projection you must know the focal length of the lens used in taking the aeroplane photograph, and you must also understand fairly thoroughly the principles of perspective, and so on, on which it is based. So that in the hands of anybody who does not know exactly what he is doing it may go wrong. With the enlarging camera apparatus I do not think you can make a mistake; provided you get your four points to agree exactly, you have a correct projection, and your print will be absolutely correct. The difficulty of focal length, I feel sure, is only a difficulty because we have not had time to work out the best methods of making the adjustments. With the French camera devised by Commandant Roussilhe, they say it takes four hours to make the adjustments for a single photograph, and I gather from this pamphlet that they have to do a good deal of preliminary calculation. I feel sure that four hours can be reduced a great deal. With our rough-and-ready method we found that by letting the focus go we were able to adjust each photo in about five minutes, but we never used any photographs which were not nearly vertical. If they were very distorted we rejected them and asked the Flying Corps to take others; they were very obliging in that way, and the quality of the photographs was, I consider, wonderful. I feel sure the difficulty of the focal length can be got over, and if it can I myself prefer the enlarging lantern as both quicker and more accurate than the camera lucida and entailing far less strain on the workman, which is an important consideration.

The CHAIRMAN: I think you will agree with me that we are indebted to Colonel MacLeod, not only for an extremely interesting paper, but for originating a very instructive discussion. I will ask you to pass a hearty vote of thanks to him.

A RECENT TRIP INTO THE CHUMBI VALLEY, TIBET

Lieut.-Colonel Sir Walter Buchanan, K.C.I.E., I.M.S., Calcutta

THE following account of a recent trip through the Chumbi Valley of Tibet describes this part of Tibet as it now is, and shows the changes that have taken place since the days of the Mission-Expedition of 1903–4, mainly due to the entire disappearance of Chinese influence.*

Up the Chumbi Valley to Phari Dzong.

The journey has not been done (except by the few Sikkim officials on duty and by a Calcutta artist) since the close of the Tibet Mission-Expedition under Sir Francis Younghusband and General S. R. Macdonald in 1903–4.

We arranged to go into Tibet by the Natu Pass (14,400 feet), to go up the Chumbi Valley to Phari, and come out by the well-known trade route over the Jelep La. We decided to take pack-pony or mule

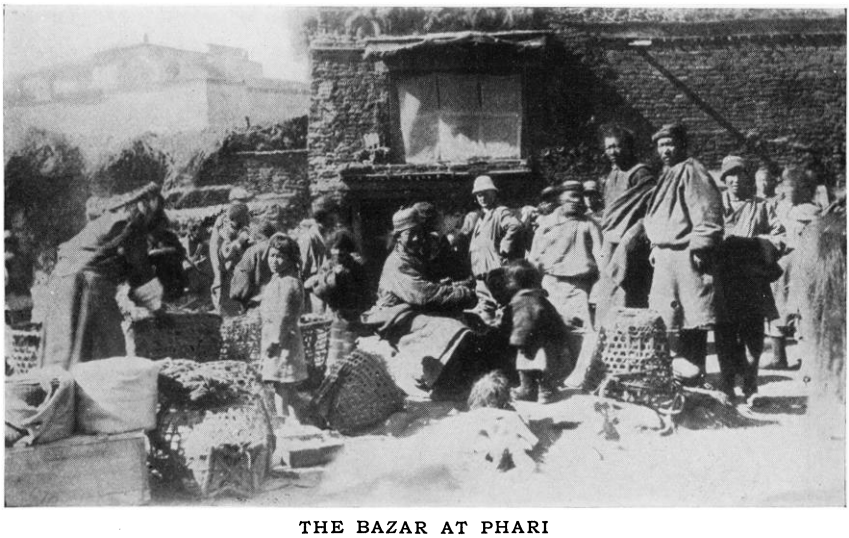
* For the Expedition, see admirable books by Colonel Waddell, P. Landon, and E. Candler; all are good, but for this portion of the way to Lhasa that of P. Landon is the fuller.

transport with us, and we found it on the whole much more satisfactory than coolies, whom we had employed on many trips through Sikkim.

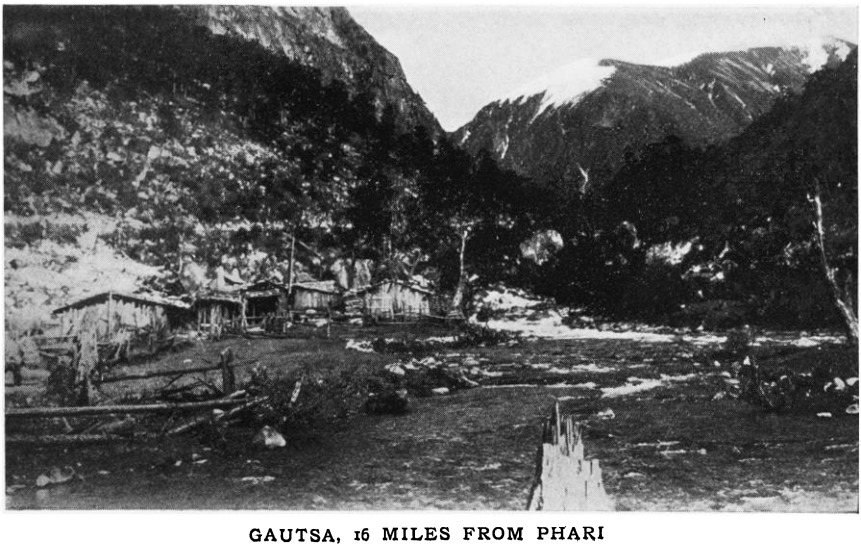
The road to Tibet starts from the rather shabby rest-house. After 5 miles we reach a small village called Lagyap, near which in the days of the expedition of 1903–4 a difficult pass had to be negotiated. This Lagyap Pass is not now used; a decent bridle-path now runs round the hill, and then on to the place (9500 feet) called Karponang, consisting of only a mule camping-ground and a small whitewashed rest-house (Karpo nang, "the White House," in Tibetan *). Next day we set out on a short march of 10 miles to Changu (12,600 feet). The first 3 miles are very rough, though possibly not so bad as in the Expedition days, when the "10th to 13th" mile were proverbial for badness. In several places the road has been cut out from the rocky cliff, with deep *Khuds* or precipices on the outer side, especially at a point between mileposts 13 and 14 (from Gangtok). This passed, we turn up the Changu Valley, which soon widens out till near the 15th milepost it divides into two, of which we take that on the right hand or east, and after crossing a log bridge keep along the left flank of this valley, parallel with the Changu torrent. The sides of the valley are lofty and rocky, while the river and the hills for several hundred feet up are densely covered with rhododendrons of all varieties—a sight which in the month of May must equal in beauty, or possibly surpass, the famous 30 miles of rhododendrons on the better-known tourist route from Tonglu to beyond Phallut, on the Nepal Boundary road. Near the 17th mile we see before us a ridge blocking the head of the valley, and a stream tumbling over it to form the Changu River. The path zigzags up to this ridge, which we find to be the end of a splendid lake, 1 mile long and 600 feet broad, bounded on the west by bare rocky hills, and on the east by a steep hill covered with rhododendrons to its summit. The road runs along the west bank to a small draughty wooden bungalow at the north end of the lake (12,600 feet). We had snow and sleet that afternoon, but next morning was fine and frosty. Starting early we soon reached the ridge beyond the lake, and got a close view of the Cho La (the "Chola Pass"), formerly the great route into Tibet, from which the Dikchu River (Ryott of Hooker) takes its rise. In early days, when the Sikkim Raj had its capital at Tumlong, the Rajas used to keep this road over the Cho La as their nearest way into the Chumbi Valley of Tibet, where they preferred to live and (like our early King Georges) treated it as a sort of Hanover. Near this pass Hooker and Campbell were captured by the Sikkimese in 1849. The road then runs over a level upland or alp and round a huge bay or amphitheatre (2 miles long); then on turning the corner the passes lie above us, and the road runs on the left side of a very deep gorge

* The name was given, it is said, by Landon, the *Times* correspondent. It has remained, though in strict Tibetan it should be *Nang Karpo*, cf. *Ta Karpo*, *Chorten Karpo*.

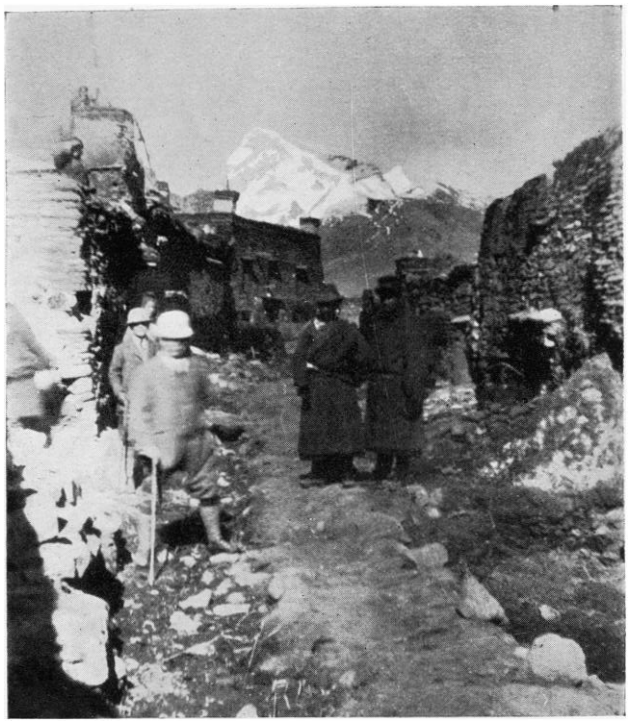
KAGIN MONASTERY ABOVE CHUMBI VALLEY ON WAY DOWN FROM NATHU LA



THE BAZAR AT PHARI



GAUTSA, 16 MILES FROM PHARI



THE MAIN STREET OF PHARI: CHUMALHARI IN DISTANCE

ON ROAD TO PHARI NEAR ANUNO: CHUMALHARI IN DISTANCE

which receives the drainage from the Natu Pass and the neighbouring hills (all about 14,000 to 16,000 feet). The way lay along the side of this deep gorge for about 2 miles, then zigzagged down to a small picturesque lake at the foot of the pass, at a place called on the maps Sherab or Sherabthang, a camping-place in Expedition days. From here a broad transverse stony valley runs along at the foot of the passes till it meets the road to the Jelep, 4 miles to the south-east. We keep up towards the Natu Pass, and soon reach a new signpost showing the way to Kapup (which is 2½ miles from the top of the Jelep Pass), and the way up the hill to the Natu. The better road, which existed in the expedition days, has been neglected, but a fair bridle-path exists which soon led us up to the milepost (G. 26 N.O.), which also for us marked the beginning of the deep snow. For a while the path was clear enough, till we reached a point from which we could see the cairn on the top of the pass. The road was now obliterated with snow, but two of us had been up twice before and knew that we could safely steer for the cairn at the top. From the pass could be seen part of the Chumbi Valley and Mount Chumalhari, beyond Phari in Tibet, and to the south the plains of Bengal and its winding rivers. On the Tibet side no road was visible till below the snowline several hundred feet down; but the snow was firm, and we stumbled, slid, and glissaded over it, now and then sinking up to our armpits when we got too near a rhododendron bush buried in snow. Our animals followed us laboriously, but an hour's time saw us on the clear track below the snow. The road descends rather rapidly, so soon we reached the pine forests, and 5 miles from the top of the pass we came to the picturesque Swiss chalet-like wooden bungalow of Champithang (about 13,000 feet alt.), an excellent rest-house with plenty of fuel for the fires. We were in Tibet and beyond the rain, fog, and mist of monsoon-drenched Sikkim.

Below us lay the Chumbi Valley and the River Amochu; to the south-east the huge snow-covered ridge which divided us from the neighbouring pass, the Jelep.

From Champithang to the Chumbi Valley the road runs downhill, at first in easy gradients. About a mile below the rest-house we had a grand view of the pyramidal peak of Chumalhari, and on looking back a fine view of the Natu Pass from the Tibet side. Further down we see in a deep valley on the right, the ruins of the houses and barracks which once were *old* Yatung. *Old* Yatung was the place where Sir Francis Young-husband's Mission, after crossing the Jelep, met with a feeble show of resistance. It is a very narrow part of a valley, quite unsuitable for a camp or place of residence. The old Chinese barracks still remain, roofless and ruined. The name Yatung is *now* given to "New Chumbi," the residence of the British Trade Agent situated 6 or 7 miles up the Chumbi Valley, in a fine open space to be described below. "Old Chumbi" is the name of a small village in the valley, on the Amochu and close by the *present* Yatung.

About 3 miles out we pass over a bad landslip, and a mile further on we reach a point with a magnificent view of the Chumbi Valley and of the bright green sparkling waters of the Amochu River, as it makes for the pass into Bhutan, which it traverses to become, in the Duars, the Torsa River, and join the Bramaputra in the plains of Bengal. This is the destined line of the locomotive should time ever lead to the necessity of another expedition into Tibet. Looking back from here we can see the two great passes, the Natu (over which we have come) and the Jelep by which we were to return, both snow covered (October 21). A few minutes later we catch sight of three *Chortens* on a ridge above the important monastery of Kajui (or Karjui). We are now well out of the forest, and leaving pines and junipers we descend over bare grassy hills to the Kajui Monastery, where we were hospitably entertained by the Lamas to the inevitable salted tea, and shown over the buildings. The Buddha statues were very good, as also were the pictures on the temple walls.

Very soon after leaving Phema (or Chema) and crossing a bridge we came to the remains of what was till recently a flourishing Chinese town called Pibitang. It is practically deserted and in ruins; all trace of China is gone, except for some Chinese characters still clinging to the walls and a few coloured drawings of fearful Chinese warriors in mail armour, with moustaches as fierce as their daggers!

Leaving this bit of old China, we rode along a level but rough stony road and passed through "Old Chumbi," a few houses, among which are the remains of what was once the palace of the Rajas of Sikkim. On passing old Chumbi the valley opens out, the road still keeping close to the Amochu River. We pass a tiny village known as Eusakha, and in a few minutes are in New Yatung, the headquarters of the British Trade Agent.

Most of modern Yatung lies on the east bank of the Amochu, which runs clear and glittering through the town. The valley here is wide, and there is ample room for the small bazar, the offices and residence of the Trade Agent, and for a row of barracks for his guard and escort. Supplies are available from a Commissariat overseer, who keeps them for the use of the few officials going on to Phari, and to our small garrison at Gyantse, where another British Trade Agent resides.

The altitude of (new) Yatung is 9780 feet above the sea-level. The minimum temperature in the end of October was only 42° Fahr., but it falls to 20° Fahr. in the winter. In the summer the climate is superior to anything in the Darjeeling Hills or in Sikkim. European vegetables of all kinds can be grown and many kinds of fruit (especially apples). There is a British Post and Telegraph Office, a dispensary, and even a long-distance telephone to Gyantse. Half a mile beyond Yatung the valley divides; one branch, the Kambo Valley, leads up to some hot springs, which are locally celebrated for their virtues, even by the never-washing Tibetans.

We keep up the main valley (to the right) following the Amochu River, past a small bridge leading to a little Gumpa or temple across the river. Soon the valley narrows; on the left are high precipitous rocks, 1000 feet above us, on top of which is another *Gumpa*, not unsuitably named Gab-Dzong (or the Vulture's Fort), and round the corner a place famous in the Expedition days, called Chortenkarpo (the white Chorten). The road and river wind through a narrow gap, "where half a hundred might well be stopped by three," and indeed a half-hearted attempt was made to stop Sir Francis Younghusband's party at this place. A wall with a gate used to run down to the river on both sides; now both are gone, only a few bits of the walls remain, with the remains of the Chinese barracks, on the right, where once a Chinese garrison guarded the pass. All is now in ruins; the stone houses stand; the woodwork has been removed, but on the walls of the chief house are still to be seen pictures of painted emperors and fierce armour-clad warriors.

Close by the big prosperous village of Galingka we passed a long string of mules and pack-ponies coming down with wool from Lhasa, and stopped to have a talk with a traveller (a well-known man and a "Khan Sahib") who was journeying from Lhasa back to Ladak, and found it easier to return *viâ* Chumbi, Darjeeling, India, and Kashmir than to face the long trek across Tibet to his home in far-off Ladak. Galingka is well situated and is a typical Tibetan village. Many of the houses are substantial, stone walled, and roofed with shingle, held in place by huge stones. The long flat Lingma plain (Lingmathang), described by all writers on the Expedition of 1903–4, was covered with thick long grass, and as we went up was absolutely deserted; on our return a few days later the whole was covered with black yak-hair tents (we counted 150), and hundreds of people were cutting the grass and carrying it away on mules and ponies; a busy harvest scene, which we did not expect in this austere land. At this point upper "Tromo" or *upper* Chumbi begins; Lammergayers (*Gypaetus barbatus*) flying aloft, like small aeroplanes, to use a very modern simile.

At the north end of this flat plain the valley is blocked by a huge rock, the "Ta Karpo" of the Expedition, a bare conical mass. The Amochu, recently so swift and smooth in the plain, becomes again a fierce torrent. We cross a bridge to the other bank (right) and go up a long rocky defile or canyon to the rest-house at Gautsa, "the plain of gladness," an open short valley where the river divides to flow round some jungle-covered small stony islands, some of which were even cultivated by the few inhabitants of this small village. Gautsa is an important halting-place for the wool-laden pack-mules, and on this day's march we happened to count the animals carrying wool down to the railway and mart near Kalimpong. They numbered as many as 360.

The road for Phari ascends at once after leaving the village and reaches another deep black canyon. It is so rough that only a mule or

a "Bhutia" pony could be ridden over it or carry a load. After some 3 miles we leave the canyon, the valley widens, the road runs on the right bank high above the river which roars in a deep gully below. We rapidly descend to a small flat plain (13,300 feet), called Dotag, an earlier formation on a smaller scale like the Lingma plain below. Across the plain is the "Frozen Waterfall" of the Expedition. It was not frozen when we passed it (October 25 and 29), but the bare hills all round were snow-covered. In the winter days of the Expedition this otherwise admirably flat camping-ground was known as the "coldest spot in Asia"!

Riding for some 3 miles through a widening valley we are at Kamparab and on the edge of the great plains of Tibet.

We have left Himalayan scenery behind, and the Chumbi valley. We soon caught sight of Phari with its dzong or fort, and were at first puzzled by the long rows of black lines around the walls of the fort. These on nearer view were found to be the black walls of the turf-sod houses which comprise the town of Phari, the highest (altitude 14,570 feet), the most dirty and the quaintest town in the world, higher by some hundred feet even than the villages in the higher Andes.

We arrived at an auspicious moment in the middle of a "harvest home." All round the dzong and the town were loose heaps of earless barley-straw; dozens of men, women and children were busy packing up huge bales of straw and carrying them to be stacked on the flat roofs of their turf-walled houses, these being the only places where the valuable fodder could be stored safe from the numerous mules, ponies and yaks which were grazing round the town. This earless barley is useless as a human food, but it is much needed as fodder for the mules and ponies which carry the wool from Lhasa to the Indian market. The people obtain their grain for food mainly from Bhutan over the neighbouring pass, the Tremo La. It was over this Bhutan Pass (Tremo La) that Warren Hastings' agents, Bogle and Turner, as well as the eccentric Manning, entered Tibet.

The Phari fort is a strong stone square building on a slight elevation above the town, which surrounds it more or less, and especially on the south. Manning, who arrived at Phari in the same week in October, 1811, as we did in 1917, described it in his disjointed diary in four words, "dirt, dirt, grease, and smoke," and it cannot be said that the passage of one hundred and six years has rendered this terse description any the less applicable. The fort is said to be of Chinese origin; it has been repaired since the Expedition of 1904, and the inside has been (to judge by the descriptions of 1904) considerably altered. The town is very quaint; the dirt of ages lies around, and snow persisted since the previous winter in many corners. The floors of the black sod-huts are generally below the level of the ground, and are entered by a couple of steps from the road. This may be due to their being warmer by being so made, though most travellers have attributed it to the raising of the

road outside by the accumulated filth of ages. There are generally no windows, the door and the smoke-exit in the roof sufficing for ventilation, but two or three of the more important houses had a window covered with China paper. In spite of all these sanitary defects (as we would call them) the people generally are healthy and sturdy. Goitre is very rare, and this in marked contrast (we were told) to its prevalence in the neighbouring Bhutan valley of Paro. Sore eyes were very common among the bright and intelligent children, but adults seem to have outgrown that trouble, which is, of course, produced by dirt and the irritating smoke of the yak-dung fires.

The views from Phari are splendid. The plain is surrounded by distant low hills, mostly snow-topped. The grand mountain of Chumalhari (23,960 ft.) on the north-east towers 9000 feet above the fort and town, like the Matterhorn above Zermatt, and is quite close (some 6 miles off). As we stand with our backs to Chumalhari, there lie before us the northern aspects of the great Dongkya Peak (as Hooker always calls the great hill known on the maps as Pawhunri) and part of Chomiomo. To the south through a gap in some lower hills we saw the snow-covered Bhutan Mountains (Masongchongdrong). Due north across the plain we see the small monastery, Chatsa, and beyond it the open smooth pass called the Tang La, 15,200 feet, on the way to Gyantse and Lhasa, near which was the first unexpected fight with the Tibetans in 1904. To this spot some of our party rode during our stay at Phari; it is about 9 miles off, and on reaching it the syces raised the well-known cry "*Ki ki so so Cha Gyal lo*" as they topped the pass. From here in the distance could be seen herds of the kyang or untamed wild ass of Tibet (*Equus hemionus*). One of these kyangs captured while young was purchased for £25 by one of our party, who is President of the Calcutta Zoo. The animal was safely brought to Calcutta, and after one year there through a Calcutta hot weather, is fat and flourishing, though its *habitat* is 14,000 feet and over. Having spent three days in this fascinating place we had to return, and in two days reached (new) Yatung again.

The road from old Yatung up to the Jelep rises 5000 feet, and is extremely bad. It is extraordinary that so bad a road can be used as the main trade route from Tibet to India. No wonder we were told of the short lives of the mules that have to carry heavy loads up it. We can only attribute this to the "forbidden land" policy, which still governs our dealings with Tibet, with Bhutan, and with Nepal. About halfway to the pass is a Tibetan rest-house, where we halted till our laden mules and servants got up. Just as we reached the cairn which marks the top of the pass and re-entered Sikkim we were met with a cold deluge of snow and sleet, which turned soon to rain and thoroughly drenched us before we reached the new but small uncomfortable two-roomed bungalow, 2½ miles from the Jelep, at Kapup (altitude 13,000 feet). All Sikkim bungalows have beds and accommodation for four travellers. It is strange

that this *new* bungalow should have only two small rooms and two beds, a very weak link in a chain of excellent rest-houses.

A mile or so past Gnatong begins the very steep rough causeway which runs down the side of Mount Lingtu to Sedongchen. In a few days we reached Rikyisum, a beautifully situated bungalow with a glorious view of the snows, 12 miles from Kalimpong, and here ended the best short holiday we have had in India.

POPULATION CHANGES IN THE EASTERN PART OF THE SOUTH WALES COALFIELD

A. E. Trueman, D.Sc., F.G.S., University College, Cardiff

THE eastern portion of the South Wales coalfield, including parts of Glamorganshire and Monmouthshire, has developed during the past century from an almost exclusively agricultural region into one of the busiest industrial regions in the country, the population of Glamorgan increasing from 70,879 in 1801 to 1,120,910 in 1911. This rapid development was at first due to the iron trade, and later to the expansion of the coal export trade. These were affected in a very striking manner by the facts of mineral distribution, but also by the relief and the facilities for communications. These factors have exercised a marked influence on the rate of development of the various parts of the area, causing remarkable difference in the population even in adjoining parishes, so that while the district dealt with is generally considered to be a densely populated industrial region, several agricultural areas of scanty population also occur. It will be convenient to consider first the leading geographical factors which have influenced the changes in population, the development of the district will then be best treated historically.

The district represented on the map (Fig. 1)* falls naturally into two divisions, the coalfield on the north (*Blaenau Morganwg*), and the area outside the coalfield on the south (*Bro Morganwg*). The coalfield consists of a plateau of Pennant Sandstone, reaching to an average height of 800 feet in the south and 1500 feet in the north, deeply trenched by the parallel valleys of the rivers Rhondda, Cynon, Taff, Rhymney, Sirhowy and Ebbw.† The southern rim of the coalfield is marked by several escarpments through which the rivers have cut steep-sided gorges, like those of the Taff at Tongwynlais, the Rhymney at Machen, and the Ebbw at Risca.‡ Before the development of the coal and iron trades, the

* This district is included in sheets 248, 249, 262 and 263 (1-inch) of the Ordnance Survey.

† A. Strahan, "On the Origin of the River-system of South Wales," *Q.J.G.S.*, vol. 58 (1902), p. 207.

‡ See F. Dixey and T. F. Sibly in *Q.J.G.S.*, vol. 73 (1918), plate 13.