in the second volume of the German health reports.[1] In this article, Koch re-affirms his original announcement, and gives the results of further work in the same direction, all reached by experiments conducted with the same precision as the first series. They bear out his assertions to the full, and with the exception of a few slight changes of technique, and a modification of the staining methods employed, have led him to no change whatever in regard to his views as first expressed more than two years ago.

These two papers taken together form a monument of scientific accuracy and care, and, so far as subsequent investigations go, will carry conviction to the mind of any impartial judge. Confirmatory evidence, as regards the occurrence of the organism in question in tuberculous lesions, has been offered upon all sides, and in enormous mass. The real evidence, however, the repetition of the culture and inoculation experiments, is sadly deficient. This is, perhaps, not to be wondered at, because the apparatus necessary is so extensive, the training so severe, and the aptitude for the work so rare. In addition to all this, the time necessary for the experiments is so great, that the chances are that they never will be repeated to their full extent, although it is only by such thorough and exhaustive investigation that progress in this branch of scientific medicine can be expected.

Some few observers have pretended to upset the conclusions of Koch upon the basis of extremely unsatisfactory and incomplete observations. Spina of Vienna is, or was, a prominent champion of this class. His book was announced with a flourish as being intended to overturn, and as actually accomplishing the destruction of, all Koch's theories. Upon its publication, it was found to be nothing but a criticism of methods that Koch himself acknowledged to be faulty, and a few observations upon the occurrence of the bacillus, but with an entire absence of any culture, or properly conducted inoculation, experiments whatever; in all respects being so far below the work it was meant to criticise, that it was with pain and mortification that we heard it mentioned on the same plane, in the annual address to the Massachusetts medical society of this year. This, however, seems to be the limit of any noteworthy objections in Europe: in this country it is different, a number of gentlemen having considered themselves authorized to speak in opposition to Koch's views upon the ground of personal observations. For the most part, however, their pretensions are too weak to receive serious notice: as, for example, Schmidt's cry of 'fat crystals;' Gregg's, of 'fibrine filaments;' Cutter's, of 'Mycoderma aceti;' or Formad's, of 'narrow lymph-spaces.' It is, perhaps, hardly fair to speak of Formad's deplorable failure to maintain his opposition to Koch by any reasonable arguments at the last annual session of the American medical association. Through imperfect counsel, the gentleman was induced to come before the meeting, and after announcing far and wide his intention to give results that would destroy the last vestige of strength to Koch's assertion in regard to the specific nature of the bacillus of tuberculosis, instead of doing this, proceeded to read a reprint of an article published by him last fall, announcing that his results would be published in the near future. This, in the present condition of all questions relating to micro-organisms in this country, seems to be almost inexcusable. These results have been promised for months, and at the time of writing have not yet appeared. It seems as if it were the bounden duty of all those honestly interested in the advancement of scientific knowledge to talk and publish less, and to work more. What is needed is the publication of the results of work carefully and conscientiously performed, together with the exact details of every step in every process by which those results were reached. In addition to this, we have a right to demand that all work of this kind shall be done by trained observers, in the presence of others equally well qualified for the observation, — not with and by half-trained students, — and that the very best appliances of modern research shall be employed in each and every observation made. In this way, and in this way only, can reliance be placed upon observations recorded in work on micro-organisms; and it is the absence of work of this kind which gives so very little force to the opponents of the specific nature of the bacillus of tuberculosis. At the same time, it is the presence of this very accuracy of the detailed account of every step in the process by which the results were reached, and of the completeness of the experiments and control experiments, that gives the convincing power to Koch's work. Nothing that can be for an instant compared with it for simplicity and directness of statement, or completeness of detail, has yet been brought forward by his opponents. Until that is done, and it does not look probable at the present writing, his work must be accepted as conclusive; and measures should be taken to control to some extent the wide-spread destruction of this disease, as it is most certainly within our power to do.

Koch's own work upon the subject of tuberculosis has been suspended for a year, owing to his absence in the east with the German cholera commission, with which he has lately returned. Whether he himself will take it up again is to be doubted; for his facilities for work are unbounded, and his natural impulse will, of course, be to open up untrodden paths of research.

[1] *Mittheilungen aus dem rais. gesundheit*, bd. ii., 1884.

## *THE GREENWICH OBSERVATORY.*

THE board of visitors of this institution held its annual session on Saturday, June 14, and heard the report of the astronomer royal on the work of the observatory during the twelve-month ended May 20. Of this, Mr. Christie says, "It has gone on steadily in the same lines as in former years, with such small extensions in certain directions as could be made without infringing the long-established principle that

all observations are to be reduced and published without delay."

The fundamental instrument, the transit circle, has been kept well at work on the regular observations of the sun, the moon, the planets and fundamental stars, together with other stars, which, in the annual catalogue for 1883, number 1,550. The total number of transits observed was 5,213, and of circle-observations, 5,049, — a larger number of meridian observations than usual. But what is of more interest, the reductions of these observations are maintained in a state of forwardness unknown in national observatories generally. The computations on certain stages of the reductions of the meridian-work were reported to be well advanced on all observations up to the middle of May, 1884. It is worthy of note here, that the mean correction of the 'Nautical almanac' positions of the moon in right ascension turns out to be no larger than $-0^s.03$ for the year 1883. This interesting concordance of theory and observation is due to the adoption in the 'Nautical almanac' of Professor Newcomb's corrections to the 'Tables de la lune' of Hansen, which are the same as those employed in the construction of the 'American ephemeris.'

The observations with the altazimuth have been restricted to the period from the last quarter of the moon to the first quarter in each lunation; it being considered, that, from the first quarter to the last, the observations of the moon on the meridian will be obtained in sufficient abundance. The astronomer royal regards it as evidence of the great value of the altazimuth, that, during the former period, nineteen observations of the moon were secured with it at times when the moon's meridian-passage took place within three hours of the sun, and when observation with the transit circle was thus impracticable.

With the equatorially mounted refracting telescopes, only the usual observations were conducted; but, with the spectroscope, results of much importance and interest were reached. "For the determination of motions of stars in the line of sight, four hundred and twelve measures have been made of the displacement of the *F* line in the spectra of forty-eight stars, ninety-one measures of the *b* lines in nineteen stars, and two measures of the *D* lines in one star, besides measures of the displacements of the *b* and *F* lines in the spectra of the east and west limbs of Jupiter, and in the spectra of Venus and Mars. . . . Some preliminary measures have also been made of the *F* line in the spectrum of the Orion nebula. The progressive change in the motion of Sirius from recession to approach, alluded to in the last two reports, is fully confirmed by numerous observations since last autumn, and a change of the same character is indicated in the case of Procyon."

With regard to solar photography, undertaken with the view to determine the amount of spotted area, it is interesting to note that the heliograph, which up to the present time has given pictures of four inches diameter only, has been modified so as to take eight-inch pictures, as was suggested two years ago by the solar-physics committee. The photographs taken in India under the auspices of the same committee are now sent to Greenwich for reduction, thus resulting in a considerable increase in the number of days for which photographs are available. In 1883, for example, photographs on 215 days at Greenwich are supplemented by those on 125 days of India, giving a total of 340. In 1882, to 201 days at Greenwich were added 142 India, thus leaving only 22 days without photographs in the entire year. In the photographic branch of the observatory-work there has been much pressure "during the long-continued maximum of sun-spots, the work of measuring the photographs having been somewhat further increased by the adoption of large-scale photographs of the sun."

The acquisition of the Lassell equatorial, and the uses to which the astronomer royal proposed putting it, were mentioned in the report of the previous year. A new dome for this telescope, thirty feet in diameter, and covered with *papier-maché* on a framework of iron, was completed by the Messrs. T. Cooke & Sons of York in March last; and the building is now about complete in all its details. The instrument itself has been generally cleaned and repaired. The mirror is in very good condition as regards polish, and the definition on stars is satisfactory.

The magnetic and meteorological observations have been continued with the same regularity as in previous years. The mean temperature of 1883 was 49°.3, being 0°.4 lower than the average. The highest air-temperature was 85°.1, on Aug. 21; and the lowest, 20°.6, on March 24. The mean daily motion of the air during the year was 291 miles, which is 12 miles more than the average. The number of hours of bright sunshine during 1883 was 1,241, being about 30 hours above the average of the six preceding years. Mr. Christie informs us that no definite connection was noticed between magnetic or electric disturbances and the phenomena of the remarkable sunsets of the past winter.

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## *THE UNITED-STATES GEOLOGICAL SURVEY.*

*Annual reports of the United-States geological survey to the secretary of the interior*, ii., iii. J. W. POWELL, director. Washington, *Government*, 1882–83. 55+588 p., 32 fig., 62 pl.; 18+564 p., 56 fig., 35+32 pl. 8°.

IT has often been remarked that the problems of geology are expressed in far simpler terms in America than in Europe, the birthplace of the science. It is hard to say whether it would have been better for geology if it had been born in a less adverse environment. Perhaps it might have developed more rapidly, but probably not so healthily. Perhaps the very difficulties of the problems of geology in Europe — the conflicts of the schools through which the young science passed — have tended to invig-