

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 $0^\circ 57' 17''$. 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