The *Connaissance des Temps* for 1861 has been published. The additions contain a memoir by M. Delaunay, "Nouvelle Méthode pour l'intégration des équations différentielles du Mouvement de la Lune autour de la Terre": the most detailed exposition he has as yet given of the method employed in his researches in the lunar theory, some of the results of which, in relation to the acceleration of the mean motion, have been already published in the *Comptes Rendus.*

Johannis Kepleri Astronomi Opera Omnia. Ed. Ch. Fusch, Frankfort and Erlangen.

Volumes i. and ii. of this important publication have appeared.

Report on the Teneriffe Astronomical Experiment of 1856, *Addressed to the Lords Commissioners of the Admiralty.* By Professor C. Piazzi Smyth, F.R.SS.L. and E., &c., H.M. Astronomer for Scotland.

This paper has been printed at the expense of the Admiralty. Some of the principal results recorded in it have been already published in the Annual Report of the Council of the Society for the year 1857. The paper is divided into eight chapters.* The first chapter is devoted to an account of the circumstances connected with the origin of the expedition. In the second chapter the author describes the improvement of astronomical vision, depending on the increase of height above the level of the sea. The third chapter is occupied with an account of the astronomical observations made by the author during his residence on the Peak. The fourth chapter contains the physical observations. The fifth chapter is devoted to the meteorological observations; the sixth, to the geology of the mountain; the seventh, to the botany; the eighth, to the miscellaneous observations. Appended to the paper are a series of valuable drawings illustrative of the facts recorded in it.

By favour of General T. F. de Schubert, Honorary Member of the Imperial Academy of Sciences at St. Petersburg, copies of his "Essai d'une Détermination de la véritable Figure de la Terre" (printed in the *Mém. de l'Acad. Imp. des Sciences de St. Pétersbourg*, vii Série, Tome i. No. 6) have lately been received in this country. The meridian arcs used by the

* The first five chapters form a paper which is printed at the expense of the Admiralty in Part II. of the *Philosophical Transactions* of the Royal Society, t. cxlviii. (1858).

author are the following, in which the longitudes are measured eastwardly from an imaginary meridian 20° west of Paris:—

The Russian Arc	Longitude	45	20	to	70	40	Longitude 44 23
The Indian Arc	,,	8	10	to	29	31	,, 95 20
The French Arc	,,	38	40	to	51	2	,, 20 0
The Cape Arc	,,	−29	44	to	−34	21	,, 36 9
The Peruvian Arc	,,	0	3	to	− 3	5	,, 298 44
The Prussian Arc	,,	54	13	to	55	43	,, 38 10
The English Arc	,,	50	37	to	53	28	,, 17 40
		(in first calculations)					
		50	37	to	60	50	
		(in final calculations)					
The Pennsylvanian Arc	,,	38	27	to	39	56	,, 300 10

The author first exhibits the elliptic formulæ which he has used, and which appear well adapted to give results of great accuracy and with much convenience. He then applies them to the comparison of each of these eight arcs with every other, and thus obtains 28 systems of elements, presenting great discordances. For the earth's polar semiaxis, expressed in toises, the largest result is 3274069, and the smallest 3245754; for the earth's equatoreal semiaxis, the largest result is 3279418, and the smallest 3259832; for the denominator of the fraction expressing the oblateness, the largest number is 14501, and the smallest 116. These discrepancies appear to the author to show that a different method of treatment is required; and he proposes and applies the following:—

First, he remarks that we have assumed in the preceding calculations "that the terrestrial meridians are ellipses," and "that their minor axis is, for all, the same as the axis of rotation of the earth," which assumptions our observations do not enable us to disprove; but we have also assumed "that the earth is a solid of revolution, or that all the meridians are equal," an assumption which he conceives the discrepancies above mentioned show to be untenable, if the two preceding assumptions are maintained. As soon as this is given up, all comparisons of arcs of meridian in different longitudes become illusory. The next inquiry is, What element is common to all the ellipses? and this, it is evident, is the minor semiaxis. [We have been very much astonished to see that in several late discussions this important principle has been entirely forgotten.] It is clear that this minor axis cannot be determined from a combination of arcs in different meridians, but must be found from a comparison of arcs in the same meridian, or (which amounts to the same), by dividing a long arc into two segments, and comparing one segment with the other, or comparing each segment with the whole arc. Thus the author uses the three following arcs (the longest of the series):—

The Russian arc, divided into two parts at Dorpat, latitude 58° 23′, and giving for the minor semiaxis 3261429.

The Indian arc, divided into two parts at Damargida, latitude 18° 3′, and giving for minor semiaxis 3261547.

The French arc, divided into two parts at Carcassonne, latitude 43° 13′, and giving for minor semiaxis 3260365.

The author then expresses his unwillingness to combine this French result with the others, on account of its discordance; but remarks that this discordance would be removed by supposing an error of 2″ in the latitude of Carcassonne. [We conceive that this explanation brings to light what is really a weak point in the investigation. The curvature of the meridian changes more rapidly in the arc divided in latitude 43° than in any other arc; and if an error of 2″ is fatal to that determination, an error of 1″ might be fatal to either of the others.] Using the Russian arc with weight 2, and the Indian arc with weight 1, he adopts for polar semiaxis 3261468.

Using this polar semiaxis as a known quantity, in the formulæ applying to the three arcs of Peru, Russia, and India, (the selection of which is determined in part by their difference of longitude), the author finds the following values for the major semiaxes of the meridians of those arcs:—

Major Semiaxis of Peruvian Meridian,	Longitude	298° 44′,	3272383
Major Semiaxis of Russian Meridian,	Longitude	44 23,	3272650
Major Semiaxis of Indian Meridian,	Longitude	95 20,	3272581

The question now arises, What is the form of the terrestrial equator? The author assumes it to be an ellipse. The three numbers just found are the values of three radii of that ellipse; and are sufficient to determine its elements. They give,—

Major Semiaxis	3272671;	its Longitude	58° 44′	or	238° 44′
Minor Semiaxis	3272303;	its Longitude	148 44	or	328 44

(The combination of these with the polar semiaxis above gives for the oblateness of the two principal meridians $\frac{1}{292}$ and $\frac{1}{302}$.)

With these semiaxes he computes the radii of the equatoreal ellipse corresponding to the different arcs (which are, in fact, the major semiaxes of their meridians), and finds them as follows:—

Major Semiaxis of Peruvian Meridian	...	3272395
Pennsylvanian	...	3272388
English ...	...	3272513
French ...	...	3272528
Cape of Good Hope	...	3272618
Prussian ...	...	3272626
Russian ...	...	3272650
Indian ...	...	3272540
Also, in Meridian of Warsaw ...	...	3272628
Pulkowa ...	...	3272659

With the arcs computed from these elements and the astronomical differences of latitude, the geodetic measures are compared, and the residual discordances are as follows:—

Geodetic Amplitude — Astronomical Amplitude.

Peruvian Arc	...	...	+0".077
Pennsylvanian	...	...	—6·687
English (entire arc)	...	...	+0·736
French	...	...	—1·607
Cape of Good Hope	...	...	—0·442
Prussian	...	...	+1·267
Russian	...	...	—1·289
Indian	...	...	+1·619

The Pennsylvanian arc, as is well known, deserves no *à priori* confidence, and has been introduced only as a matter of curiosity.

In the Indian arc no calculation is made of the effects of the attraction of mountains.

The author then applies his elements to compute the longitudes of Warsaw and Dorpat, as referred to Pulkowa. On comparison with the geodetic measures of parallel, it is found that the discordances are reduced as follows:—

Astronomical Diff. Long. — Geodetic Diff. Long.

For Warsaw, is reduced from —124·7 toises to +58·8 toises.
For Dorpat, ,, from —57·9 ,, to — 7·8

We think that this investigation merits the most careful attention of geodetists. In repeating or extending it, we would suggest for consideration whether the determination of the value of the polar semiaxis would not be more satisfactory if it were left to be decided, with the other semiaxes, by a general process combining the consideration of the lengths of all the arcs, introducing also the latitudes of middle stations.

Referring to the mechanical explanation of the existence of a fluid ellipsoid with three unequal axes (two nearly equal), it appears that it can be explained by supposing the existence of an ellipsoidal nucleus of three unequal axes. Should the existence of the former be established, the mode of original formation of the latter may be a problem for speculators in cosmogony. [G. B. A.]

ERRATUM.

Page 58, line 12, *dele* the word "muddled."