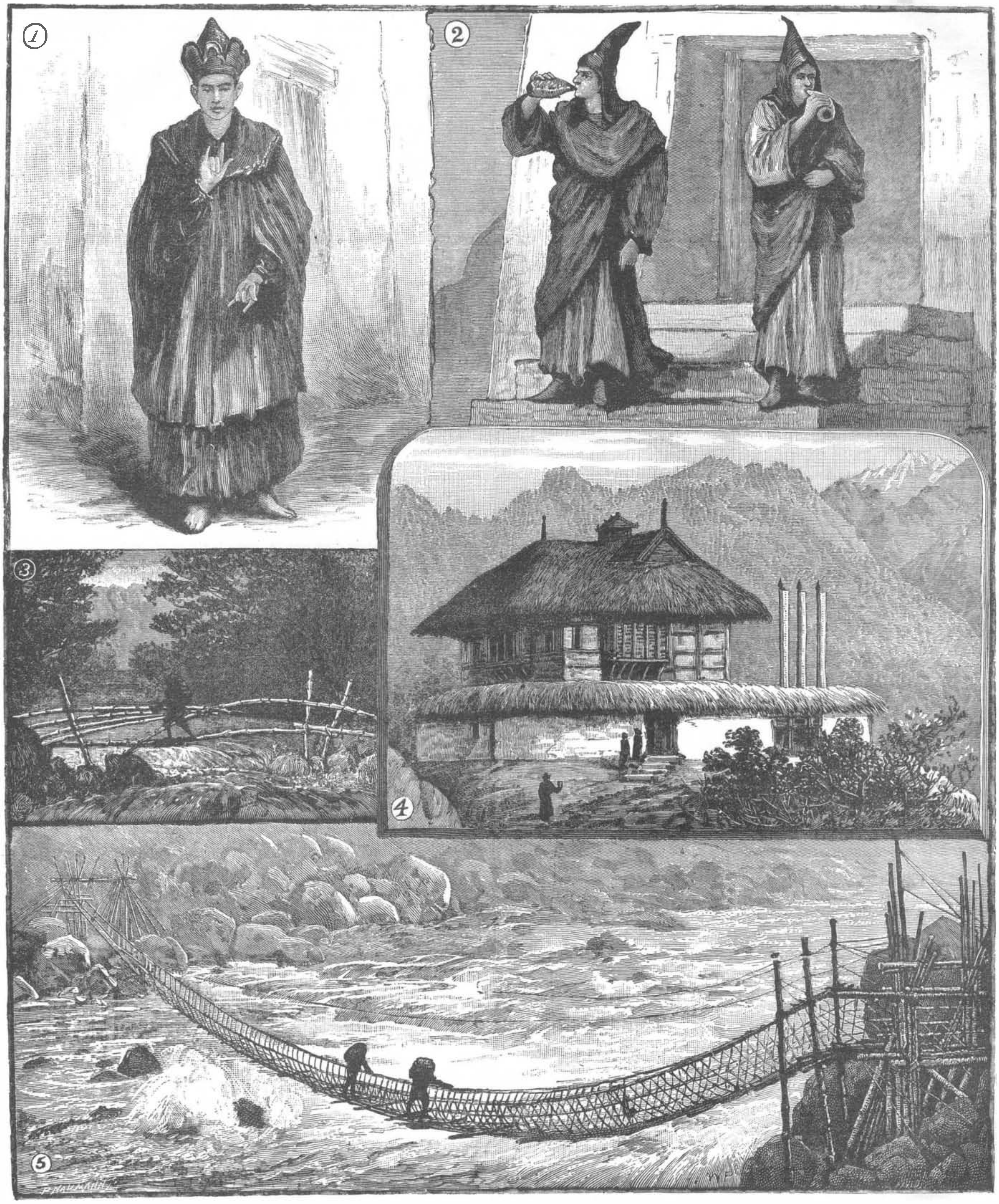
SKETCHES IN THIBET.

By Colonel C. J. Cramer Roberts.

The Himalayan mountain territory and small native state of Sikkim, adjacent to Darjeeling and Bhotan, on the northeastern frontier of India, was recently described as the scene of military operations conducted by Colonel Thomas Graham, Brigadier-General, to repress the Thibetan incursions. It was explained that the Rajah of Sikkim, whose feudal allegiance is divided between the British imperial government and the Dalai Lama or Buddhist ecclesiastical sovereign of Thibet, has a Thibetan residence at Chumbi, on the farther side of the frontier mountain range, and a Sikkim capital at Tumlong. We are favored by Colonel C. J. Cramer Roberts with a few sketches of Tumlong and the peculiar establishments maintained there, which have some interest from their Thibetan origin and character, and of which he writes to us as follows:

Tumlong, on the occasion of my visiting the capital of Sikkim, a few years back, I was much surprised to find a mere scattered collection of lamaseries or Buddhist monasteries on the hillside; among which the rajah's palace was distinguished by a copper gilt cupola on the top of its heavy thatched roof. It was surrounded by a more pretentious mud wall, inclosing the servants' or lay brothers' dormitories, the stables, and outbuildings. The main building consisted of the usual two-storied temple, the lower apartment forming a strange combination for devotional and secular purposes, as prayers and receptions are equally carried on here by the rajah and his head lamas. The upper room was almost a duplicate of the one below, except that it formed also a library, in which every volume of their sacred books had a pigeon hole to itself. The rest of the building consisted of dark passages and small dormitories, redolent of strange and powerful smells. I was fortunate in getting the head lama of one of the leading monasteries to have his portrait sketched, to which he willingly consented, on the distinct understanding he should be drawn in the attitude of prayer or blessing, being most particular that all his fingers were correctly represented, and that his acolytes or heralds should also be drawn in their picturesque caps and vestments, blowing conches, by which the faithful Buddhist far away on the mountain side is reminded of the hour of prayer. Occasionally they exchange these sea conches for human thigh bones, which are equally adapted as trumpets, and can be heard at a great distance. The last sketch of this series represents the great cane suspension bridge over the Teesta River, which on its way collects most of the tributary streams ever rushing down from the



1. Head Lama of the Changachilling Monastery at Tumlong, Sikkim. 2. Heralds of the Monastery calling out hours of prayer. 3. Light bamboo-cane bridge. 4. The Rajah's Palace, Tumlong, Sikkim. 5. Great cane bridge over the Teesta River.

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great glaciers of the Kinchinjunga range, and is even here a powerful stream, sweeping down everything before it—bowlders, giant forest trees—in its headlong course. This fragile fabric of a bridge, which appears as if the very winds could blow it away, is the only means of communication that the natives of this part of the country possess. It consists chiefly of tough wattles or small bamboos, closely interlaced, and capable of supporting two or three ordinary coolies with good heavy loads on their backs. But these bridges require a cool head to cross over them, as the footway is seldom more than six inches wide; in fact, were it not for the slender bamboo handrails, it would require the nerve of a Blondin to venture on such a spider-webbed concern, swayed about by the breeze over the torrent roaring below.—*Illustrated London News.*

WEIGELA (BUSH HONEYSUCKLE).

THE weigelas have long been in the front rank of flowering shrubs; they are deservedly popular everywhere, being elegant, rapid in growth, and beautiful when in bloom. There is now a multitude of varieties, the originals of which are W. grandiflora, known also as W. amabilis; W. rosea, W. floribunda, and W. hortensis. These type species are natives of China and Japan, whence they have been introduced within the last forty years. They have been so much hybridized that the original kinds are rarely found pure. The most valuable sorts have sprung from W. grandiflora, which has the largest flowers, while the smaller but more numerously flowered kinds have originated from W. rosea and W. floribunda. The varieties have been raised chiefly on the Continent, as may be inferred from their names. A selection of the best kinds of weigela include the following: Abel Carriere, flowers small, very numerous, and deep red. Isolinæ, flowers large, white, or pale rose, with yellow markings. Van Houttei, flowers white and red, large and showy. Lemoinei, flowers small, numerous, deep crimson red. Groenowegenei, one of the best, the flowers being large, pale rose or pink, with yellow blotch. Striata, a very pretty sort, with flowers striped red and white. Stelzneri, flowers numerous, deep red. Lavallei, crimson red, and numerous. Hortensis nivea (see illustration), growth more spreading than that of others, foliage larger and paler, flowers large and pure white. Candida resembles the last, but is superior. These last two should always be selected, and if a larger collection is needed, the following may be added: Carminea, Emile Galle, Docteur Baillon, Edouard Andre, Aug. Wilhelm, Diderot, Montesquieu, and Desboisi. The golden-leaved W. Looymansi aurea is a very fine ornamental shrub that usually retains its bright golden foliage through the season, and the variegated-leaved form is also an excellent kind. All the above are of good habit of growth if planted in good soil in an open position to enable them to grow freely. They should never be crowded, their proper place being as isolated groups on lawns or on the margins of shrubberies. Where weigelas flourish they make large, symmetrically shaped specimens from 6 to 10 feet high and as much in diameter, with gracefully drooping branches, which, even when leafless in winter, are ornamental. Attention should be paid to top dressing them with good rich soil annually, and to pruning them well, so as to retain only the vigorous stems and branches that yield the finest bloom. Weigelas are now known botanically under the genus Diervilla, which also includes other species, D. sessiliflora and D. trifida, from North America, being among them, but neither of these is, in its present stage, to be recommended for general cultivation, though they are worth planting on account of the bright tints of their autumn foliage.—*The Garden.*

WEIGELA HORTENSIS NIVEA.

THE FOUNDATION STONES OF THE EARTH'S CRUST.

THE Monday evening discourse during the recent meeting of the British Association was delivered by Prof. T. G. Bonney, D.Sc., F.R.S., who commenced an interesting lecture by asking, Do we know anything about the earth in the beginning of its history—anything of those rock masses on which, as on foundation stones, the great superstructure of the fossiliferous strata must rest?

Paleontologists, by their patient industry, have deciphered many of the inscriptions, blurred and battered though they be, in which the story of life is engraved on the great stone book of nature. Of its beginnings, indeed, we cannot yet speak. The first lines of the record are at present wanting—perhaps never will be recovered. But apart from this, before the grass and herb and tree, before the "moving creature in the water," before the "beast of the earth after his kind," there was a land and there was a sea.

Do we know anything of that globe, as yet void of life? Will the rocks themselves give us any aid in interpreting the cryptogram which shrouds its history, or must we reply that there is neither voice nor language, and thus accept with blind submission, or spurn with no less blind incredulity, the conclusions of the physicist and the chemist?

The secret of the earth's hot youth has doubtless been well kept. So well that we have often been tempted to guess idly rather than to labor patiently. Nevertheless we are beginning, as I believe, to feel firm ground after long walking through a region of quicksands; we are laying hold of principles of interpretation, the relative value of which we cannot in all cases as yet fully apprehend—principles which sometimes even appear to be in conflict, but which will some day lead us to the truth.

The name Cambrian has been given to the oldest rocks in which fossils have been found. This group forms the first chapter in the first volume, called Paleozoic, of the history of living creatures. Any older rocks are provisionally termed Archæan. These—I speak at present of those indubitably underlying the Cambrian—exhibit marked differences from one another. Some are indubitably the detritus of other, and often of older, materials—slates and grits, volcanic dust and ashes, even lava flows.

Such rocks differ but little from the basement beds of the Cambrian; probably they are not much older, comparatively speaking. But in some places we find in a like position rocks, as to the origin of which it is more difficult to decide. Often in their general aspect they resemble sedimentary deposits, but they seldom retain any distinct indications of their original fragmental constituents. They have been metamorphosed, the old structures have been obliterated, new minerals have been developed, and these exhibit that peculiar orientation, that rudely parallel arrangement, which is called foliation. That these rocks are older than the Cambrian can often be demonstrated.

Sometimes it can often be proved that their present distinctive character had been assumed before the overlying Cambrian rocks were deposited. Such rocks, then, we may confidently bring forward as types of the earth's foundation stones. I must assume what I believe few, if any, competent workers will deny, that certain structures are distinctive of rocks which have solidified from a state of fusion under this or that environment; others are distinctive of sedimentary rocks; others again, whatever may be their significance, belong to rocks of the so-called metamorphic group.

Our initial difficulty is to find examples of the oldest rocks in which the original structures are still unmodified. Commonly they are like palimpsests, where the primitive character can only be discerned at best faintly, under the more recent inscription. Here, then, is one of the best which I possess—a Laurentian gneiss from Canada. Its structure is characteristic of the whole group; the crystals of mica or hornblende are well defined, and commonly have a more or less parallel arrangement; here and there are bands in which these minerals are more abundant than elsewhere.

The quartz and the feldspar are granular in form; the boundaries of these minerals are not rectilinear, but curved, wavy, or lobate; small grains of the one sometimes appear to be inclosed in larger grains of the other. Though the structure of this rock has a superficial resemblance to that of a granite of similar coarseness, it differs from it in this respect, as we can see from the next instance, a true granite, where the rectilinear outline of the feldspar is conspicuous.

Here, then, is one of our problems. This difference of structure is too general to be without significance. What then does it mean?

Among the agents of change known to geologists, three are admittedly of great importance; these are water, heat, and pressure. The first effect of pressure due to great earth movements is to flatten somewhat the larger fragments in rocks, and to produce in those of finer grain the structure called cleavage. This, however, is a modification mainly mechanical. It consists in a rearrangement of the constituent particles, mineral changes, so far as they occur, being quite subordinate. But in certain extreme instances the latter are also conspicuous.

From the fine mud, generally the result of the disintegration of feldspar, a mica, usually colorless, has been produced which occurs in tiny flakes, often less than one-hundredth of an inch long. In this process a certain amount of silica has been liberated, which sometimes augments pre-existing granules of quartz, sometimes consolidates independently as micro-crystalline quartz. Simultaneously carbonaceous and ferruginous constituents are converted into particles of graphite or of iron oxide.

As to the effects of pressure when it acts upon a rock already crystalline, there are, as it seems to me, differences in the resultant structures which are dependent upon the mode in which pressure has acted. They are divisible into two groups, one indicating the result of simple, direct crushing, the other of crushing accompanied by shearing.

In the former case, the rock mass has been so situated that any appreciable lateral movement has been impossible; it has yielded like a block in a crushing machine. In the latter a differential lateral movement of the particles has been possible, and it has prevailed when (as in the case of an overthrust fault) the whole mass has not only suffered compression, but also has traveled slowly forward.

Obviously the two cases cannot be sharply divided, for the crushing up of a non-homogeneous rock may render some local shearing possible.

To sum up the evidence. In the oldest gneissoid rocks we find structures different from those of granite, but bearing some resemblance to, though on a larger scale than, the structures of vein granites or the surfaces of larger masses when intrusive in sedimentary deposits.

We find that pressure alone does not produce structures like these in crystalline rocks, and that when it gives rise to mineral banding this is only on a comparatively minute scale. We find that pressures acting upon ordinary sediments in Paleozoic or later times do not produce more than colorable imitations of crystalline schists. We find that when they act upon the latter the result differs, and is generally distinguishable from stratification foliation. We see that elevation of temperature obviously facilitates changes and promotes coarseness of structure. We see also that the rocks in a crystalline series which appear to occupy the highest position seem to be the least metamorphosed, and present the strongest resemblance to stratified rocks. Lastly we see that mineral change appears to have taken place more readily in the later Archæan times than it ever did afterward.

It seems, then, a legitimate induction that in Archæan times conditions favorable to mineral change and molecular movement—in short, to metamorphism—were general, which in later ages have become rare and local, so that, as a rule, these gneisses and schists represent the foundation stones of the earth's crust.

On the other side what evidence can be offered? In the first place, any number of vague or rash assertions. So many of these have already come to an untimely end, and I have spent so much time and money in attending their executions, that I do not mean to trouble about any more till its advocates express themselves willing to let the question stand or fall on that issue.

To a geologist (especially one belonging to the school of Lyell) it is equally difficult to conceive that there should be a broad distinction between the metamorphic rocks of Archæan and post-Archæan age, respectively, as that the pre-Tertiary volcanic rocks should be altogether different in character from those of Tertiary and recent times.

During the periods mentioned volcanic rocks appear, as we should expect, to have been ejected from beneath the earth's crust similar in composition and condition, and to have solidified with identical environment. Hence the results, allowing for secondary changes, should still be similar. But to assume that environment of a rock in early Archæan times was identical with that of similar material at a much later period is to beg the whole question.

My creed also is the uniformitarian, but this does not bind me to follow a formula into a position which is untenable. "The weakness and the logical defect of uniformitarianism," these are Professor Huxley's words, "is a refusal, or at least a reluctance, to look beyond the 'present order of things' and the being content for all time to regard the oldest fossiliferous rocks as the *Ultima Thule* of our science."

Now, speaking for myself, I see no evidence since the time of these rocks, as at present known, of any very material difference in the condition of things on the earth's surface. The relations of sea and land, the climate of regions, have been altered, but because I decline to revel in extemporized catastrophes, and because I believe that in nature order has prevailed and law has ruled, am I, therefore, to stop my inquiries where life is no longer found and we seem approaching the first fruits of the creative power?