

for the induced current are similarly electrically connected. In constructing the secondary coils, they are fixed together between two insulating surfaces by bolts and nuts, the projections by which the several conducting disks are connected projecting helically or spirally around the coil (the projections of the primary alternating with those of the secondary coil), and form convenient means for connecting up any number of convolutions as required.

The end disks of one of the helices thus formed are connected to the leads of the primary circuit by binding-screws, and the end disks of the other helix are similarly connected to the leads for the induced or secondary current. In the centre of the disks is a hollow cylinder of paraffined cardboard or other suitable insulating material, around which the helices are arranged, and in this cylinder is a core of soft iron, or of soft iron wires, which is capable of being automatically raised and lowered in the cylinder, so as to regulate as required the current passing through the coil.

The main wire from the dynamo is connected up in series to the primary helices of a group of secondary generators, and, in passing through the primary helices, induces a current in the secondaries, the tension of which, according to the experimental investigations of the inventors, increases first with the intensity or quantity of the primary current, and, secondly, with the rapidity of the interruptions or alternations, or the variations of its potential. Each secondary generator forms a complete installation, and can be put in or out of circuit at pleasure. The secondaries may be connected up in series, in multiple arc, or in multiple series, as desired, the connections being readily altered by means of a switch-board; tension or quantity is thus obtained according to the nature of the current required. The lamps or other receivers fed from the secondary generator can be connected at will to their respective circuits, and are also independent of one another.

These generators are made to work in connection with alternate-current machines, because the latter can be constructed up to almost any power, as no two parts of the machine having great difference of potential need be in close proximity, and the alternation of current may be made as quickly as desired. The generating dynamo is so constructed and operated that the quantity of current is preserved constant, and the tension is varied to carry this current through the primary conductor against the varying counter electromotive force due to variations in the work done in the secondary circuits of a number of secondary generators. If W represents work, C current, E electromotive force, and R resistance, and if either of these factors be changed, the others must be altered in the same ratio, according to the formula—

$$W = CE = C^2R = \frac{E^2}{R},$$

if uniform effects in the secondary circuits are to be desired.

One of the chief characteristics of this system is that if the primary current be kept constant the loss due to resistance remains fixed, no matter what energy is transmitted—so that if an increase of energy is desired, the only factor that has to be increased is the electromotive force, which bears no ratio to the loss in the conductor. This circumstance is of importance in any house-to-house lighting scheme, where a conductor may be laid down to supply a certain area, and if the lights are not taken up at once, the necessary current can be supplied later within the limits of the dynamo, by increasing the electromotive force, without increasing the size of the conductor, the strength of the current, or the loss in the line.

As regards the very high potential required upon the secondary generator system, the danger is limited to the supply station, as between the two poles of the main

dynamo there is an unbroken metallic circuit, which maintains the continuity of the flow of current; and as regards each secondary circuit the work done is represented by a secondary generator, and the only danger would be in grasping both primary terminals at once, which may be made impossible of performance. It will be necessary as regards the dynamo that it shall be insulated from the earth, and also that such parts of the circuit as carry high tension electricity shall be so protected that it shall be impossible to make contact between them and the earth.

In comparing this system, in which there is a loss in the transformation of the energy by the secondary generator, with the direct system, this loss will have to be balanced against that caused by resistance due to distance, whilst as regards the regulation of the supply of energy, this is effected by means of a regulator working the exciting machine of the dynamo at the station; by its means, when a secondary generator is cut out of circuit, a proportionate amount of power is saved. The secondary generators also regulate the energy absorbed, so that a perfect control of power is obtained, which is especially important for domestic supplies of electricity, as, when a suitable current measurer has been designed, consumers will be able to pay simply according to the amount consumed.

At present the extreme northern end only of the East Arcade at the Exhibition is being lighted on this system; it is proposed, however, to extend it to the full length of the East Arcade and to the concert-room.

THE AFGHAN DELIMITATION COMMISSION

WE are indebted to the courtesy of the Kew authorities for the opportunity of publishing the accompanying letter from Surgeon-Major Aitchison, C.I.E., F.R.S., which gives the most recent account of his work as naturalist to the Expedition:—

*Camp Tir-Phul, Northern Afghanistan,
6 miles from Khusan*

DEAR SIR JOSEPH HOOKER,—

I am now able to write to you with some pleasure, as I have been able to put together this year some 300 species in all. The last 100 I obtained on a ten days' trip that I made from this camp. I left this on April 25 under very bad auspices, as it had blown all night and was blowing a terrible gale with every chance of a heavy fall of rain from the north. But I started and got as far as Khusan, in the vicinity of which, beside the ruins of an old "serai," I halted. I picked up a few odds and ends, the chief attraction was the *Rosa margerita* (if a new sp.) *mihl*. It covers the whole country in localised patches, and being very dwarf in habit, not above 2 feet, the flowers are seen to perfection; they open out expanding almost flat, when the brilliant eyes, formed by the claret colour of the bases of the petals, gives it quite a character. Amongst my rose hips sent to you last year this was one of the species. I hope to be able to supply you with a lot more, it would make a lovely flower border.

I marched next to a place on the right bank of the Hari-rud River opposite Tomän-ághá, fifteen miles. Our route lay over a plain that had once been the bed of the river where the river had made a great bend; the river, after silting up this bend, had left it. The most characteristic plant here was a Rhubarb, usually with 3-root leaves of immense proportion for the size of the flowering stem; these leaves are so pressed flat to the ground that it reminds one more of the *Victoria regia* leaves (without the margin), and this is the habit of the plant; the plant was fruiting, having large winged fruit of a most brilliant scarlet; it will make a grand thing in gardens. The

beautiful colour of the fruit is much helped out by the splendid green of the leaf background. There are, one may almost say, no leaves on the flowering stem—one or two most minute. I measured one of the largest on the ground: it was 4 feet from the base to apex and 5 feet across; the other two with this one were a little smaller; the three together gave it a very curious look. I hope soon to get the seeds home. I have collected a good deal of the root; it is called "Fool's Rhubarb" owing to its purgative qualities, and curiously enough the fruit is employed in preference to the root as a purgative, given as a decoction. With the exception of an occasional woody shrub that may rise to five feet, the place was covered with a species of *Artemisia* (probably several) about 2 feet high, and occasional *Umbelliferae*. There were no trees of any sort: these are only to be found in the river bed—viz. *Populus euphratica*, and two species of Tamarisk and a *Lycium*. At Tomān-ághá, in the bed of the river, was a woody salsolaceous shrub which I do not know. I got good specimens of the wood and flowering branches.

I left Tomān-ághá on the 28th, passing the remains of some old ruins two miles from my encampment, and turned east by north towards "Galicha" (a carpet). As we marched along, fancy crossing the markings of two pairs of carriage wheels! These had been made some months ago by the carriage of a Persian Prince who had come to our camp at Gulran to be doctored. The route lay now across towards the base of the Paropamisus range over a most extensive plain on which the attraction was a miniature forest of a species of *Umbelliferae*, excessively like, but not the, *Assafoetida*. This was in full bloom, the stem and flowers being at first all of a light orange yellow; as the fruit ripens, the whole colour changes to a russet brown. Each flowering stem is from 3 to 5 feet high, and there are usually 50 plants to 100 yards square, the interspaces being altogether filled up by a grass of a foot in height. On the 29th, left Galicha for the Kambao Pass to enable me to cross through the range. Our march lay over a plain the continuation of that of yesterday, and which from its extent is lost to the sight. This is celebrated as the plain of the wild donkey, and here I counted sixteen herds of at least 10,000 in each. The nearest was a mile off, and their presence was recognised by a cloud of dust rising in a swirl on their galloping—like the smoke from the chimney of a steamer. It was a most extraordinary sight, watching these clumps moving from place to place. They are occasionally shot and eaten. I forgot to tell you that, except my own party, there was probably not a human being within thirty miles of us. The country has no inhabitants, and until the nomads turn up with their flocks from the lower regions it is a desolation. The last part of our march was for six miles within the ridges of the base of the hills, and here in the stream beds Tamarisk was the only (woody) shrub. I halted some five miles to the west of the pass, hoping to make a great haul on the 30th. From the moment of entering these valleys they seem a mass of colour—one from buttercups (one species only), another from a poppy; the bed of the stream purple with a tall onion, and the interstices green with one grass. I had previously got most of the things so promising here, but saw signs of getting into a very fine new lot. On the morning of the 30th a regular hurricane of wind blew from the north, so that I thought the best plan would be to move my camp across the pass, and get a better and more sheltered locality. I just managed to get to the north-east side, when it *did* come down—such a torrent! but as all preparations had been made we were comfortable; had I remained on we must have been swept out of our old camp.

May 1 proved a most superb morning, so I was up and out at 6 a.m., went straight back to my old encampment on the west side, and from there collected back. I got

some thirty-five species—a second *Arum*; a *Prunus*; an *Elæagnus*, of which I sent you the fruit last year; one *Pistachia* bush, a large number of *Astragali*, which I feel sure will stump Baker; a curious *Rubiaceous* shrub, a fine *Orobanche*, only five grasses, and a most lovely everlasting pea, like the ordinary English cultivated one, only dwarf. I believe everything here is dwarfed by exposure to the winds. You cannot understand the difficulty I have with it in collecting. To save my plants at all, I have to put them *at once* into paper. It takes three of us to do this, and not allow paper or plants to blow away. I must say it does not improve one's temper.

I got one or two species of a very nice *Gentian* like *Gentiana Kurroo* of Royle, the altitude of Hari-rúd River, 2000 feet; Kambao Pass, west side, 2900 feet; pass itself, 3550 feet; Kambao on north-east, 3250 feet. Not a fern of any sort, not even *Ophioglossum*, which I looked upon as a certain find. I spent my second day—viz. May 2—at the camp on the north-east side of pass; here there is a fine hawthorn, from which I collected flowers in bud on the 1st. Along the whole of this range, well within it, where the water is sweet and the air cool, the hawthorn, a common plum, and *Amygdalus eburnea*, are more or less plentiful. I picked up an *Oxygraphis*, and a very pretty geranium with a most curious potato-like root, only the tubers are heaped up on each other when there is more than one to a plant. You know they made me naturalist, so, in addition to collecting plants, I have to shoot poor little birds, and I hate it. I got two bee-eaters, the one more lovely than the other, and a nightingale.

On the 3rd I marched to a place 8 miles nearer our first Gulran encampment. I had picked up most of the cream, and there was not much, except additions in the way of fruiting species, to be made. This I did, and got a venomous snake which may be a cobra—all but walked on to him—5 feet long and 6 inches at his thickest, fangs three-quarters of an inch; a most unpleasant fellow to meet. I shot him, and after fancying I had killed him, cut off his head and neck to keep (I could not keep his whole body), when lo! his body, minus his head, walked off searching for escape, the head trying to fang its own neck.

On the 4th I moved still east-by-north some 12 miles to our first encampment at Gulran. I got some nice things *en route*, and had just ticketed and arranged them preparatory to great work for the morrow, when in came a letter from Sir Peter Lumsden telling me to return at once. Alas for my great expectations! I packed up, and we moved camp at 2 a.m. on the 5th, marched up the valley, passing our second Gulran encampment, and on south to the east-by-north side of the Chashma-sabz Pass. I had no time to halt and collect. I passed a *Gladiolus* and an immense number of things. On the pass I collected the "Siah-chot," which is to me, in all probability, *Cotoneaster nummularia*. I had collected its fruit and sent it to you from these very bushes. I got it in this pass last year. It is from this shrub that "Shir-Khist," the manna of these parts, is collected. I have sent you a bottle of it packed amongst some other things. They have two other kinds—one from a Tamarisk and the other from Alhagi. I myself collected it from a *Salsola*. I got across the pass by 2 p.m.; halted until 8 p.m. and got into Tir-Phul at 8 a.m., the camels at 10 a.m. of the 6th; did 60 miles in 34 hours—good going for camels, and men more or less on foot.

I am glad I am in, because my plants had to be looked to. I got, as I said before, 100 species in this tour, not less than 1200 specimens. It is much harder work than Kurram; the fact is, I am not younger, and my back wants a good deal of oiling.

Yours very truly,

J. E. T. AITCHISON