Selous to successfully guide the Pioneer Force of the Chartered Company in 1890, when they took possession of Mashonaland.

With regard to the health of Zambesia he says:—"Owing to severe exposure to wet and cold during several days and nights, in the early part of 1872, I got an attack of fever and ague in Griqualand so that I was handicapped before starting for the interior. This fever and ague was exactly what I have seen people get on the high plateau of Mashonaland, during the last few years, from similar exposure to rain and cold. It took me some time to shake off, and was still in my system when I reached Matabeleland, but the attacks only came on when I halted anywhere for a few days. During November and December, 1872, hunting down in the low hot country towards the Zambesi, I was again very much exposed to wet, and on several occasions lay out all night long, without any shelter, drenched through with such heavy rain that it put out the largest fire and converted hard ground into a swamp. I naturally again got soaked with fever poison, but as long as I remained hunting the disease did not show itself. Directly I got back to Bulawayo it broke out, and during a month or so I had several sharp attacks. By that time, however, my sound constitution had choked all the fever germs, and from that day until in 1878, when very severe exposure in Central Africa once more filled me up with malarial poison, I do not remember ever to have had one single hour's illness, or to have taken one drop of medicine. The life I led was, however, if a very hard, at any rate, in many respects, a very healthy one; for the most part I ate nothing but meat and Mashona rice, and drank nothing but tea, usually without milk and sugar—not because I like it so, but because those adjuncts were unobtainable."

North of the Zambesi Mr. Selous made several journeys among the Batongas, and spent a wretched rainy season, almost without equipment, on the Manica table-land. After the rains the country looked charming. The young grass, thanks to the recent heavy rain, had shot up one foot or eighteen inches in height over hill and dale, every tree and shrub was in full leaf, and everything looked green, and fresh, and smiling. Many of the shrubs on the edge of the hills bore sweet-smelling flowers, and, as on all the plateaus of the interior of Africa, small but beautiful ground-flowers were very abundant.

Interesting observations were made on some of the northern rivers. The curious phenomenon of the steady rise of the waters of the Chobe and Machabi—an outlet of the Okavango—was observed from the first week in June until the last week in September, when they commenced to recede. That the Okavango and the Upper Kwando are connected on their upper courses, there can be little doubt, as the waters of the Machabi went on rising suddenly *pari passu* with the Chobe, until the end of September, when both commenced to recede simultaneously.

The explanation of this remarkable phenomenon is difficult, as there are no snow mountains at the sources of the Kwando and Okavango rivers and the Zambesi, which rises in the same latitude, decreases steadily in volume from day to day during the dry season like almost all other rivers in South Central Africa. Besides the channels which still become annually filled with water from the overflow of the Chobe and Okavango river systems, there are many others which are now quite dry, but in which the natives say they once used to travel in canoes.

From 1882 the journeys acquired additional geographical importance, and Mr. Selous proceeded to rectify the maps of Mashonaland laid down by earlier travellers, taking constant compass bearings, sketching the course of rivers, and fixing the position of the junction of tributaries. The value of this work was made manifest in a magnificent large scale map of the country, drawn as well as surveyed by Mr. Selous, which was used to illustrate the lecture. It would be impossible, without practically reproducing the whole address, to do justice to the immense variety and solid value of the contributions to African geography made by this most energetic of pioneers; or to the thrilling adventures, the recital of which was listened to with breathless attention and greeted with the heartiest applause. With the exception of a treacherous night attack made upon his camp by the Mashuku-sumbwe, led by a few rebel Marotse, in 1888, he had never had any other serious trouble with the natives. During his twenty years' wanderings he went amongst many tribes who had never previously seen a white man, and he was always absolutely in their power, as he seldom had more than from five to ten native servants, none of whom were ever armed.

THE DISTRIBUTION OF POWER BY ELECTRICITY FROM A CENTRAL GENERATING STATION.

On Friday evening, the 3rd inst., Mr. A. Siemens delivered at the Royal Institution an interesting lecture on the ways in which science is applied to practice. In the course of the lecture he made the following remarks on the distribution of power by electricity from a central generating station:—

Before entering further into this, let me remind you that the earliest magneto-electric machines were used nearly sixty years ago for the production of power. I will mention only Jacobi's electric launch of 1835 as an example. It must, therefore, be considered altogether erroneous to ascribe the invention of the transmission of power to an accident at the Vienna Exhibition in 1873, when, it is said, an attendant placed some stray wires into the terminals of a dynamo machine; it began to turn, and the transmission of power was first demonstrated. As a matter of fact, Sir Wm. Siemens once informed me, that his brother Werner was led to the discovery of the dynamo-electric principle by the consideration that an electro-magnetic machine behaved like a magneto-electric machine, when a current of electricity was sent into it, viz. both turn round and give out power. It was, of course, well known that a magneto-electric machine produces a current of electricity, when turned by mechanical power, and Werner concluded that an electro-magnetic machine would behave in the same manner. We all know that he was right, but I relate this circumstance only as a further proof that the generation of power by electric currents has been a well-known fact long previous to the Vienna Exhibition.

Another well-known instance of transmission of power to a distance is furnished by the magneto-electric ABC telegraph instruments, where the motion at the sending end supplies the currents necessary to move the indicator at the receiving station.

As an illustration of the distribution of power by electricity, I will briefly describe some radical alterations that have been made at the works of Messrs. Siemens Brothers and Co., by the introduction of electric motors in the place of steam engines.

[A diagram on the wall showed in outline the various buildings in which work of different kinds is carried on with the help of different machines.]

Electric motors are supplying the power, sometimes by driving shafting to which a group of tools is connected by belting, and sometimes by being coupled direct to the moving mechanism. Each section of the works has its own meter, measuring the energy that is used there, and all of them are connected by underground cables to a central station, where three sets of engines and dynamos generate the electric current for all purposes. There are two Willans and one Belliss steam engines, each of 300 horse-power, coupled direct to the dynamos, and running at a speed of 350 revolutions per minute. Room is left for a fourth set, but including some auxiliary pumps and the switchboards for controlling the dynamos and for distributing the current, the whole space occupied by 1200 horse-power measures only 32×42 feet. Close by are the condensers and three high-pressure boilers, which have replaced some low-pressure ones formerly used for some steam engines driving the machinery in the nearest building.

The advantages that have been secured by the introduction of electric motors may be briefly stated under the following heads:—

1. Various valuable spaces formerly occupied by steam engines and boilers have been made available for the extension of workshops, and these are indicated on the diagram by shading.

2. By abolishing to a great extent the mechanical transmission of power a considerable saving is effected in motive power, which is especially noticeable at times when part only of the machinery is in use.

3. As the electric motors take only as much current as is actually required for the work they are doing, a further saving is effected, and at the same time the facility with which the speed of the motors can be altered without their interfering with each other presents a feature that is absent from mechanical transmission.

4. The big steam engines being compound and condensing, produce a horse-power with a smaller consumption of fuel than the small high-pressure steam engines scattered throughout the works.

5. The numerous attendants of the old steam engines and boilers have mostly been transferred to other work, only a few of them are required at the central station, and one or two men can easily look after all the electric motors used in the various parts of the works.

Elsewhere equally favourable results have been obtained by the introduction of electrical distribution of power, and in this respect I beg to refer you to a paper read before the German Institution of Civil Engineers by Mr. E. Hartmann in April of last year, and to a paper read by Mr. Castermans before the Society of Engineers in Liège, in August last, in which he compares in detail various methods of transmission of power, of which the electrical one was adopted for a new small arms factory.

We may therefore take it for granted that the advantages alluded to above have not resulted from local circumstances at Woolwich, but that they can be realised anywhere by the adoption of the electric current for distributing power from a central station.

At first sight this result appears to be of interest only to the manufacturer; but the development of this idea may lead to far-reaching consequences, when we consider that cheap power is one of the most important requisites for cheap production.

While power was generated by steam engines the cost of producing one-horse-power varied a good deal in the different parts, and the various owners could not have obtained their power on equal terms, those possessing the largest steam engines having a distinct advantage. This inequality is done away with altogether when the power is distributed by electricity, as the current can be supplied for large or small powers at the same rate per Board of Trade unit. It is therefore clear that the establishment of central stations for the generation of electricity on a large scale will bring about the possibility of small works competing with large works in quite a number of trades where cheap power is the first consideration.

Another circumstance favouring small works is the diminution of capital outlay brought about by the employment of electric motors. Not only are the motors cheaper than boilers and steam engines of corresponding power would be, but the outlay for belting and shafts is saved, and the structure of the building need not be as substantial as is necessary where belts and shafting have to be supported by it. A commencement has already been made in this direction by the starting of electric light stations, where the owners do all in their power to encourage the use of the current in motors, in order to keep the machinery at their central station more uniformly at work. The introduction of electricity as motive power will apparently present a strong contrast to the effect steam has had on the development of industries for the reasons already stated; and in addition there are many cases where the erection of boilers and steam engines, or even of gas engines, would be inadmissible on account of want of space or of the nuisances that are inseparable from them. Motive power will therefore be available in a number of instances where up to the present time no mechanical power could be used, but the work had to be done by manual labour or not at all.

You may have noticed that I have confined my remarks hitherto to the case of distributing electricity over a limited area, but that I have not yet discussed the question of transmitting power to a great distance.

Theoretically we have been told over and over again that the motive power of the future will be supplied by waterfalls, and that their power can be made available over large areas by means of electric currents. As a prominent example the installation is constantly mentioned by which the power of a turbine at Lauffen was transmitted over a distance of 110 statute miles to the Frankfurt Exhibition with an efficiency of 75 per cent. No doubt this result is very gratifying from a purely scientific point of view, but unfortunately in practical life only commercially successful applications of science will have a lasting influence, and in this respect the Lauffen installation left much to be desired. On the one hand science tells us that the section of the conductor can be diminished as the pressure of electricity is increased, and it appears to be only necessary to construct apparatus for generating electricity at a sufficiently high pressure so as to reduce the cost of a long conductor to reasonable limits. On the other hand, experience shows that at these high potentials the insulation of the electric current becomes a most difficult problem, and for practical purposes difficulty means an increased outlay of money.

MAGNETICAL AND METEOROLOGICAL OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORY, BOMBAY, 1890, WITH AN APPENDIX.

THIS volume, we are informed, is the thirtieth of the series of "Bombay Magnetical and Meteorological Observations," extending the previous record from 1845 to 1889, up to 1890. At this well-organized observatory, under the direction of Mr. Charles Chambers, continuous registration of the different magnetical and meteorological elements is maintained by means of automatic recording instruments, of which there are five sets, the magnetographs (three), the barograph, the thermograph, the pluviograph, and the anemograph, all being photographic records excepting that of the anemograph, which is mechanical. In addition eye observations are also made, including the usual meteorological observations of weather and other phenomena. Daily values for 1890 are given of atmospheric pressure, temperature of the air, rainfall, wind and cloud, with some further discussion of the anemometric results; five day means of meteorological elements are also given. In the magnetic section is found observations of absolute horizontal force, magnetic declination and dip, at short intervals throughout the year. And in the appendix is contained a collection of the monthly values of declination and horizontal force from 1868 to 1890, accompanied by a discussion of the secular changes of these elements. In regard to declination the results show the eastern magnetic declination to have increased during the early years of the series, arriving at a maximum at about the middle of the period, and decreasing in the later years. Taking the annual values of declination to be represented by the formula $\delta = at^2 + bt + c$, it is found that the maximum easterly declination occurred in 1880, with value 0° 57′ 17″. This actual observation of the turning-point at this place, in the long cycle of change, is very interesting. The horizontal force values are similarly discussed, but in this case the values are generally progressive. There is no discussion of diurnal inequalities, but these were elaborately treated in a previous volume. Magnetic observatories in tropical and southern regions are valuable. Many exist in Europe with others scattered over different parts of the northern hemisphere, generally publishing with regularity their results, but there is a want of similar establishments in southern regions. There are magnetic observatories at Batavia, Mauritius, and Melbourne, but we do not get from them all that might be desired. England possesses no regularly maintained southern establishment of this kind. A magnetic observatory existed many years ago at the Cape of Good Hope, which, long since destroyed, we believe, by fire, was never again reorganized, which was unfortunate. The attention of the Magnetic Committee of the British Association was several years ago drawn to the question of re-establishing the Cape Magnetic Observatory, and in the Report of the Committee for the year 1891 it is stated that a representation had been made to the Admiralty as to the desirability of so doing. An efficient magnetic observatory in such a position, with regular publication of the results, would provide information of great value for the discussion of various questions in magnetic phenomena that now arise. It would be well also if the study of earth currents were taken up at some of the magnetic observatories in different parts of the world by continuous photographic registration thereof, for the better elucidation of the physical relation that may exist between magnetic and earth current variations, in regard to which our knowledge seems at present to be so imperfect.

BACTERIA AND BEER.

THE examination of water for micro-organisms since the publication by Koch in 1881 of his beautiful process of gelatine-plate cultures has come more and more into general use, as the public has gradually become cognisant of its value for hygienic and practical purposes. But whilst affording much valuable information on many subjects, Hansen has pointed out, as far back as 1888, that as applied to the examination of waters for brewing purposes it cannot be considered wholly satisfactory. Working on lines suggested by Hansen, Holm has recently published a paper, "Analyses biologiques et zymotechniques de l'eau destinée aux brasseries" (*Compte-rendu des travaux du laboratoire de Carlsberg*, vol. iii., Copenhagen, 1892), in which he describes a large number of investigations on brewing-waters examined by Hansen's method, and in which the relative merit for brewing