through the Himalaya on to the plateau of Tibet. This particular journey I never made, though I wrote to the Society about it. But I relate my experiences and feelings because they show that while there is this great natural feature to attract there are also in India men who respond to the attraction and who are led on step by step in pursuit of geographical objects.

For I was, of course, only one of many hundreds of Englishmen in India who are similarly drawn to the Himalaya, some for sport, some for travel, some on administrative business, some for scientific investigation. In the first place are those in the great Survey Department whose professional duties have led them to make observations of extreme accuracy regarding the exact position and height of the great peaks; to carry a triangulation through the length of India and over the Himalaya to Central Asia; to map the topographical details of the mountains and to send reconnaissance parties in the countries beyond. The Geographical Society has awarded its Gold Medal to several officers of this department; and still living among these recipients are Colonel Godwin Austen, who originally surveyed as far back as the early sixties the glacier region round the great peaks of the Karakoram Range at the back of Kashmir; Colonel Sir Henry Trotter, who surveyed the Pamirs and the sources of the Oxus; Sir Thomas Holdich, who spent the greater part of his service on Indian frontier survey and boundary delimitation; Major Ryder, who was in charge of the Survey on the Tibet Mission, and who surveyed the upper course of the Brahmaputra and the region at the back of the Himalaya.

Besides the officers whose profession it is to determine the positions of selected points and the heights above sea-level with extreme exactitude, and to delineate the natural features accurately on maps, there are also numbers of men serving or living in India who are drawn to the Himalaya by sheer love of adventure, and who on their own initiative have undertaken journeys which have brought in valuable information and geographical results. Such were Captains Bower, Deasy, Rawling, and Bailey, and Mr. Carey and Mr. Sherring of the Indian Civil Service, all of whom penetrated the Himalaya and made valuable exploration in Tibet; Sir Aurel Stein, who has crossed the Himalaya and Hindu Kush at several points, and made journeys productive of valuable results in Chinese Turkestan; Dr. Kellas, who has made valuable surveys and observations in Sikkim and other parts of the Himalaya; Colonel the Hon. C. Bruce, the famous mountaineer; Dr. Arthur Neve, the well-known Mission doctor in Kashmir; and many other residents in India who have felt the lure of the Himalaya and been stirred to study and contribute to geography. There are Indians, too, who have done splendid geographical work, chief among them being Nain Singh, who was employed by the Survey Department and made reconnaissances of great accuracy in Tibet. There is also the remarkably adventurous Bengali traveller, Sarat Chandra Das,



Telephotograph, V. Sella

KANGCHENJUNGA AND PANDIM FROM GANTOK

Phot. by Bourne

KANGRA VALLEY

who has just died, who at great personal risk reached Lhasa more than twenty years ago, and who wrote an account, published by the Society, of the country and its inhabitants which I afterwards found of the very greatest assistance. Nor should we forget the intrepid surveyor, K. P., who explored the courses of the Brahmaputra between India and Tibet.

Thus India itself supplies a number of geographers, surveyors and pioneering explorers. And from here in England others have gone out. You yourself, sir, have been unable to resist the attraction of Kanchenjunga. I remember the interest that Sir Martin Conway's expedition aroused in us dwellers on the Kashmir frontier. Littledale explored Tibet and came down to us in India from the side of Turkestan. Longstaff came and cleared up one most interesting geographical problem.

Explorers came from other countries also. The American travellers, Dr. Workman and Mrs. Bullock Workman, have made several well-organized and scientifically equipped expeditions into the Karakoram range. Sven Hedin struck through Persia to India, then over the Himalaya into Turkestan, and thence to Tibet and back to India. The French traveller Captain de la Costa, and the German traveller Le Coq, crossed the Himalaya from the north. Lastly, there have been the Italian expeditions led by the Duke of the Abruzzi and Dr. de Filippi, which of all the expeditions from either India, England, or foreign countries have been the best led and the most scientifically equipped.

We see, therefore, that in India there are both the natural features which attract geographers and which are the subject-matter of geographical science, and also numbers of men to take up the great geographical work which lies ready to their hand. That is to say, there are available men of initiative and inspired by a love of adventure. And it is no less necessary to appreciate the value of these human qualities and understand the importance of developing them than it is to appreciate the importance of the Himalaya as a subject for geographical investigation. It is only by personal initiative and love of adventure that the inner secrets of the Himalaya will ever be discovered.

The love of adventure is, moreover, of value because it leads inevitably on from adventure in the physical domain to adventure in the world of thought. The explorer is brought in touch with most of the leading sciences, more particularly with astronomy and geology, but also with the sciences dealing with the development of plant-life and of the human race. Wonderful vistas open out before him in every direction. The field of exploration is illimitably increased. From having to use the stars to guide him on his travels he gets to live among them; he is eager to know more about them; his conception of the Universe continually expands as he hears of the tremendous distances of the stars, their number and their size; and his imagination inevitably strives to people some few of the

planets of these thousand million stars with beings, at least equal to ourselves in quality, if very different from ourselves in form. And from having to observe and describe the structure and character of the natural features among which he is travelling the explorer learns of the vast age of the Earth, of the vicissitudes through which it has passed, of its being composed of precisely the same materials of which the stars are built, and of its having originally been part of the same fiery stuff from which they also are formed. He feels, therefore, in direct and intimate connection with the whole vast universe; as he looks down the long avenue of times past which geology discloses, and as he becomes assured that there must also be a future of no less length, he is impelled to turn round and search into that future as far as he can see. And when he learns of the development of plant and animal and human life which has occurred during geological time—that is roughly during the last hundred million years—he strains his mind to conceive of the developments which must occur among us in the many million years to come. So it is that adventure in the realms of geography naturally leads on to adventure in the realms of thought; the pioneering habit grows, and the geographer learns to link his Science with Time past and Time to come, with Time immeasurable in each direction; and with Space, with Space if not absolutely and literally without limit at any rate with a limit beyond all possibility of human conception.

But if this spirit of initiative springing spontaneously from individuals, and their love of adventure which is the dominant characteristic of explorers, is to achieve all it ought, it must be fostered and encouraged by the community which will benefit from it, and must be organized and directed into suitable avenues by those best able to direct it.

I have given you proofs that there are individuals in plenty who have the initiative, the resourcefulness, and the enterprise to undertake geographical work of the most valuable kind in one of the most important regions in the world. But if the most is to be got out of the individual traveller he must be made to feel that the community is interested in getting that most out of him; that it really wants and requires what he can do for them, and will value his contribution to the common stock of human knowledge. He must be made to feel that the community expects the best of him on this line which he has chosen for himself of his own accord, and chosen presumably because he feels he has a special aptitude for good work along it. And to give this encouragement and support to individual travellers on behalf of the community, this Society—which is itself composed of men and women who have voluntarily come together from love of travel and adventure and interest in geography—is specially fitted. This is indeed the chief function of our Society, and it would be all the better if this were more widely known among those who might become geographers and explorers. It is not as well known in India as it might be that in numerous ways this Society puts out a helping hand to those

who seriously mean to contribute to geographical knowledge; that it is ready to help with advice; that it puts would-be travellers in touch with those possessing expert knowledge of the regions in which they wish to travel; that the Society's premises with all their books, periodicals, maps are at their disposal; that instruction in surveying is obtainable; that in approved cases instruments are lent and occasionally financial assistance given. For those resident in India most of these facilities are only available when they are in England on leave. But there is one form of assistance which is available to all, and that is the little work 'Hints to Travellers' written for and published by the Society. It contains valuable hints on all that concerns a traveller, and it was from this work alone that I was able to learn how to take sextant observations for the determination of latitude and longitude. In all these ways the Society helps the prospective traveller. Hayward years ago was given as much as £600 from this Society for his journey across the Himalaya to Chinese Turkestan. Deasy, Rawling, and others have received smaller grants and have been lent instruments; and among those who have received instruction was Lord Curzon. These things help the traveller during the prosecution of his journey, and when he returns from his travel with good results he may be sure of a hearty welcome at the meetings of the Society.

And it is well that the young traveller should receive all the encouragement and wise direction that this Society can give, for it is in making his first start that his chief difficulties lie, and in those fresh early stages of his geographical career that help is most necessary and most appreciated and most likely to bring fruitful return.

But besides directly helping individual travellers in this way the Society can also assist them by obtaining for them facilities from the Government of India and its agents. This assistance the Society affords in special cases; and when Resident in Kashmir I have myself had letters from the President of the Society asking me to give whatever help might be possible —for instance in the case of Dr. Longstaff. I venture to suggest that it is the proper part of Government to help a voluntary organization of this kind when it appeals to them, for the more of the world's work that is done by personal initiative and spontaneous effort, and the less that is done by state agency, the more will individuals develop individuality and the more likely therefore is the world to progress. For precisely the same reason that the Society should help and encourage individual travellers Government should help and encourage the Society, respond to its appeals, and increase its influence and power.

The Government of India must necessarily be circumspect in countenancing and helping individual travellers, for it has to be mindful of the welfare of the peoples in its charge, and has to beware also of travellers involving it in trouble with unruly people beyond the Indian border. Great hardships and risks are incurred in taking villagers on to glacier passes for example; and an inexperienced and tactless traveller may so

exasperate some frontier tribe as seriously to embarrass Government. Government has therefore to be cautious in granting its support. But if this Society assumes the responsibility of recommending a traveller the way is made easier for Government, and Government can then give most valuable aid to this Society by directing its agents to help the traveller in securing transport supplies and native assistance of all kinds, by placing at his disposal available official records and maps, and by putting him in touch with officials who have knowledge of the part in which he wishes to travel. This much at least Government can do to help the Society.

And Government on its side will reap many advantages from travellers making detailed investigations of its borderland. Without expense it gains additional knowledge of the countries over which its influence extends; and more important still it reaps benefit from having men at its disposal who possess an accurate knowledge of different parts of the borderland, and who have trained themselves in observation and gained experience in dealing with many varieties of people, often in very critical conditions. Military and civil officers of the Government of India when so employed during their leave increase their resourcefulness, experience, and capacity for serving Government; and Government is so far the gainer. And when the good offices of the Government are given to foreigners, Government may well feel satisfaction that they are in a position to afford the help. As an agent of Government I have had to help Frenchmen, Germans, Italians, Russians, Americans, and Swedes, and I have always felt pride that we British by our labours in India have been enabled to do this service for civilization in general. I have known the difficulties travellers experienced before we arrived, and I have seen the splendid results travellers in these days have been able to obtain on account of that order and respect which we have been able to establish in India. A century ago the Duke of the Abruzzi's and Dr. de Filippi's expeditions would never have been able to achieve the magnificent scientific results they did. They would not have been able to obtain the permission of the native rulers, nor the coolies, nor the supplies. The experiences of Vigne and Moorcroft show this. That these scientific results are now at the disposal of mankind is largely due to the position which the British have been able to establish in India.

And not only the Government of India but science in general gains by the enterprise of individual travellers and by the support which the Society gives them. Geography gains of course; but other sciences also gain, for Geography is the pioneer science; it paves the way for others to follow after. The geographical explorer pioneers the ground, the geologist, the naturalist, the anthropologist, the botanist, the meteorologist, the geodesist, follow where he has led the way.

Coming now to matters of detail and where particularly geographical work may be undertaken in the Himalaya and the borders of India, I would give the following as instances of the kind of work which might be done

Nowadays there is not much room for original exploration; travellers have penetrated almost everywhere. Still there are some parts not even yet explored. No human being has yet planted his foot on the highest point on the Earth's surface—the summit of Mount Everest, 29,140 feet above sea-level—or told us how men can stand such altitudes. There is, too, all that region near this mountain at the back of Nepal which has not been visited, though it has been observed from a distance by Ryder, Rawling, and Wood. Then there is still a gap in the Brahmaputra where it breaks through the Himalaya in its fall from the Tibetan highlands to India which has not been surveyed. Bailey and Moorhead surveyed sufficiently to prove that the San-po of Tibet is identical with the Brahmaputra of India, but we have not yet a complete survey of the course through the mountains. Nor do we know all we should like to about the region at the back of Bhutan, nor of that between Assam and China; and perhaps political difficulties may stand in the way of geographical knowledge for some time yet. But at the other end of the Himalaya there is an uninhabited part where there are one or two points of great interest to be cleared up. It is in the region at the back of the Karakoram range and of the great peak K_2, the next highest mountain in the world after Mount Everest. When I was exploring this region in 1887 and 1889 from the north I saw a peak standing high above the others; and as it was near about where K_2 should be I assumed that it was K_2 and interpolated my position from it on this assumption. But the Duke of the Abruzzi conclusively proved that it could not have been K_2. It must, therefore, be some unfixed peak, and what we require now is that some one should fix its position, determine its height, and give it a name. There is, I think, no chance of its proving higher than K_2, but I should be surprised if it proves to be very much less than 25,000 feet in altitude, and as I was the first European to see it, and am in fact the only European who has seen it, I am naturally interested in hearing more about it. This mountain overhangs the valley of the Oprang—a river which I discovered in 1887—and it may be seen from a patch of shrub which I named Durbin Jangal, and which is about half a dozen miles up the valley from the foot of the Aghil Pass. In 1889 I ascended the valley of the Oprang for another couple of marches, but I had not time at my disposal to ascend the river to its source. That remains, therefore, to be discovered. I could see in the distance immense glaciers and mountains which must have been well over 20,000 feet in height, so there is an interesting little piece of exploration to be done here, and in a region so remote and difficult of access that I do not suppose that any human being has ever been there.

These are some of the fields for original exploration which still remain; but it is in the more detailed examination of parts which have already been pioneered over that the chief geographical work will have to be done in future. There is here unlimited room for work of the type of that done by Sir Martin Conway, Mr. Freshfield, the Duke of the

Abruzzi, Dr. de Filippi's and the Bullock-Workman expeditions—that is to say, of expeditions including highly trained specialists in particular branches of geographical science, skilled surveyors, photographers, geodesists, equipped with the best and most up-to-date instruments for the accurate determination of the position of cardinal features; of the height of peaks and passes; of the temperature and humidity of the air; of the drift of air currents; the amount of rain and snowfall; the advance or retrogression of glaciers, and so on.

All the detailed work has now to be done by skilled and trained observers and according to methodical plan. But I am not sure that it is necessary that such work need be done by means of big expeditions—that is to say, it may not be necessary that the surveyor, the naturalist, the meteorologist, the photographer, should all go together in one large party. In most parts of the Himalaya there is difficulty in getting supplies and coolies or transport animals for any considerable party, and a single traveller may be able to penetrate where a large party may find its progress hindered. I have led an expedition consisting of myself alone with only such men as I could pick up on the spot; I have led another consisting of myself, a native surveyor, and half a dozen Gurkhas as a guard; and I have led an expedition with a military escort of several battalions and a large political and scientific staff. Different types of expedition are necessary for different occasions. But I should like to lay stress on the point that very valuable work can be done by single individuals, and even by single individuals when they are very young. Any well-educated young Englishman could, with the assistance I have indicated this Society can give him, and provided he is keen and determined to make a good job of the work he is undertaking, do most valuable geographical work. He could for instance quite well discover and fix the position of the source of the Oprang River. Or he might make a speciality of the study of glaciers and proceed from one to the other, marking on the spot, surveying and photographing the snouts of the glacier, and noting all the indications and gathering all the information with respect to the question whether they are advancing or receding. Or he might specialize in photography alone and travel about taking, as is the habit of that great photographer Vittorio Sella, a few supremely good photographs of important geographical features. Or he might take up some special region and return to it time after time as opportunity occurs, making it his own, as it were, and getting to know it intimately and learning what more is wanted to be known about it. Or again he might take up one special feature, say one of the great rivers—the Ganges, the Indus, or the Sutlej—and trace and describe it as a whole. There is ample scope for the efforts of single individuals.

Women also can do excellent work—women of the type of the late Miss Mary Kingsley or Miss Gertrude Bell. They would, I believe, be especially useful in describing any particular locality in such a way as to

bring it truthfully and impressively before those of us who have not a chance of going there ourselves. This Society would not tolerate flashy journalese descriptions, but I am sure it would welcome the impressions of a cultured mind recorded with distinction and accuracy, so that we might understand the true inward character of a particular region. For if we are really to "know" some natural feature, a range of mountains, a valley, or a river, we must have something more than what tape measurements can give us. We must get imbued with its essential character and all its moods; understand its qualities, its strong points and its weaknesses and limitations. Such intimate knowledge of the essential character of a great geographical feature may be of high practical value. When sanction came from the Secretary of State for the Tibet Mission to go to Gyantse, the summer and autumn had passed and it had hitherto been presumed that it would be impossible to cross the Himalaya into Tibet in winter, and that we should have to wait for the spring. But putting my general knowledge of the Himalaya into conjunction with Mr. Claude White's and Captain O'Connor's knowledge of the particular region, I was able to advise Lord Curzon that we should be allowed to proceed at once, even though it would mean crossing the Himalaya in the depth of winter. We managed to cross in December and January and to keep communications open throughout the winter without any greater loss of life than troops are accustomed to expect if they are ordered to hot and malarial countries, and we had in consequence a full spring and summer for negotiations, and had proved once for all that Tibet could be entered at any time of year. These were valuable objects to have gained. But the point I now wish to make is that Lord Curzon in making his decision did not depend so much upon the data furnished by exact measurement, necessary as these data are for certain purposes, but upon that more intimate knowledge which is not susceptible of expression in terms of measurement of feet and yards and degrees and minutes, but which I submit may yet be called geographical. It was from Mr. White, Captain O'Connor and myself knowing the character and habits of the Himalaya, having, as it were, the "feel" of these mountains, that I was able to convince Lord Curzon of the feasibility of my proposal; and it was because he himself too had known the Himalaya that he was able to accept our judgment. Something more than measurements and mapping details must, then, be included in the term "geographical knowledge." An appreciation of the essential nature of geographical forms must also be included.

And I would venture to go further still. I would regard our knowledge of the natural features of the Earth as incomplete unless we are aware of their beauties. It is, as I conceive, no mean part of the duties of a geographer mentally to equip himself so that he may recognize the beauties nature can unfold to those with eyes to see. Discoveries in the realm of beauty are continually being made. A traveller should know of these discoveries so that he may himself be able to see them, and so that he may be

able to discover others. For what is quite certain is that in the forms of nature there is vastly more beauty than we now recognize. Only last month, for instance, I learnt of the beauty of rock. "Few people," says Mr. Reginald Farrer in his fascinating book 'Among the Hills,' "seem to have any adequate sense of the beauty of rock as mere rock. Without consideration of garniture or surroundings, rock itself can be one of the most beautiful things in all beautiful nature." He declares that many people have neither sight nor reverence, though gods as surely dwell in rock and cliff as in the oak or glittering water. All stone, he admits, has not the same mystery of holiness and beauty, but he thinks the noble limestone of our country the loveliest of formations that he knows. For if it has not the rosy blush of the Jurassic, nor the rich glow and glory of the Dolomite, yet its shades of colour, though gentler, are no less wonderful; and in form of individual block it surpasses either.

With this certainty that there is far more beauty to be seen than most of us—or even the best of us—see at present; and, with the assurance also that the more of this beauty we see the better we shall know and understand, I would urge that appreciation of beauty in natural forms should be recognized as part of geography.

But whether or no Geography as a science recognizes beauty as within its sphere, what is quite certain is that meetings of the Society like and expect travellers to describe the beauties of the mountains, rivers, plains, or valleys that they have been privileged to see. And this I believe to be a perfectly sound and reasonable instinct; for until we have seen the underlying beauty of natural features we have not really known and understood them—we are not therefore, as I would contend, completely scientific. Those who come and tell us of some new beauty they have discovered in a natural feature would be as welcome here as one who has discovered a new river. Wordsworth ought certainly to have had the Gold Medal of this Society, and Shelley and Byron, too, if they had lived till it was formed. I believe in future love of beauty will be as great a lure to the traveller as love of adventure. Prompted by these high motives, and joining to them a love of truth, the traveller of the future will observe with scrupulous accuracy and record with fidelity not only the outward appearance but also the inward soul and significance of the natural phenomena he meets with and their mutual relations to one another. And nowhere will he find a fuller scope for all his faculties of observation and description than in the sublime Himalaya and the far borderlands of India. I most earnestly recommend this wonderful region to the special notice of this Society, and hope that some amount of the attention it has hitherto devoted to Arctic, Antarctic, and African exploration may now be devoted to the Himalaya.

Before the paper the PRESIDENT said: No one can be better qualified to speak on the subject before us this afternoon, Geographical Work in India, than our Vice-President Sir Francis Younghusband. He knows the Himalaya

Phot. by V. Sella

LARCHES NEAR LACHEN, SIKKIM

Phot. by V. Sella

FOREST NEAR DARJILING

from end to end. Thirty years ago as a young man in the adventurous journey for which he received one of the Society's Gold Medals, he crossed and explored the Karakoram on his way from China to India. Since that time he has travelled on the Pamirs and has been actively employed in the frontier districts of Hunza and Chitral. In 1904 he led the memorable expedition to Lhasa. Still more recently he has represented the Indian Government in Kashmir. It is not only as a traveller that Sir Francis Younghusband is competent to address us to-day; he can also as an old frontier official speak with authority of the political difficulties there have been in the exploration of the Himalaya, and can tell us, perhaps, how far those political difficulties are likely to remain in the future. For it would be affectation in me not to admit that exploration in the Himalaya has been a good deal hampered in times past by the official attitude. I am not criticizing this attitude in any way. I simply state the fact. Nor am I forgetful of, or ungrateful for, the great services rendered to geography by the Indian Government; the surveys it has carried out and the reports and maps it has produced are of the greatest value to geographers. To individual travellers or expeditions it has rendered many kindnesses; it has helped travellers, Italian and American as well as English, in the Western Himalaya. Seventeen years ago when I was in the wilderness where three countries meet at the back of Kangchenjunga I received much friendly aid from our then Resident at Sikkim, the late Colonel le Messurier. The Government has also extended its kindness to certain parties who assuredly brought no credentials either from this Society or the Alpine Club! But these good services have not been incompatible with the existence of very serious restrictions upon independent travellers, and still more so on any officers in the Indian Service who were anxious to take part in frontier exploration, restrictions which prevented exploration being as full as it might have been, because travellers were unable to cross at any time the Indian border. The reasons for these restrictions, as I said before, I do not in the least wish to contest; but what I hope we may hear to-day is that there is a reasonable prospect that among all the great changes this world-war must effect it may so modify our political relations with our neighbours in the Farther East as to make it possible for geographers to look forward to the thorough exploration of this vast mountain region. I will now ask Sir Francis Younghusband to read his paper.

(*Sir Francis Younghusband then read the paper printed above, and a discussion followed.*)

Sir THOMAS HOLDICH: It is a great pleasure for once in a way to get away from the lurid atmosphere of the West into the purer air of Himalayan Asia, and it is a greater pleasure to me to hear the beauties of the Himalaya described by an old friend who is such an expert in the matter as Sir Francis Younghusband; for he knows the Himalaya from the foothills to the snow ranges and from the Brahmaputra to the bend of the Indus on the far north-west. If I say a word or two it is to endorse what he has said of the advantages that may accrue to explorers in the Himalaya from working in concert with the scientific institutions that are in India. The Indian Survey has fixed a great many points with extreme accuracy, and they did it in the hope that others would take advantage of what they had done as a basis for their own scientific work in the wilder parts of the Himalaya. It is quite impossible for that one department with its somewhat limited income to find surveyors to undertake missions in the far parts of the Himalaya, and it is always our hope that all explorers of a scientific bent who go to India will take full advantage of

what they may find ready in the Survey of India to assist them in their work. And the benefit is double: the Survey Department gains by work that is accurately done; the explorers themselves gain by the increased value of their work. But there is another class of explorers in the Himalaya, with whom I have some sympathy, not so strenuous, and who are more inclined to study the beauties of nature than to search for scientific results. Now, Sir Francis Younghusband has briefly described many of the beauties of the Himalaya, but it would take a long time to indicate all that is to be found in that vast region. We cannot here have any accurate conception of how much of the Himalaya is absolutely unknown. To the west of Nepal, for instance, and reaching to the far north of the hinterland of Kashmir, we may say that the country is fairly known; but beyond that from Nepal itself eastward, from Sikkim and Bhutan, right away to the great bend of the Brahmaputra we cannot say that we know the country. It is there that we hope in the future for opportunities for further exploration. At present that country is not altogether open to explorers. Sir Francis Younghusband has referred very briefly to the difficulties that explorers may find in India owing to the desire of the Government to avoid complications in unknown places. I hope and believe that those difficulties are very much less now than they used to be. There was a time, no doubt, when the intense desire of the Government to keep everything confidential and secret was distinctly deleterious to our success on the frontier. Officers living on the frontier within sight of the frontier hills knew nothing of what lay beyond them; they could see the outline of the hills—just a line of peaks—but of what those peaks stood for they had not the least idea. I remember well meeting Russian officers in Afghanistan who I will not say were as well acquainted with our frontier as the Germans are said to be with the coast of Scotland and Yorkshire, but who did, nevertheless, know a very great deal about the general features of our frontier and a very great deal more than our own officers knew. Now it is hoped that people will visit the Himalaya for the purpose of studying nature under new aspects and in new climes. But I would not recommend those who are looking for the beauties of nature to take that line of least resistance which leads most explorers up to the far north-west. Although there are many delights in Kashmir, yet beyond it you pass from the best beauties of the Himalaya into some most unattractive country. I cannot sympathize altogether with Sir Francis Younghusband's regard for the beauty of rocks. Rock in itself may be beautiful; but after wandering day after day through a landscape of rocks and stones it gets a little monotonous. On the contrary, there are other parts of the mountains, easily reached, which I would certainly recommend to casual travellers. From any hill station you may reach country exceedingly beautiful and highly interesting. Take, for instance, the comparatively small hill station of Masuri; from there you can drop down at once into the valley of the Jumna, and following up that valley to its head you may reach the great dominant peaks of Badrinath, by passing over an intermediate range where you travel through park-like snow-covered country full of white and lilac rhododendrons; you will have left the scarlet ones behind. You pass to the head of the Ganges, which now you can follow to Hardwar. That is a tour which is easily within the reach of anybody and which affords some of the very finest views that the Himalaya has to offer. But the best of all views are those which exhibit the tropical jungle of the Eastern frontier, combined with a panorama of magnificent snowy peaks. I know nothing finer than this extraordinary contrast. It may happen, as happened in Bhutan when I was there, that you may experience winter in the tropical jungle. I have looked down

from a height into a valley full of bamboos covered with snow; and as the snow weighed them down the effect was that of one mass of lacework spread far up the side of the hills. There are opportunities such as occur in all mountain regions, though not with such accessories as in the Himalaya, of studying nature under its most impressive aspect. Many of you have spent strenuous early morning hours climbing to see the sun rise on the snows, and will know exactly what I mean when I say that there is no call on earth, not the call of the East or the West, of the Polar regions or Tropics, that appeals so strongly to those who have once felt it, as the call of the mountains.

Sir MARTIN CONWAY: One of the points that struck me is this: Sir Francis Younghusband has spoken of the work which remains to be done by explorers in the Himalaya. I would suggest that there is a further branch which has up to the present been almost entirely neglected; it is the work of anthropological exploration. The remoter valleys of this great mountain range and of the Hindu Kush contain many communities of ancient peoples who have been driven up into the remotest fastnesses and have there survived as fossilized remnants of all sorts of civilizations. I can speak only of those I have myself seen, the peoples of Hunza and Nagar and that neighbourhood, where there were remnants of at least four races entirely distinct from one another, talking different languages, having different traditions, an extremely interesting folk. Sir George Robertson spent a year in studying the extraordinarily interesting people of Kafiristan. He described how they retained, at all events until recently—I do not know how they may be now—most interesting ancient customs. Such customs ought to be carefully studied by an expert. The habits, the traditions, the superstitions of the tribes ought to be written down, and that quickly, or it will be too late. The people of Hunza retained their ancient dances, their religious ceremonials—they were excellent pagans—at the opening of spring. The king priest still existed there, and he drove the first furrow of the plough. A number of interesting survivals could still be observed in those remote valleys, and I have no doubt that along the whole range of the Himalaya there may be found communities of corresponding interest. I believe up to the present they have hardly been studied at all. It is an important piece of research that needs to be done, and would provide a most interesting career for a properly equipped observer.

Lord BRYCE: Since you, Mr. President, have called upon me I should have been tempted, had not the hour been so late, to have addressed a few questions to Sir Francis with regard to the regions which he just briefly mentioned in passing, namely, the mountain country east of Sikkim and south of Tibet as far as the point where the Tsan river pierces the great range southward to become the Brahmaputra, and also with regard to the central part of Nepal, in both of which regions the high peaks appear to be very little known to us. I also should have liked to ask him if he thought the objections which the Indian Government formerly entertained would still apply to requests made by those explorers who might attack these regions either from the Tibetan side or from the side of India. But the hour is so late that I will be content to reinforce what has been so well said by Sir Martin Conway—that the study of the small tribes which have survived in these mountainous regions is a matter of the greatest possible interest, and as he has said, and as it is known to all who have followed the course of exploration in recent years, those small tribes with their peculiar languages, their religions, their customs and their folk lore are now very fast disappearing. Every addition that is made to our knowledge means an opening up of new and easier routes; opening up of routes brings

in new elements, and these small ancient races or peoples lose their characteristic features which are of special interest to us. You, Mr. President, better than any one else, know how true it is that the Caucasus has been the refuge of many races, many languages, many habits and customs, and the same thing exists more or less in all mountain regions. Not very long ago we had at the British Academy an interesting account from Sir William Ramsay of some small tribes who remain distinct in the mountainous recesses of Central Asia Minor. I should therefore like to urge the great importance of what Sir Martin Conway has said, that we must endeavour to preserve, before it is too late, what can be ascertained with regard to these small remnants of ancient peoples and tribes which are to be found in the mountain recesses of the Himalaya. I trust that both you and Sir Francis Younghusband, and the Society as a whole, will exert your and their influence towards this end.

Brig.-General C. G. RAWLING: It is a presumption on my part to say anything after what we have heard to-night from Sir Francis Younghusband and the gentlemen who followed. I was very pleased to hear Sir Francis refer to those officers who went with me into Tibet and with whom I worked and who are still my friends. They are all doing good work for this country now, except Captain Hargreaves, who I am sorry to say is a prisoner. Just before the war, as several gentlemen here will know, I was getting up an expedition to survey and to explore the northern slopes of the Himalaya. That was to have taken two years, and it was to have been on exactly the line Sir Francis mentions. It was to be an expedition in which every officer was to have a special job, and to be a specialist in his own line. I am sorry to say that two of those whom I chose at the time have been killed; but I hope that after the war, if I am not too old for it, we shall be allowed to go. Lord Chelmsford, now the Viceroy of India, was the chairman of my committee, and I am sure we shall again get as much, if not greater, help from him than before the war. We have to get new officers, new men to do the work, and I trust that these very young people whom Sir Francis Younghusband has mentioned to-night as being trained up for this work will be then available. I hope they are not too young, for if they are to be of use that means the war will last for several years to come. The sooner the war is over and the sooner we can get on to geographical work the more I shall be pleased.

Sir FRANCIS YOUNGHUSBAND: Lord Bryce wanted to know if there was any possibility of being able to explore the country at the back of Bhutan and Nepal. I do not think myself that there are any insuperable political difficulties to be overcome. The Tibetans are now in a very friendly state, and I think it really ought to be quite possible. As General Rawling has suggested, an expedition may be able to go to the back of the Himalaya and carry out this very useful piece of exploration. I hope General Rawling will lead that Expedition.

The PRESIDENT: It remains for me to wind up the debate by thanking Sir Francis Younghusband for the very suggestive paper to which we have listened, a paper which might almost be described as an Essay on Travel. Sir Francis, in most vivid and romantic language, has put before us the true place in life both of travel and of its offspring geography. In an eloquent passage he suggested that the child's impulse to get to the top of, and round to the back of, any lump of gravel or hillock in his path might in the end make him a traveller, or even a cosmographer! He reminded me of the days when as a child I used to imitate in imagination the travels of Dr. Livingstone among the morasses of Hampstead Heath, which at that time were undrained by the

County Council. His voice seemed almost an echo of the words of Conrad Gesner, a great botanist who lived in the middle of the sixteenth century and who went up Pilatus, the familiar mountain near the Lake of Lucerne. Gesner wrote an account of his climb in very sound Latin, and after forcibly rating some of his compatriots who objected to sleeping in a hayloft, he burst into the following rhapsody, "Here in the deep and, as it were, divine silence of the mountain-tops you will seem to catch the very harmony, if such there be, of the heavenly orbs." My translation conveys but a poor sense of the subtle suggestion of a sub-conscious feeling which is given by the original text. "Hic in profundo et religioso quodam silentio ex prealtis montium jugis ipsam fere celestium, si quæ est, orbium harmoniam exaudire tibi videberis!"

To-day Sir F. Younghusband has given a practical and particular as well as a general application to his remarks. He points out as a proper object for the efforts of our Society the thorough exploration in all its aspects of the great range that circles round and protects India far more efficiently than the Alps protect Italy; the range which we speak of collectively as the Himalaya. In so doing he endorsed and amplified a suggestion I made in one of my recent annual addresses. The Poles have had their day, and a very costly one it has been, not only in money but in human enterprise, endurance, and life. To complete the exploration of the great mountains that girdle Asia, to climb the highest point of the Earth's surface, may very reasonably be made our next endeavour. For this enterprise we could have no better promoter than Sir Francis Younghusband. He has, I think, rendered us a real service this afternoon by pointing out how much may be done to aid in this exploration by such parties and even by individuals, holiday ramblers, officers on leave, or independent tourists. I trust such travellers will in the future be encouraged to take an intelligent interest in all the branches of knowledge which may be studied in the mountains. I am quite sure that they may rely in the future as in the past on the help of this Society. I say "as in the past" because I would recall that in the years while I was one of your Honorary Secretaries, and when Sir Mountstuart Grant-Duff, himself an old Indian Governor, was President, we addressed many, I will not say remonstrances, but representations to the Indian Government in the interests of geographical exploration. We had some unofficial support from an old friend of Sir Mountstuart's, Lord Roberts, Commander-in-Chief in India.

I would particularly emphasize this point: a great deal of very valuable and curious information touching on more than one branch of knowledge may be acquired by independent observers; information in bulk no less valuable, as Sir Francis has told us, than that of one great expedition. But as the Poles have drawn adventurers to the Arctic or Antarctic Circles, so doubtless the highest mountain in the world will draw the Alpine climber to itself. The spectacular both invites the peak-hunter, and delights the public. But shall we who have approved the quest of the Poles as the primary object of great and costly expeditions, shall we not allow the mountaineer to have his particular pole to climb? I think we shall agree that the mountain we are told to call Mount Everest ought to be climbed by an Englishman for scientific purposes and not by the delegates of some newspaper as a speculation. I have been invited more than once to say which would be the shortest way to the top. Here one may perhaps indulge in a confidence so far as to say that I have no doubt that the shortest way to get to Mount Everest would be by approaching it from Tibet. If I may use a builder's phrase, the "back-front" of Mount Everest is probably its easiest access. We have in this Society, I am glad to

say, an eminent Himalayan climber who is also a very eminent chemist and has devoted a great deal of time to studying the difficult problem of the adaptation of the human frame to the higher altitudes up to 30,000 feet. I refer to Dr. Kellas. I sincerely hope that at no very distant date, when the war is over, he may be able to put his experiments to a practical test, and that in so doing he will have the support and help not only of the Royal Geographical Society but of the Government of India. Time does not allow me to say more. I am sure the audience has fully appreciated the eloquence and versatility of Sir Francis Younghusband's discourse, and the way in which he put so many aspects of the mountains before us as well as gave us practical suggestions towards further exploration.

YUN-NAN AND THE WEST RIVER OF CHINA

E. C. Wilton

Read at the Meeting of the Society, 22 January 1917.

A GLANCE at the map of China shows that the line of long. 110° E. divides China proper into approximately two equal parts, separating at the same time the level from the mountainous. The province of Yun-nan is the south-western corner of the latter half, and is approached from the outside world along the lines of four principal routes, viz.—

1. From Hongkong *viâ* the West River into eastern Yun-nan.
2. From Shanghai following the Yang-tse River as far as Sui Fu, the limit of steam navigation, thence southerly into northern Yun-nan.
3. From Indo-China into southern Yun-nan.
4. From Burma into western Yun-nan.

The first of these is the least known of the four, and the travellers that have entered eastern Yun-nan from this direction are few and far between. The other three routes have been dwelt upon at length in numerous books of travel, and it is not the purpose of this paper to touch upon them, but to limit itself more particularly to the West River and East Yun-nan.

Yun-nan has of recent years attracted perhaps more geographical and political interest in this country than any other province of the Chinese Empire, as it is situated upon the frontiers of Tibet, Burma, and Indo-China; and it has been the dream of many practical men to link up Burma and Yun-nan by a railway which would reach the vast markets of the neighbouring province of Se-chuan and the Yang-tse Valley. Fascinating as this problem is, and strenuous as the attempts at its solution have been, the time at our disposal to-night will not permit of a discussion as to its practicability; nor can we examine in any detail the merits of the four above-mentioned routes as compared with one another; and we will confine ourselves more particularly to the question of railway penetration from the eastern side.

The area of Yun-nan is about 150,000 square miles, and with the

exception of numerous lake-basins, the aggregate area of which does not exceed 10,000 square miles, may be described as mountainous. Geographically speaking, Yun-nan is a broken plateau with an average elevation of 6000 feet, traversed by ranges running north and south, with smaller lateral chains east to west. The plateau falls abruptly to the deep valleys of the Yang-tse on the north; of the Irrawady, Mekong, and Red Rivers on the west and south; and with an easier gradient to that of the West River on the east. In the west, the courses of the great rivers Shewli, Salween, and Mekong—unnavigable through the province—are marked by deep troughs cut through the wild and precipitous country. In the east, the plateau is scored only by one large river, the Ta Chiang, which follows the general course of Yun-nan rivers from north to south for a distance of about 150 miles, and then suddenly bears eastward until it leaves the province and finally discharges itself into the southern China Sea.

The figures given for the population vary from five to fifteen millions, but Davies' estimate of about ten millions is probably not far wrong. Forty per cent. of these dwell in the lake-basins, and the remainder are found in the hilly areas. The Chinese element is in the majority on the level lands, while the members of various tribes like the Shan, the Lolo, and the Miao predominate in the highlands.

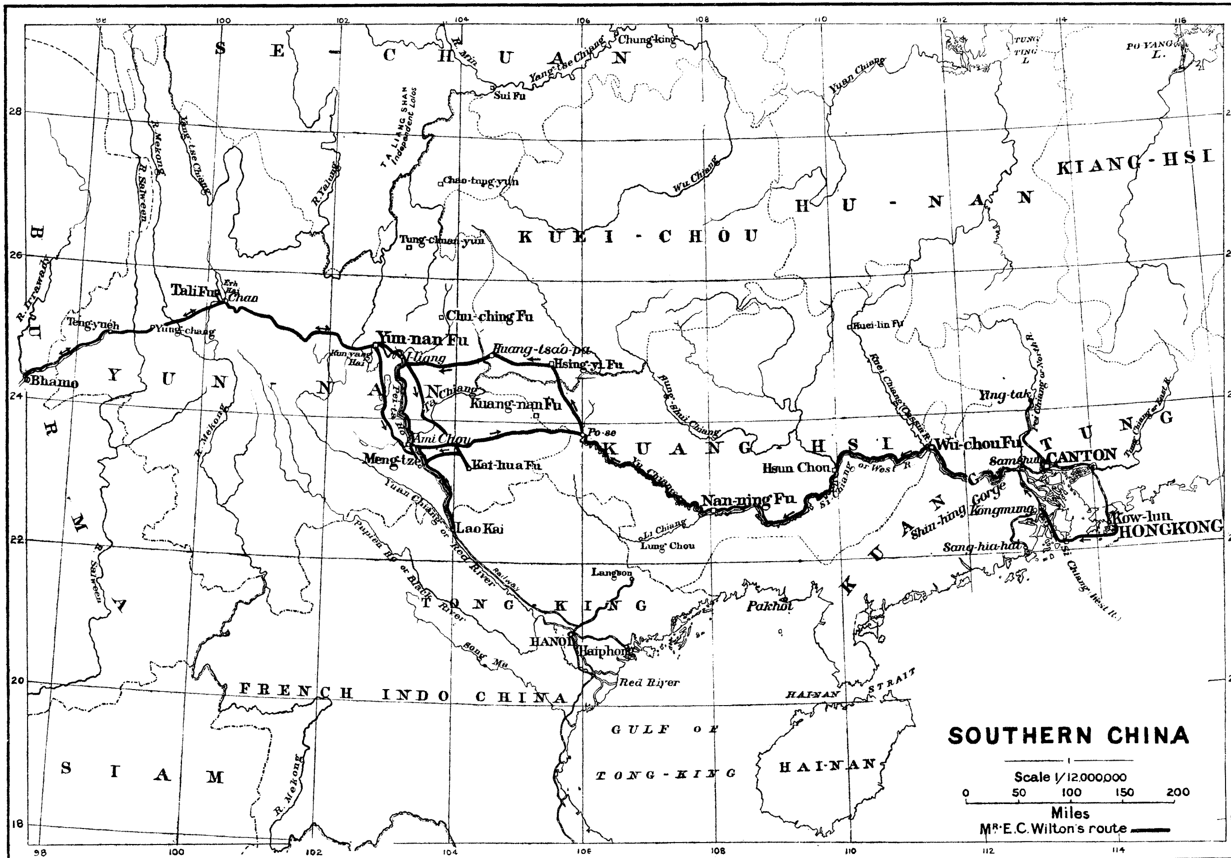
Hongkong from its geographical position may be regarded as the seaport of the West River, the natural outlet of Yun-nan to the sea, and that colony has shared the disappointment of the hopes raised in the Far East twenty years ago that the commercial development of the West River region would speedily follow on the opening to foreign trade of Wu-chou, a town on the northern bank rather more than 200 miles from Hongkong. These hopes would not have been entertained, however, had the physical difficulties of the upper navigable reaches of the river and the mountainous nature of the surrounding country been sufficiently understood in their bearing not only upon the question of communications, but also upon those of brigandage and the comparative poverty of the hinterland of Canton and the delta area of the river.

The two main branches of the West River take their rise in the eastern highlands of Yun-nan not far from the towns of Chu'ching and Kuang-nan respectively. The former and more northerly is the principal geographical branch, and in its course through the province is generally known as Ta Chiang (Great River), until it reaches the red sandstone between the provinces of Yun-nan, Kuei-chou and Kuang-hsi, when it is called the Hung-shui Chiang or Red Water River. Broken by frequent rapids, it is unnavigable until approaching its junction with the main navigable stream at the town of Hsün Chou, about 300 miles from Hongkong. The union of the two streams forms, strictly speaking, the West River, but the more southerly branch, known as Yu Chiang (Right River), is generally regarded as the West River on account of its greater navigability.

It will be remarked that the important affluents of the West River

are all on the northern bank, with the exception of the Tso Chiang (Left River), which rises close to the China–Tong-king frontier. In its journey to the South China Sea the river has carried down vast quantities of sand, which have been deposited between what were once islands but are now part of the famous Canton delta, the most intensely cultivated, highly industrial, and densely populated area in China. From the delta the river discharges itself by five mouths, and may be compared to the outstretched hand with fingers open pointing to the sea.

The appearance of steamers on the river dates from the opening of Wu-chou to foreign trade in 1897. From Hongkong they enter by the Wang Moon mouth and pass through the fertile delta traversed by hundreds of navigable creeks and waterways alive with thousands of steam launches, junks, and small craft. At Sam-shui, a walled town opened to foreign trade, the North River joins the main stream, and this river, although of no great commercial importance, is a source of danger to life and property. During the summer freshets it sometimes happens that the force and volume of the current break down the dykes above the junction, and the water diverted from its natural channel pours in a devastating flood over the delta. In the summer of 1915 the loss of life was estimated at 60,000, the whole of the first crop of rice was lost, and a vast amount of property destroyed. Beyond, hills appear and come close down to the river, leaving but a narrow margin for cultivation. The Shiu Hing gorge, 4 miles long, is the finest on the river. The town of the same name on the left bank was once the provincial capital, and is solidly built to withstand the force of floods which arise very suddenly in the summer months. Above the gorge the country becomes more open, is well wooded in places, and shows a fair amount of cultivation. Two hundred and twenty-four miles from Hongkong lies Wu-chou in the right angle formed by the junction of the Fu, also called Kuei (Cassia) River, a northern tributary which leads through wild and beautiful gorges to Kuei-lin, one of the most picturesque of the cities of China. As the province of Kuang-hsi within which it is situated is mountainous and has no road communications, it follows that the trade with its neighbours Kuang-tung and Hu-nan must follow the rivers, and the meeting-place at Wu-chou is the door through which all merchandise to and from west and north must pass. The houses are built on piles against inundation, which is of frequent occurrence in this vicinity in the summer, the Cassia and West rivers each acting as a dam to the other when either is in spate. As an instance of this, it may be mentioned that the height of the river on 11 June 1908 was 6 feet 8 inches, and eight days later the level was 67 feet 3 inches above the winter mark; in July 1915 the water-mark was 79 feet. Deforestation has a good deal to answer for as a cause of these freshets. Chinese settlers in clearing forest and jungle for cultivation make use of fire, and by this destructive method not only get rid of the timber and grass but also kill every vestige of sapling and seed. The heavy rains of the


SOUTHERN CHINA
Scale 1/12,000,000
0 50 100 150 200
Miles
Mr. E. C. Wilton's route
SE-CHUAN
KUEI-CHOU
HU-NAN
KIANG-HSI
KUANG-HSI
KUANG-TUNG
YUN-NAN
BURMA
SIAM
FRENCH INDO CHINA
TONG-KING
GULF OF TONG-KING
HAI-NAN
HAINAN STRAIT
Chung-king
Sui Fu
Chao-tung-yun
Tung-chuan-yun
Chu-ching Fu
Yun-nan Fu
Tali Fu
Teng-yueh
Yung-chang
Bhamo
Huang-tsao-pa
Hsing-yi Fu
Kuang-nan Fu
Po-se
Ami Chou
Meng-tze
Kai-hua Fu
Lao Kai
Langson
HANOI
Haiphong
Red River
Pakhoi
Lung Chou
Nan-ning Fu
Hsun Chou
Wu-chou Fu
Ying-tak
CANTON
Samshui
Kongmun
Shiu-hing Gorge
Sang-hia-hai
Kow-lun
HONGKONG
Kuei-lin Fu
R. Mekong
R. Salween
R. Irrawady
Yang-tse Chiang
R. Yalung
Wu Chiang
Yuan Chiang
Si Chiang or West R.
Pei Chiang or North R.
Tung Chiang or East R.
Yuan Chiang or Red River
Pupien Ho or Black River
Song Ma
Tung Ting L.
Po Yang L.
Ta Liang Shan Independent Lolos

summer months pour unchecked off the bare slopes of the hills, draining into the river and its feeders and helping to swell the volume of the stream at the extraordinary rate we have noted above. The stretch of river from Wu-chow to the sea may be regarded as the easiest of the three sections into which the navigable portion of the river is divided. The second and most difficult is between Wu-chou and Nan-ning, a distance of 320 miles, broken by reefs and rapids and impassable to the ordinary river steamer.

At Wu-chou I was fortunate enough to be able to proceed by the first motor-boat which made a successful voyage to Nan-ning. The vessel was the property of a small local British firm, and was little more than a native boat of about 30 tons fitted with a motor engine and with a maximum speed of 7 knots.

After leaving Wu-chou the aspect of the river entirely changes. Masses of rocky reefs now frequently break the course of the stream; there are wild and deserted gorges and the river winds tortuously, at one moment hemmed in by bare rugged hills, losing themselves in the background of densely wooded range upon range, at another flowing through small valleys cultivated with maize and dotted with clumps of bamboo. There is an absence of sameness in the scenery, and at times the stream has the appearance of a succession of lochs framed in a setting of forest and mountain. Where there is cultivation small villages appear, and here and there a walled town. These towns to this day carry the marks of the devastation and cruel treatment they experienced during the Taiping rebellion which had its origin in this province sixty years ago. Once flourishing and prosperous, they seem to-day but melancholy ghosts of their former selves, and their glory has departed since the days of the Mings when the trade from the west and Yun-nan passed their gates on its way to the coast. The city of Nan-ning, 500 miles from the sea, lies on the left bank of the river, and unlike its neighbours, suffered but little at the hands of the Taipings. The opening of the city to foreign trade in 1907, the year in which I first visited it, has not realized the sanguine hopes formed by Hongkong merchants, but in spite of difficulties the most serious of which has been the political unrest prevailing during the last five years, the trade which is entirely in the hands of the Cantonese continues to develop somewhat slowly but steadily.

Between Wu-chou and Nan-ning navigation is not exceptionally difficult for the present day motor-boats except at two places. The first of these is known as the Ta T'an (Great Rapid) and is by far the more dangerous of the two. It is in reality a succession of three bad rapids, separated by lesser ones, with a total length of 4½ miles and a drop of 8 feet. The approach up-river seems impassable, so choked with rocks and boulders does the river appear, but the narrow channel winds through the limestone ridges which jut across from either bank. The second, the Pan T'an (Slab Rapid), is less formidable, but none the less constitutes a danger to navigation.

The Tso Chiang (Left River) joins the West River from the south 25 miles above Nan-ning, and 2 miles above the junction is the Kam Ling Rapid, dangerous only on account of the tortuous channel among partially submerged rocks. With this exception, the stretch of river between Nan-ning (elevation 380 feet) and Po-se (640 feet; both taken by aneroid and boiling point), the limit of navigation, a distance of 250 miles, presents no serious obstacles to shallow-draught vessels. Sandbanks are of more frequent occurrence in this uppermost section, and at dead low-water season (January and February) the channels are narrow and in many places only 2 feet deep. The river is full of sharp angular bends and the general character of the country is low and undulating, separated from more open ground by a succession of gorges backed by precipitous hills. The sandy shoals increase as Po-se is approached, the momentum of the water being insufficient to carry off the quantities of sand brought down. The town, which is on the left bank, is commercially and strategically of some importance as it commands the lines of communication from the west and north-west with the province of Kuang-hsi, within which it is situated.

We have now arrived at a convenient point to pause for a moment on our journey to Yun-nan and glance back at the West River and the two provinces of Kuang-hsi and Kuang-tung through which its navigable course is confined.

The maritime province of Kuang-tung covers an area of 100,000 square miles and has a population of thirty-two million. It is largely mountainous, except in the delta region, which is the most intensely cultivated, industrial, and populous area in the empire. The provincial capital, Canton, has over a million inhabitants, including 100,000 Tankhas who live exclusively upon their boats which ply on the Canton waterways. It is connected by rail with Hongkong and Sam-shui, and is the terminus of the Yueh-Han Railway of which about 150 miles have been laid from Canton. In spite of piracy, which is rarely absent from the waterways of the delta, there is an enormous traffic not only with Hongkong but with different parts of the Chinese Empire, and the Cantonese are justly regarded as among the most astute and enterprising of Chinese merchants. The northern and north-westerly portions of the province are hilly, and the inhabitants largely native tribes and Hakkhas. The latter are the descendants of the earliest Chinese settlers, who intermarried with the native tribes, and possess a far more restless, turbulent spirit than the ordinary Cantonese, a term popularly applied to the Chinese population of the province. There are rich mineral deposits, but these have hitherto been but little exploited.

The province of Kuang-hsi adjoins Kuang-ung on the west and covers an area of 77,000 square miles, with a population of five million. It is the most sparsely populated of all the provinces, and the surface is mostly broken up by mountains running south-west to north-east and appearing to rise about 3000 feet above the general elevation of 1000 feet. The

country is well watered and, although its agricultural wealth is small, there are indications of large and valuable mineral deposits. The province is in a backward, unsettled condition, nor is this to be wondered at seeing that it has never really been free from insurrections and unrest for a hundred years, and it will be remembered that the Taiping rebellion which devastated the fairest parts of China sixty years ago had its origin in Kuang-hsi. Brigandage is rife throughout the length and breadth of the province, and this may largely be attributed to the character of its inhabitants and the physical nature of the country. Two-thirds of the population consist of native tribes among whom the clans of the Shan and Miao families predominate. The remaining one-third is made up principally of Hakkhas (descendants of Chinese soldiers married to tribal women) and a comparatively small number of Cantonese. The latter are to be found in the easterly and south-easterly parts and constitute what may fairly be called the civilizing element of the province. The Hakkhas, generally called "Kuang-hsi men," are principally in the west and north-west and form the turbulent element which is a frequent source of anxiety to the Central Government even so far away as at Peking.

The two provinces lying side by side afford an extraordinary contrast both from the geographical and the economic points of view. Kuang-ung has an extensive seaboard, and its delta is one of the most fertile and industrial areas in China; Kuang-hsi lies wholly inland and is a low plateau cut up by rugged mountain systems. The former is, commercially speaking, the most enterprising; the latter is the most backward of all the Chinese provinces.

In regard to the West River itself, we have seen that, while rising in Yun-nan, its navigable course lies wholly in the two provinces of Kuang-hsi and Kuang-tung for a distance of 800 miles. The stretch of river in the latter province is easy; the second as far as Nan-ning is the most difficult; the third from Nan-ning to Po-se is troublesome rather on account of shallows than of rapids. On the whole, it may be said that the navigation of the river is not exceptionally difficult for a suitable type of vessel, except in the two places already referred to—the Ta T'an and the Pan T'an. A competent survey of these two has been made under the direction of the Coast Inspector of the Maritime Customs, and I understand that the dangers of the latter could be altogether eliminated at a cost of less than £20,000. The former is a more serious problem; nevertheless it would appear possible to improve the conditions for navigation to an appreciable degree, even if some of its dangers should still remain. The rapids are generally formed by the narrowing of the rocky river-bed by reefs and shingle-banks which force the surface of the water into a tongue. The greatest velocity is at the tip or lower end of this tongue, but it is the base or upper end which a vessel finds so difficult to ascend. The reason of this is, I think, because the tongue is an inclined plane of water, and should the open stretch above the rapid be wide and deep the volume

of water pouring down may be sufficient to check the passage of any craft trusting to speed alone. The rate of the fastest rapid on the West River at any time of the year would probably not exceed 8 knots, but it does not follow that a vessel with a speed of 12 knots could surmount it. What is required is a lifting power to raise the boat up the inclined plane, and this can be supplied either by a hawser on board attached to a fixed point above the rapid, or, if the water be shallow, by shoulder poles pushed by the crew on board. The West River rapids are comparatively shallow, and shoulder poles can be manipulated from the narrow platforms encircling the boat. None of the boats on the upper Yang-tse River carry similar platforms, as the water is generally too deep to permit of the use of these poles, and it may be said that not even the Ta T'an and the Pan T'an are anything like as formidable to negotiate as the worst rapids on the Upper Yang-tse, where I have seen the dreaded Yeh T'an running at 14 knots with many times the volume of water that the Ta T'an could boast of. High speed and an expensive class of vessel is unnecessary anywhere along the West River, and the present type seems the most suitable for the river above Nan-ning; this is a motor-boat of 50 tons with 4-cylinder Parsons motors developing 120 horse-power and a speed of 11 knots on a 2 foot 8 inches draught, and one of these boats can make the round trip from Wu-Chou to Nan-ning and back in six days as against twenty-six days by native junk. The first motor-boat to reach Nan-ning in 1907 was British, and so was the first that arrived at Po-se in 1908, and the credit of the successful experiment belongs to the small British firm which patiently persevered in spite of pessimistic forecasts and many disappointments. To-day eight to ten of these boats ply between Wu-chou and Nan-ning and two run beyond to Po-se. Just as British enterprise led the way for steam navigation on the Upper Yang-tse, so it has been the first to place motor-boats on the West River, and where it has shown the way others have followed.

The West River Conservancy Board has been formed under the control of the Central Government, assisted by foreign engineers. The scope of its labours, however, has not included the improvement of the river above Wu-chou, but has been confined to devising and examining schemes for the prevention of floods in the delta and neighbourhood. A proposal to carry off the surplus waters by means of a waterway from the West River to the Gulf of Tong-king has been definitely abandoned, as the intervening watershed has been found impracticable to pierce. Other attractive schemes have been ruled out after careful investigation, and nothing better appears to offer itself at present than the strengthening of the system of dykes so as to keep the flood water as far as possible in the existing channels. Although no amelioration of the conditions in the upper reaches can be expected for many years, it cannot be denied that some rectification is possible which would render the river fairly safe for navigation as far as Po-se. Nevertheless, the commercial development and prosperity of the

West River region depend not so much upon the conservancy of the river as upon the repression of piracy and brigandage, the immigration of Cantonese into Kuang-hsi, and the opening up of the valuable mineral resources of the two provinces. More than thirty years have elapsed since Colquhoun's journey up the river, and the traveller to-day makes his voyage under more favourable conditions. The anti-foreign feeling described by Colquhoun as so intense is but little noticeable nowadays, and the decaying towns on the river-banks show some signs of revival due to the increase of commerce which has followed upon the opening of Wu-chou and Nan-ning to foreign trade and the introduction of steamers, steam-launches, and motor-boats.

We have now seen that, although there are many obstacles in the way, the journey from Hongkong to the navigable limits of the West River is not one of exceptional difficulty. As further water communication is no longer practicable beyond this point, it remains for us to consider the geographical nature of the overland communication between Po-se and the province of Yun-nan. There are two directions in which we may go: either ascend as far as Pongai just within the Yun-nan frontier, or else proceed northerly into the neighbouring province of Kuei-chou and then bear westerly into Yun-nan.

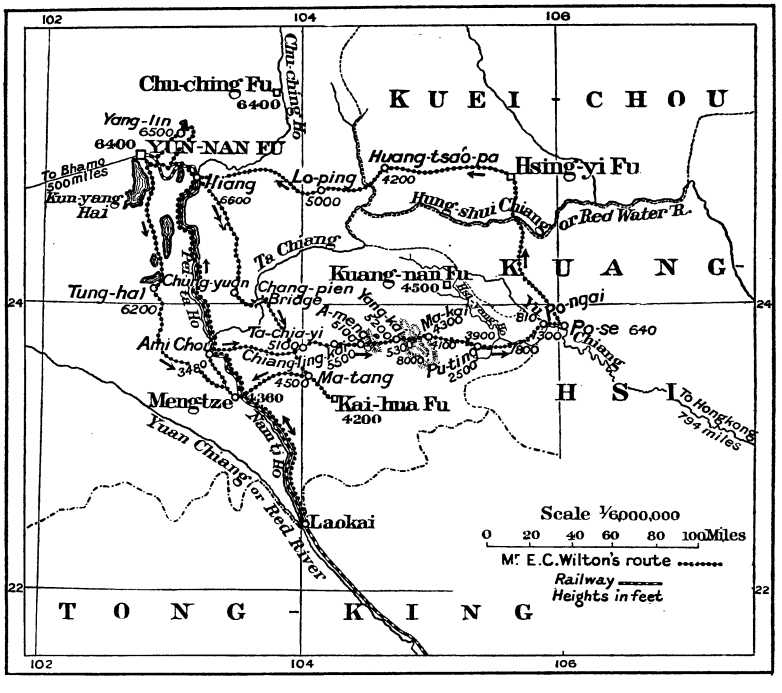
The first of these routes follows for 40 miles a tributary which rises near the town of Kuang-nan in Yun-nan. The water journey is remarkable for a succession of bad rapids—I counted over fifty—and this is not surprising when we consider that the average fall between Po-ngai (810 feet) and Po-se (640 feet), by boiling point and aneroid, is over 4 feet per mile. Steam or motor communication is out of the question, and only a few small boats drawing barely 9 inches ascend and descend this stream, and even these small craft cannot proceed into Yun-nan beyond Po-ngai.

The second of the two routes proceeds overland in a northerly direction and passes over the low watershed between the Hung-shui River and the Yu Chiang to a ferry across the former. The mandarin at Po-se advanced every argument against my proceeding by this route, hitherto untrodden by foreign travellers and infested with lawless characters, and urged his case with such reiteration and persistency that—to use his own picturesque description—his lips were scorched and his tongue clave to the roof of his mouth. He gave way with a good grace, but countered by sending to my inn a company of fifty soldiers as escort for the journey. I evaded this unnecessary encumbrance, however, by the simple expedient of starting some hours before the advertised time, and, as my little party travelled fast and light, they were unable to catch us up, if indeed they made any attempt to do so; at any rate, I was ungrateful enough to be thankful that I never set eyes on them from start to finish. In passing through country troubled by robbers I have invariably found in China that no serious molestation will befall a traveller who moves rapidly with little baggage, and the sole robbers I came in contact with on this occasion were the

official tax-collectors at the ferry, who were routed by the display of my passport, the first and only time it was produced during the journey.

The countryside is but thinly inhabited, and there is no doubt that the deserted appearance is due to brigandage and a general sense of unrest. Twenty years ago the Yu Yung (Vagabond Braves), who were soldiers disbanded from the Tong-king frontier at the close of the war with France, overran this corner and successfully defied the Government forces in the forests and ravines that border the frontiers of the three provinces of Yun-nan, Kuei-chou, and Kuang-hsi, and the villagers had many a tale to tell of Li erh laopan, the bandit chief with a long beard, who marched

EAST AND SOUTH EAST YUN-NAN



on foot at the head of his men, shared their rations, and was long the terror of the mandarins. Although these robber bands were eventually crushed in 1904, the spirit of lawlessness has remained in these parts, and the trade caravans avoid this route, so that the local traffic with Yun-nan is insignificant.

Crossing to the left bank of the Red Water River, a steep climb from the level of the Kuang-hsi plateau has to be negotiated before the western ledge of Kuei-chou can be reached. The market town of Huang-t'sao Pa, 144 miles from the provincial capital of Yun-nan, lies about midway between the latter and Po-se, and touches the road across the bend made by the northern affluent and the main geographical branch of the river

here flowing in an easterly direction. The junction marks also the meeting-point of the three plateaus of Yun-nan (6000 feet), Kuei-chou (4000 feet) and Kuang-hsi (1000 feet), separated from one another by a barrier range of 7000 to 8000 feet skirting the left bank of the river. From Huang-t'sao Pa, also known as Hsing-yi Hsien, the road crosses this range and drops sharply to the waters of the northern affluent, broken by frequent rapids and running through deep narrow gorges; the breadth of the stream at this point is but little more than 100 feet and its bed about 300 feet. Ascending to the Yun-nan plateau, the country presents an uninteresting contrast to the wild and picturesque scenery of Kuei-chou with its bold and rugged limestone crags. Comparatively level and barren except where occasionally traversed by small streams, the country now is generally sterile until the main branch of the Red Water River is crossed again at Iliang, a town on the French railway 30 miles from the capital. There are but few inhabitants on these waste lands, and away from the Chinese villages are to be found settlements of Lolos who are gradually becoming merged into Chinese.

Yun-nan Fu, the provincial capital, stands at an elevation of 6300 feet and was described by Marco Polo as "a very great and noble city." In spite of the destruction of its suburbs during the Mohammedan rebellion, it has a population of 100,000 and the circuit of its walls is 6½ miles. Most picturesquely situated on the shores of the K'unyang Lake surrounded by mountains and wooded hills, it is the terminus of the French railway from Tongking and is 536 miles from the sea in that direction. The railway, which is the only one in the province, touches but two small towns between the French frontier and Yun-nan Fu and passes barren country. Enormous difficulties were experienced in its construction owing to physical and climatic conditions, and it has been estimated that during the summer of 1905 deaths, fever, and desertion accounted for 40 per cent. of the native labour employed in the Namti Valley, the most southerly section. There is no great exaggeration in the saying that every sleeper in this valley represents a human life. The length of the railway actually in Yun-nan is 296 miles; it occupied eight years in building, at a cost of about eight million sterling. The Yun-nan section was opened to traffic in 1910 and is remarkable for the engineering skill exhibited in its construction, although it is a source of constant anxiety and expense owing to the frequency of landslides and slips. The interest on the capital has been guaranteed by the French Government, but the railway has yet to show that, commercially speaking, it is a success. There is little doubt, however, that it is attracting a portion of the trade of East Yun-nan which used to find its way to Hongkong *viâ* the West River, and a branch line to Kai-hua, the most important town in South-East Yun-nan, has been projected

From Yun-nan Fu to Kai-hua is 182 miles, and in the autumn of 1909 I made this journey by a little-frequented route east of the French railway. The country generally is hilly and well wooded, and for the first half runs

through a belt of Lolo settlements. Away from the beaten track Chinese are but rarely met with, and their officials exercise little more than a nominal authority over these Lolos, who are directly administered by their own T'u Ssu or chieftains. The Red Water River, locally known as the Great River, and in its higher reaches as Pei-ta River and Ch'u-ching River, is crossed about 80 miles from Yun-nan Fu by a suspension bridge, 280 feet by 6 feet, slung on six iron chains, and erected in 1904. The country leading down to the bridge is thickly wooded and undulating, and the level of the river is fully 2000 feet below that of the plateau through which it has cut its way. Immediately below the bridge the Small River pours forth to join the main stream, falling from a vast limestone cave which has concealed its course for many miles. Beyond the river numerous tribes are to be met with, and their nomenclature is bewildering. Nevertheless, all the different names fall into one or other of three groups—Lolo, Miao, and Shan, and these will be found separated from one another according to the elevation at which they dwell. Thus, for instance, you may find representatives of all three families in a particular area, but on the tops of the highest hills you will invariably discover Miao hamlets, on the slopes Lolo settlements, and at the lowest elevation Shan villages. Inter-marriage between these tribes is not the rule, although there are instances of it. Chinese not infrequently marry tribal women, but the tendency in these cases is to revert to Chinese alliances in later generations. Rice, sugar-cane, and cotton are grown in the valley of the river, but there is little or no cultivation in the grassy uplands, in spite of the fact that the soil is good. Between these grasslands and the low wooded hills to the north of Kai-hua the ground dips down to a large extent of marsh and swamp covered with tall waving reeds for many miles. Fifteen miles from Kai-hua the road runs between well-wooded hillsides, crosses a natural limestone bridge, and finally descends into the cultivated plain in which the town stands, after first crossing and then following a limestone range. The town itself is walled, and is the most important in these parts in spite of the fact that it has seen better days. Half a century ago it was an important mining centre, but persecution after the Mohammedan rebellion, in which ten millions of the inhabitants of Yun-nan lost their lives, drove the Mussulman to seek a refuge in the remoter districts, where the rate of increase and their friendship with the tribes are a source of uneasiness to the Chinese official mind. The best Kai-hua miners were the Mohammedans, and little or nothing is now being done at the once flourishing silver-mines of Malati to the south of the town. Coal, graphite, antimony, and gold are known to exist in considerable quantities; limestone is present in unlimited amount, and I saw many traces of iron. In spite of its dwindling importance Kai-hua is perhaps the most interesting town in Yun-nan from an ethnographical point of view, for in the surrounding mountains and valleys dwell numerous clans of the Miao, Lolo, and Shan families. Market day is the great

attraction for these tribespeople, and from an early hour they flock in thousands through the thoroughfares, the women wearing their distinctive tribal costume, although the men, or nearly all of them, have adopted Chinese dress. These markets are common wherever Chinese influence has permeated among the tribes; and the mutual intercourse which they afford not only fosters a commercial spirit among the inhabitants, who bring their surplus stocks for sale and barter, but is also promoting a healthy civilizing influence over these rough but good-natured people. Like the Burmese and Tibetans, the women attend to business at these markets while the men smoke and gossip.

The road from Kai-hua north-westerly to Mengtse, a town 8 miles from the railway and open to foreign trade, is comparatively easy for Yun-nan. In spite of the great mineral wealth of the province, which includes gold, silver, copper, coal, iron, lead, zinc, and tin, the last-named is practically the only metal exported. The famous tin-mines of Kochiu lie close to Meng-tze, and the annual export, all of which goes to Hongkong, is about 7000 tons. Mining plant to the value of £60,000 was installed there five years ago.

The railway touches the small town of Ami-chou, 27 miles to the north of Meng-tze, at an elevation of 3800 feet, and the country to the eastward for a distance of over 200 miles as far as the boundary of the neighbouring province of Kuang-hsi is a plateau of about 6000 feet sloping continuously down to the waters of the West River and broken midway by a mountainous belt about 20 miles wide. Except where the track crosses the roads from the capital to Kai-hua and from the latter place to Kuang-nan Fu, the country through which I passed was practically unknown for a distance of 180 miles, as far as Fu Chou the termination of the Yun-nan highlands, save to the Chinese patrols scattered along the Yun-nan–Tong-king border. These patrols function as military police and, quite apart from any fighting value they may have, are doing useful work for China in controlling and absorbing the tribes in an effective though slow and gradual manner. They marry tribeswomen, and the children are brought up as Chinese; they learn to speak the tribal dialects and get into familiar touch with the inhabitants; and they are also becoming well acquainted with the difficult country and the tracks leading to mountain fastnesses used as robber strongholds. In spite of the stringent prohibitions prevailing at the time against the use of opium, the veterans to a man used the drug as an antidote for fever, and my observation leads me to believe that a moderate smoker who does not deny himself food is more healthy and more capable of fatigue than an abstainer in the malarial valleys.

From Ami Chou to Chiang-ling-kai, a distance of 70 miles, the plateau is undulating and covered with woodlands dotted with innumerable limestone peaks rising barren from their timbered slopes, and too steep even for the hardy pine to find a footing. A very striking feature of this region is the absence of running water, and the presence of numerous

deep and isolated pools. These pools receive the drainage of the surrounding hills, and appear to have no outlet. Nevertheless, numerous as they are, they appear insufficient to account for the total drainage, and it is very probable that subterranean streams explain the leakage. It is by no means uncommon in these parts to discover streams suddenly appearing and as suddenly disappearing into the limestone ranges. In a season of drought the pools dry up, while they overflow and flood the countryside during abnormally heavy rains. The slow growth of population and the low standard of comfort tell only too well the tale of suffering undergone by these settlers in times of drought or of flood. The spring of 1907 was a season of partial drought in East Yun-nan, and passing through a Lolo hamlet I spent the night in the headman's hut. He, his wife, son, and daughter-in-law regarded themselves as more fortunate than their neighbours in having a handful of maize boiled with poppy-leaves for their evening meal. The poppy-leaves, he explained, deadened the appetite, and he was able to put by a morsel or two for the next day. A large number of these poor folk died of starvation that spring, but nobody knew about them, and nobody would have cared if they had known. The usual crop is maize, but sometimes a little rice is grown near the water. Throughout the wide extent of deserted lands the grass is waist-deep, and there is an abundance of timber. Continuing in an easterly direction, the country is broken up by small limestone ranges, and a few miles beyond, at Pup'iao, the point of intersection of the Kai-hua–Kuan-nan road, is the most easterly of the Lolo settlements. The abnormally late rainy season had converted a great part of the level ground into a vast swamp, and the only way to advance was by long détours along the slopes of the low hills. There are many small but flourishing colonies of Mohammedans in these parts, who are refugees from the Kai-hua district. They have intermarried with the native tribespeople, of whom the Lung-jen (a Shan clan) largely predominate in numbers and prosperity. The native wife of the Mohammedan embraces Islamism in purely a formal manner, and abstention from pork, attendance at mosque, and care in rearing a healthy offspring are the most exacting requirements.

The plateau is now gradually descending to the valley of the West River and has dropped to 5000 feet. As we proceed still easterly the character of the country becomes more open, and running streams make their appearance, piercing the limestone ranges in places and disappearing and reappearing in the course of a few miles. Wheeled carts are in evidence, and rice is grown in some quantity, but the prevailing crop is maize, and the inhabitants are now entirely of Shan stock mixed with some Chinese. Midway between Ami Chou and the frontier of Kuang-hsi, and for the next 20 miles, the track lies through a wild mountainous region notorious for robbers and roving bands of Miao dacoits well armed with modern breech-loaders. Here for the first time in Yun-nan my little party, consisting of myself, servant, two muleteers, and two patrols, was

attacked, but it was nothing more than the interchange of a dozen rifle-shots at very long range with no damage to either side. The robber band, which was a mixed one of Chinese outlaws and Miaos about thirty strong, followed us to our encampment that night, but nothing happened, and in the morning they disappeared driving the cattle they had been raiding towards the French border. Each man carried his rifle, cartridges, and a bag of maize meal slung across his back; otherwise they were unencumbered with kit of any kind. These roving bands are being thinned out gradually, and whenever harried by Chinese patrols they retire to the Tong-king frontier, thence to be chased back into Chinese territory by the French frontier guards.

The elevation drops to 4000 feet and opens into easy country with villages well watered by small streams. An affluent of the West River locally known as the Papo–Pachia River is crossed by a three-arched stone bridge. Limestone caves have been a common feature along the route after leaving Chiang-ling-kai, and are unusually numerous in this district. There is considerable cultivation (rice, hemp, and tea-oil), the villages are larger and more prosperous, and mud huts have been replaced by brick buildings for the first time; the inhabitants, too, who are mostly Shans, have the appearance of being well fed in contrast to their neighbours to the west.

The town of Pu-ting or Fu-chou lies 12 miles in a south-easterly direction, and is perhaps the smallest walled town in China. It stands at an elevation of 2500 feet, and consists of nothing more than a small hill fort with a cluster of 150 houses on the eastern side. A few years ago the place was the seat of a local T'u-ssu or chieftain who ruled the surrounding country, but as he was unable to maintain law and order the district was placed under the direct control of a Chinese magistrate. Fu-chou may be regarded as the point where the slope of the eastern highlands reaches the upper valley of the West River in this direction; eastwards the country assumes a semi-tropical appearance, while the inhabitants are largely mixed with the Kuang-hsi element, and geographically speaking this town rather than Po-ngai should be on the frontier line between the two provinces. The Spear Head Mountain stands in close proximity to and menaces Fu-chou. Twenty years ago it was the haunt of the robber bands known as Yu Yung (Vagabond Braves), and from the surrounding mountains issues the Pu-ting River, along which the road now winds for 30 miles. The stream then branches to the south and disappears in a subterranean passage for 25 miles, and emerging finally flows into the West River 10 miles below Po-ngai. Between this small town and Fu-chou there is a fair amount of local trade with the West River, and hides, medicines, and aniseed oil are exchanged for yarn, kerosene, and tobacco. At Po-ngai, the blue waters of the West River, broken by boiling rapids racing into deep quiet pools, the wooded banks, the thatched huts of the fishermen, the tall plumed grass fringing

the stream, and the picturesque little town at the end of the valley, which appears to be completely cut off by the towering hills behind, all combine to form a most charming and pleasing scene after the descent from the wild highlands of eastern Yun-nan.

The arrival at Po-ngai has completed the examination, so far as time and circumstance permitted me, of that part of the plateau of East Yun-nan, between long. 102° 40′ and 105° 40′ E. and lat. 25° and 22° 30′ N., which is in communication with the West River. The conclusions at which I have arrived are, firstly, that the conditions of navigation from Hongkong to Po-se are not exceptionally difficult and might be sensibly improved; and secondly, that while the overland routes thence into Yun-nan cannot be described as easy under present conditions, there do not appear to be very serious obstacles in the way of competent road engineers.

In the earlier part of this paper a promise was made to refer to the possibility of railway communication with Yun-nan from the east, and my observations have convinced me that not only is railway communication possible between the highest navigable point on the West River and the provincial capital or some convenient point on the eastern plateau, but also that such a line would pass through less difficult country and encounter less formidable obstacles than either the existing French line or the projected railway from Burma. A railway from Po-se into Yun-nan either following a northerly and westerly or else a direct westerly trace would tend to bring the eastern part of the province into direct touch with Hongkong by way of the West River. From a strategic point of view it would be invaluable for China, and would solve the vexed problem of the peaceful settlement of the troublesome province of Kuang-hsi. To be quite frank, however, a railway of this description would yield no return for a very long time, and it is doubtful if it would even pay the cost of its upkeep for some years. For the truth is that, with the richest flora and fauna in the empire, Yun-nan is a poor province on account of the physical difficulties which render transport costly and in many instances even prohibitive, and now that opium has been struck off her list of exports there is nothing of value to offer abroad except her still unexploited minerals. There are trustworthy indications that the province is very rich in mineral resources, and that eastern and south-eastern Yun-nan hold a fair share of these. Given the satisfactory development of mines in Yun-nan, railway enterprise would be feasible and would go a long way towards solving the economic and political troubles of the province.

Mention has been made from time to time of the various tribes inhabiting eastern and south-eastern Yun-nan, and although the time at our disposal admits only of a hasty and imperfect generalization, I should like with your permission to make a further brief reference to them and the part they have had and are still having in moulding the Yun-nan Chinese type. It has already been stated that the tribes in the east and south-east of Yun-nan can be grouped into three families (Lolo, Miao, and Shan),

with the addition of the Yao clans to be found in the Yun-nan–Kuang-hsi marches.

The Yun-nan Lolos appear to be descended from the same branch as the independent Lolos of Liang Shan, the mountainous regions north of the great bend of the Yang-tse in the area bisected by the line of longitude 103° E. between lat. 27° and 29° N. I am not able to offer any satisfactory explanation of the word "Lolo" employed by the Chinese in describing these people, for the most common name by which they call themselves is Ngo-su. Lolos wishing to pose as Chinese have at times pointed out to me other Lolos as I jen (barbarians), but this is a generic term used by Chinese to cover at once their ignorance of and contempt for the various tribes. The independent Lolo wears the hair gathered over his forehead into the shape of a horn about 9 or 10 inches long and wrapped round with stout cotton cloth. This strange form of head-dress has been described as peculiar to the male Lolo, but this is not the case, for I have seen matrons of the Tu lao (a Shan clan) coifed in a similar manner. The Liang Shan is superior to the Yun-nan Lolo in physique and courage, and it is probable that the majority of the latter belonged to tribes in subjection to and mingled with the blood of the weaker original Lolo clans. Chinese have intermarried more freely with the Lolo rather than with other tribes in East Yun-nan. The Yun-nan Lolo is of good physique and manly appearance, and in some villages individuals of the aristocratic Liang Shan type known as "Black-boned" are to be found, although but rarely. The women are clean and pleasant looking, and a good many of those married to Chinese have adopted the Chinese fashion of binding the feet. Both men and women dress like Chinese, and the boys are learning Chinese in village schools and forgetting their own language. The Yun-nan Lolo is hospitable, sociable, and fond of sport, but he is lazy in commercial pursuits, and is far behind the Chinese and the Shan in agriculture.

The Miao are contemptuously styled "Miaotzu" by the Chinese, but "Miao chia" is the more correct and polite term. They include a number of clans grouped under three principal divisions—the black, white, and coloured—so called from the distinctive colour of their clothes. In the second century B.C. they retired before the Chinese advance from north Hunan westwards into Kuei-chou and comparatively recently into East Yun-nan. The Miao live as a rule apart from the Chinese and prefer to place their rude log-huts on the secluded tops of mountains. The male is of low stature, but capable of extraordinary marches, and is as tough as the storm-strengthened pine of the hills; his food is maize, and he is a bold and skilful hunter; his clothing is spun from hempen fibre, but Chinese dress has been adopted by many. The women wear a hempen kilt short to the knees and go about bare legged and bare footed; they are of sturdy physique, active, and handsome with a ruddy complexion. They bear seven or eight children, of whom not more than two or three reach adult age owing to want of care and the hardships of life. A Chinese chronicle

ascribes "La Couvade" to the Yun-nan Miao. Under this eccentric custom, on the birth of a child the father retires to bed with the infant and receives the congratulatory visits and presents of his friends for the period of a month.

It is generally held that the Lolo family is the largest of all the tribes in Yun-nan, but, large as that family is, I am inclined to believe that it is outnumbered by the various members of the Shan or Tai family which includes the Nung or Lung jen, Sha jen, T'u lao, Pa I, and others. "Pa I" (valley barbarians) is the general, but by no means comprehensive, term in use among the Chinese to designate the Shans in reference to the well-known predilection of the Shan race for settling in lowlands rather than in uplands. Baber in the record of his travels—the most valuable and fascinating of all the works on Se-chuan and Western Yun-nan—actually commits an error in referring to the Pai Wang (White Prince) who once ruled a large kingdom with his capital at Tali. This should read Pa I Wang (Shan Prince), whose realm was that of the Nan chao in the seventh and eighth centuries A.D. In the middle of the ninth century this principality was at war with Annam and also with China, and was finally conquered and wrecked by the Mongols four centuries later.

The Yaos I came across in the extreme west of Kuang-hsi and in the south-east of Yun-nan, and they do not appear to belong to any of the three principal tribal families. The most noteworthy of the clans is the Lan tien Yao (Indigo Yao), who have been settled for a long period of time to the north of Po-se and are cultivators of indigo, an article indispensable to Chinese and Shans. Little appears to be known about them, although they are held in some awe by Chinese on account of a reputation for magic and sorcery. I have come across Lolo and Miao wizards, and their usual stock-in-trade consists of hypnotic trances, bewitching by touch, and the interpretation of dreams. Although I am unwilling to deny that there may be an instinctive touch with the supernatural peculiar in some degree to primitive people living in secluded mountain glens, some experience of their methods leads me to believe that the foundations of the magic art among the tribes rest upon the native shrewdness of the soothsayers. Their language is radically different to Chinese, Shan, or Lolo; although so competent an authority as Davies has traced some affinity between the Yao and Miao languages, I am inclined to regard the two as members of separate families; and the few I met in Yun-nan were able to speak the mandarin dialect of that province. They are said to have migrated from the region of the Yang-tse, and the Chinese state that they claim descent from the union of a dog and a princess. The dog is explained by a Chinese author as meaning a savage, and the story goes that a certain king on the north bank of the Yang-tse about 500 B.C. was menaced by invasion and promised one half of his kingdom and his daughter in marriage to a deliverer. A dog, *i.e.* barbarian, killed the invading chief and received the princess and the

sterile mountainous half of the kingdom. The issue of the union, six sons and six daughters, were the founders of the Yao clans who migrated into Hu-nan and have since retired under Chinese pressure south-westerly in the direction of Tong-king.

There is little doubt that the migration of the three tribal families into East Yun-nan has been from an easterly direction, the Lolo and Miao through the province of Kuei-chou, and the Shan chiefly through Kuang-hsi. Before the arrival of these families Yun-nan seems to have been peopled by Mon-Kkmer tribes, who were also found in Cambodia, Siam, and had even invaded Assam. The Bronze Drum Nations, a name given by Prof. Hirth in 'Ancient China' to tribes in the south of China who possessed a certain type of bronze drum for sacrificial purposes (a specimen I secured during the journey is now in the Victoria and Albert Museum) appear to have belonged to this area. It might be assumed that the Mon tribes represented the aboriginal population were it not possible to trace their precursors in the Salons or sea-gipsies of Burma, and it is interesting to note that the Malays are said to be derived from Salon stock.

In other provinces such as Kuei-chou and Hu-nan, the Miao clans, the most formidable of which was the Hei Miao (Black), have offered considerable resistance to Chinese domination, but their comparatively late arrival in Yun-nan three or four generations ago has prevented them from offering a direct challenge to Chinese supremacy, and it has been with the Lolo and the Shan that the Chinese have successfully struggled in the past for the possession of the province. The Chinese treatment of these tribes has often been represented as harsh, but the statement is misleading. It is harsh only in so far as the operation of natural laws is harsh, under which a weaker coming in contact with a stronger civilization becomes merged into the latter. Indeed the tribes in Yun-nan are much better off under direct Chinese rule than under their own T'u Ssu (chiefs), who are, in many instances, cruel and degraded wretches. Slow as the process of absorption is, it is nevertheless sure, and it is only a question of time before the whole of Yun-nan will be Chinese in language, dress, and customs, in spite of the lack of sympathy with and extraordinary ignorance of these tribes displayed by the Chinese. Enough has been said about the three families to show that they have exercised a considerable influence in the production of the present Yun-nan type of Chinese, which varies from the types in other provinces, and especially those of the north of China. In the latter, the Chinese blood is mixed with Mongol, in Yun-nan with Lolo, and to a less extent Shan; and the difference in their characteristics together with the influence of climate and environment have brought about a racial change in appearance and temperament. The comparative remoteness and inaccessibility of Yun-nan and its difficulties of internal communications have exposed the Yun-nan Chinese to the reproach of being sluggish and unenterprising. It cannot be denied that other provincials are their superiors in commercial success, but it can be

claimed that in virile qualities and physical stamina they excel many of their fellow-countrymen; they constitute a factor which will have to be taken into more serious account, not only by their compatriots but also by the neighbours on their frontiers, as soon as the development of the province follows upon the introduction of capital, the opening up of the mineral wealth, and the construction of railroads.

Before the paper the PRESIDENT said: Before we proceed to the business of the evening I have to announce that His Majesty the King of the Belgians has been pleased to assent to his name being added to the list of Honorary Members of the Society.

The paper to-night which will be read by Mr. Ernest Wilton is on a very remote part of China. Mr. Wilton has been some twenty-seven years in our Diplomatic Service. He accompanied Sir Francis Younghusband to Lhasa, and since then he has been employed as Assistant Commissioner in our negotiations with China. In 1889 he acted as our Consul-General of Yung-chou, he was at Tientsin in 1912, and he has since been an Opium Commissioner and Chinese Secretary in our Legation in Peking. He can, therefore, speak of China with extensive knowledge of the country. I am sure he will have a great deal to tell us.

(*Mr. E. C. Wilton then read the paper printed above, and a discussion followed.*)

Sir JOHN JORDAN (British Minister at Peking): I have listened to the paper to-night with very great interest, and I may say it was specially interesting to me because Mr. Wilton is one of the men in China who have a great craving for travelling, but for whose services there is always a strong demand at the Treaty Ports. It has always been a great difficulty with me to decide between the two things. In this particular case, he made his arrangements at home and escaped me very much in the same way as he escaped the Chinese Mandarin. But I am very glad, for otherwise this Society would have been deprived of the interesting paper to which we have listened this evening. As regards Yun-nan itself, I have never been there and I have no personal experience whatever of that particular part of the country. The Government at Peking has generally been strong in the north and centre of China and gradually gets weaker towards the circumference. Yun-nan is a case in point, and it is for that reason that the province has played a very important part in the history of China. It stood out for years against the Manchu conquest of China; it was the scene of the Panthay rebellion and was practically independent for a time; and a year or so ago the movement against Yuan Shih-Kai arose in that Province. General Tsai Ao left Peking one December morning, and the first we heard of him was that he had gone up the French railway to Yun-nan. He led those troops Mr. Wilton has shown you, and the result was the overthrow of Yuan Shih-Kai and the establishment of the present Government. Mr. Wilton spoke very kindly of the Yun-nanese and the treatment they gave him, but it is only forty years ago since Mr. Margary, a member of the Consular Service, in passing from Burmah to Yun-nan, was murdered. It is safe to say that at that time it was extremely dangerous to travel in those parts. The attitude of the natives towards foreign travellers has undergone a great improvement since those days. Mr. Wilton has also spoken about opium. I do not think he has been quite orthodox in his remarks. He himself has done a great deal to suppress opium. Apart from the great material changes that have taken place in China in recent

years, there are two great moral changes which I think deserve to be mentioned. When Sir Rutherford Alcock left Peking in 1869 or 1870, he told Prince Kung, the head at that time of the Chinese Government, that he was coming to England and asked what he could do for him. The reply was, "Take back your missionaries and your opium." That may not be quite authentic, but it indicates at all events the state of opinion at the time. All that has changed. At the present moment the missionary is welcomed in every part of China. During the recent upheaval there were many instances where a solitary missionary intervened between the rival factions and was able to do extremely good work. That, I think, is one of the great changes which has taken place in my time. Missionaries and all people who travel in the interior are now received in a way quite unknown as recently as twenty years ago. As regards opium, Mr. Wilton very wisely refrained from saying much on such a controversial subject—perhaps I ought to do the same—but I will say this much, that we have achieved far-reaching results during the last few years. After Lord Morley made his great speech on the subject in the House of Commons some ten years ago the Chinese Government came and told us that they wished for our assistance in suppressing the cultivation and import of opium. That assistance was given, and we have loyally co-operated with them for the last ten years. I am sure I am only saying what the Chinese themselves would admit, that they owe a great debt to the British Government for the assistance rendered. There can be no doubt that a great reform has been effected and that the Chinese are very grateful. I am afraid I can add only one point, with regard to the railways. It seems to me that railway construction in Yun-nan may come from the Yang-tse. There is already a concession from the Yang-tse down towards Yun-nan, and I rather disagree with Mr. Wilton on that point. I think the Yang-tse may eventually prove the best outlet for Yun-nan. Canton is the only part of Mr. Wilton's journey with which I am familiar. Hongkong has been a British Colony for the last seventy years. It is an immense distributing centre for British trade, but it does not seem to have exercised such a great influence on the mainland of China as we had a right to expect. That influence will come, I hope, in time when we have completed the railway from Hankow to Canton and established through communication from the British Colony to Peking. I can only conclude by expressing my great interest in the paper and thank the President for giving me an opportunity of saying these few words.

Sir FRANCIS YOUNGHUSBAND: We have heard an interesting account of a valuable and important journey; but I have risen this evening to express my apologies to our Society for having prevented Mr. Wilton from undertaking a still more valuable and important journey. I should like to explain to you the circumstances under which this was done. When Lord Curzon honoured me by asking me to undertake the mission to Lhasa, he told me to ask him for everything—officers, troops, money, or anything else which would ensure success. One of the first things which I asked of Lord Curzon was that he should obtain for me the services of a consular officer from China; I had travelled in China, I had had a number of dealings with the Chinese in Chinese Turkestan, and I knew from personal experience how important it was in dealing with the Chinese, as I should have to be doing in Lhasa, to obtain the services of a man who had been accustomed for many years to such dealings. Lord Curzon telegraphed to our Minister at Peking, and in due course Mr. Wilton appeared in my camp. I should like to take this opportunity of acknowledging the very deep debt I owe to Mr. Wilton for his valuable help on that occasion.

Mr. Wilton, as I dare say you observed this evening, is endowed with the great qualities of equanimity and coolness, and I cannot say how often I was able to benefit by those qualities as well as by his sagacity and tenacity of purpose in dealing with the Chinese, supplemented by those equally valuable qualities of understanding and appreciation of the opposite side of a case. You may have noticed in his lecture that Mr. Wilton said that he travelled for two years in Yun-nan, and yet did not remember a single case in which he had not experienced the good-will of the inhabitants of the country. When a traveller comes back and reports like that to this Society I think you may be pretty certain that the credit is not entirely due to the inhabitants, but that the traveller himself has something to do with it. When we were at Lhasa I found that Mr. Wilton, as our Minister at Peking has just said, was possessed of the craving for travel. I remember even there he used to talk to us about the Lolos, of whom he has been speaking—those curious inhabitants of Western China. When things began to go well, he came to me with a proposition that he should return from Lhasa direct to China in order to travel amongst his beloved Lolos. We then had two projects in view. We had the project of sending a party down the Brahmaputra into India, and another project of sending a party up the Brahmaputra to its source and returning to India by Simla. But there was room for a third project, and nothing seemed to be more natural than to ask leave of the officials in Lhasa for Mr. Wilton to return to China direct across Eastern Tibet instead of returning with us to India. And so I authorized Mr. Wilton to make arrangements with the Chinese, and Colonel O'Connor to make arrangements with the Tibetans for this purpose. The Tibetans and the Chinese by that time being in a good temper (probably at the prospect of our early departure from Lhasa), consented to allow Mr. Wilton to return. But unfortunately just afterwards I got information from India that a high Chinese official was to come to Calcutta to conduct some more negotiations with regard to Tibet. I then had the very unpleasant duty to perform —entirely on my own account, I must acknowledge—of asking Mr. Wilton to give up his journey and return with me to India, because his services had been so valuable in negotiating with the Chinese that I felt it was important for the Government of India to have them still at their disposal for treating with this official. I felt that in the public interests it was necessary that Mr. Wilton should return to India to help us. It was on that account that he was not able to undertake what would have been an exceedingly important journey from a scientific point of view, and one on which he had set his heart. At any rate, we have heard the account of a valuable journey, and I should like to thank Mr. Wilton for having given us so interesting an evening.

Captain SLACK: May I ask the lecturer if he could give us any further information on the projected line of railway from the Burmese line, say near Bhamo, to Yun-nan? It has been surveyed several times, I believe, sometimes favourably and sometimes unfavourably.

Colonel A. C. YATE: May I just say that when I went up in the winter of 1887-88 from Mandalay to the Kunlon Ferry on the Salween, there was also then seriously projected another railway which was intended to connect Burma with Yun-nan. This line, as I have always understood, has reached Lashio and gone no further. Perhaps the lecturer would tell us which of those two lines is most likely to be carried out. It is known that the Government of India had at one time a serious intention of connecting India by rail with the Yang-tse valley; and every member of the Royal Geographical Society is presumably well acquainted with the work to that end done by Colonel Davies.

He went up with us on that expedition from Mandalay to the Salween as a second lieut. of the Oxfordshire Light Infantry. The very important and thorough explorations which he carried out in China, with a view to giving the Government of India all possible information, are on record, and were recognized subsequently by the Murchison Grant of the Society.

Mr. W. S. LOCKHART: Mr. Wilton has given us some very interesting information with regard to the various peoples in Yun-nan. I should like to know if he has come across a people called Mainthas. When I was in Upper Burma great numbers of them came from some place supposed to be in Yun-nan, but nobody knew exactly where it was. They used to come down in batches of about five hundred at a time, and we used to employ them on mining and road-work. They came down in the early summer, and after staying some time returned to their own country to work their crops. Then next year they would come down again. They were fine, well-set-up men, blue coated, pig-tailed fellows, and splendid workers. They spoke no language but their own, but we used to get on with them and make ourselves understood. They were great opium smokers and inveterate gamblers. They did not mind what wages they earned so long as they could gamble in the evening and lose the money they had earned during the day or make some more. They could work at a great rate when they liked, but it was no use putting them on to piecework, as they simply rattled through enough for an ordinary day's wage and then went off to smoke and gamble for the rest of the day. Those were their only objects in life. We made them lines, but they would not live in them, preferring grass and sod huts, which they built for themselves and in which they could do as they liked without inspection. We always called them "Mainthas," and we understood they came from somewhere to the north of us, probably Yun-nan, but they were an interesting people, and if Mr. Wilton has heard of them I should very much like to know more about them.

Mr. E. C. WILTON: I want to thank Sir John Jordan and Sir Francis Younghusband, two of my chiefs, for their kind appreciation. With regard to Sir John Jordan's remark as to the railways in the northern part of Yun-nan, no doubt a concession has been granted for them, but that is very different to the construction, and I shall be surprised and delighted if a railway can be commercially successful in the very difficult country of northern Yun-nan unless there is a very satisfactory development of the mining industry of Yun-nan. On that satisfactory development I am absolutely certain railway enterprise in any part of the province must depend. With regard to the question of the Burma line, at the beginning of my paper I mentioned that the time at our disposal would not permit of an examination into the merits of the directions along the four lines that I named, and therefore I have expressly excluded any mention of the projected railways from Burma. I am afraid there is hardly time to go into the subject; it would take a paper of two or three hours to thrash the question out thoroughly. With regard to the Mainthas, these are no doubt western Yun-nan people, but from the description they appear to me to be probably Mohammedans. Mohammedans abound in the west of Yun-nan rather than in the east, and they are very fond of going about in gangs into Burma and hiring themselves out. They are excellent workmen, excellent with animals, and I believe they are employed very largely in the mines not only as miners but also as transport drivers.

The PRESIDENT: The time has now come to close the discussion and move a vote of thanks to Mr. Wilton for the valuable paper he has given us on this Chinese Province. I am glad we have been able to have in this

Session two interesting papers on the more remote parts of China. That country is rather at the back of the world's scene at the present moment. Even before the war, when I was at Peking three and a half years ago, the diplomatists and Europeans were complaining that it was difficult to get attention with regard to the affairs of the Far East because Europe was so much occupied with the politics of the Nearer East. I have myself no light to throw on China beyond that of the ordinary tourist. In his view one of the most striking facts is the entire neglect in which the beautiful old temples and monuments are left, even at the capital. The Temple of the Sun where the Emperor used to go to worship is weed-grown. Peking itself is a picture of ancient neglect beside the up-to-date spruceness of modern Japan. What the future of China will be must remain a mystery for our generation. She seems to have an extraordinary power of survival and to be now getting a firmer hold on some of her more remote Provinces. That Europeans should be able to travel in them, that railroads have spread far into the interior, must be of benefit to all. I hope we may within the next few years be able to welcome other travellers who will throw more light on the remote frontier lines between China and Tibet. I will ask you to join me in according a hearty vote of thanks to our lecturer.

MODERN METHODS OF FINDING THE LATITUDE WITH A THEODOLITE

John Ball, Ph.D., D.Sc., M.Inst.C.E.,
of the Survey of Egypt

Read at the Afternoon Meeting of the Society, 22 March 1917.

(*Abstract. The complete paper will be issued as a Special Publication.*)

Introduction.

THE methods most suitable for determining latitude in the field with an accuracy of a few seconds, by the use of an ordinary theodolite of 5-inch or 6-inch circles, are—

1. Altitudes of *Polaris* at any hour-angle, combined with circummeridian altitudes of a south star, the time being known.
2. Circummeridian altitudes of a pair of stars north and south of the zenith, the time being known.
3. Meridian altitudes of pairs of stars north and south of the zenith.
4. Equal altitudes of three stars.
5. Equal altitudes of two stars, one of which is observed on both sides of the meridian.
6. Equal altitudes of a north and a south star, the time being known.

The first two of these methods are those most commonly described in text-books of field astronomy, and most usually employed on exploratory and topographical surveys. The other four are less practised, but are all capable of yielding results of equal if not superior accuracy to the others,