Surveys of the Great Pyramid.

IN an article in NATURE of December 26, 1925, Sir W. M. Flinders Petrie compares unfavourably the recent survey of the Great Pyramid carried out by Mr. J. H. Cole, of the Survey of Egypt, with his own survey of 1881. He points out that the closing error in the eight angles of Mr. Cole's traverse around the pyramid, which amounts to 9·6 inches, is equal to a difference of 2·7 inches "if on the whole distance." This statement would only be relevant to his argument if the traverse were an open one run, more or less, in a straight line, and if the angular error were located entirely in the initial angle. In fact, when the measured quantities (angles and lengths) are taken as observed, the closing error of the traverse amounts to 0·7 inch, and when the traverse is adjusted to self consistency, the greatest corrections applied are 0·04 inch to a measured length and 2·7 inches to an observed angle.

In Sir Flinders Petrie's book, "The Pyramids and Temples of Gizeh," he explains in Appendix II. the methods he used for determining the precision of his work and for weeding out "occasional errors." In the example he gives, on page 230, the four observations he rejects would have been retained by such authorities as Wright and Hayford or Brunt, who only reject observations the residuals of which are at least five times as great as the probable error of a single observation, unless there are physical reasons (wrong sightings, movement of instrument, etc.) for doubting the work. In the 1881 survey, out of 108 sides of triangles around the Great Pyramid, the mean observations of no less than nine were rejected. This excessive number of rejected observations should never have been tolerated.

I have little doubt that the high precision claimed by Sir Flinders Petrie has only been obtained by the unwarranted rejection of observations with large residuals, which has decreased his computed probable error but at the same time has certainly diminished the precision of his results.

Mr. Cole's survey has now been tied up to points O, Q, and W of the 1881 survey. The bronze bolt U has gone but another bolt has been leaded into the same hole in the floor of the south-east corner socket and must agree within half an inch with point U. When the two surveys are fitted together by means of the points common to both, Sir Flinders Petrie's point on the casing edge on the east of the pyramid falls 2·7 inches to the east of the casing edge as surveyed in 1925. The other three points on the casing edge agree within one inch.

Accepting the accuracy of Mr. Cole's survey as deduced from the closure of the traverse, and from our knowledge of the precision of the methods employed, this large discrepancy on the east can only be attributed to an error in the 1881 survey.

In the course of this investigation several discrepancies in Sir Flinders Petrie's work have come to light. For example, the eastern side of the Great Pyramid is given as 9067·7 inches. On Plate X. the N.E. socket corner is stated to be 30·2 inches north and the S.E. socket corner 35·5 inches south of the corresponding pyramid corners. The eastern socket side should therefore be 9133·4 inches and not 9130·8 inches as given.

Mr. Cole's survey was an attempt to determine the exact shape and size of the pyramid as it was built. Sir Flinders Petrie, on the other hand, reconstructed the pyramid as, in his opinion, it should have been built. He remarks "we only need to compute a square that shall pass through the points of the casing found on each side, and having also its corners lying on the diagonals of the sockets."

This being the case, there is nothing to be gained by dealing with Sir Flinders Petrie's arguments published in NATURE. However, his statement that "it would be easier to achieve equality of length than of level" is, in my opinion, not true.

I therefore conclude that Sir Flinders Petrie's survey of 1881 is not nearly so accurate as he claims, that it contains errors amounting to so much as two inches, and that Mr. Cole's survey, whatever slight inaccuracies it may possess, is the most precise survey of the Great Pyramid that has yet been made.

I agree with Sir Flinders Petrie that it is highly desirable that a survey should be made joining the existing casing edge on to lines laid out close to the base, but this will have to wait until several thousands of tons of debris have been cleared away. I hope this will be done in the near future.

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Survey of Egypt,
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June 12.

THE first point raised by Mr. Richards refers to my remark that the method of placing a single triangle of survey round a pyramid (as in the 1881 survey) was better than a line of eight lengths of traverse carried on by dead reckoning round the base, as in 1925. The effect of the error being possibly caused in the first of the eight angles, was only stated by me to illustrate the unsatisfactory principle of the method.

The exclusion of anomalous observations of five times the probable error is held up as a pattern. That would be true enough on a series of 4000 observations. On a series of 109 the limit of normal variation would be much smaller. No arbitrary rule should be followed. I excluded anomalies, one by one, until the whole series became almost normal in distribution. I still think that this is the probable road to the truth. The casual causes were due to lateral lighting and refraction of hot air. I prefer not to vitiate results by including anomalies, which are detected by the distribution of errors.

The points O, Q, W, in common on the surveys of 1881 and 1925, are stated to have been now fitted together (without quoting a difference), and the only difference is on a point plumbed up from a deep hole in 1881, which was by no means the same place as was fixed and seen on that base side in 1925. The discrepancy pointed out between the socket length and the base side which was deduced from it, on the east, is due to some misprint or slip in mere addition, and has nothing to do with the accuracy of survey. There is, therefore, no ground for claiming that there are errors amounting to two inches in the 1881 survey.

FLINDERS PETRIE.

Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.

IT is well known that the conventional quantum theory must be modified in accordance with the matrix dynamics developed by Born, Heisenberg, and Jordan, and by Dirac. The purpose of the present note is twofold, namely: (1) to show that in the new theory the spacial quantisation relative to the applied field has no direct effect on the magnetic susceptibility (or the dielectric constant), and (2) to give the results of the calculation of the dielectric constant of a diatomic gas by means of the new mechanics.