measurement of the Earth carried out personally by Al-Birûnî in India.

Having, owing to practical difficulties, failed in his attempts to verify Al-Mâmûn's results by resorting to direct measurements of an arc, Al-Birûnî had recourse to a novel method of his own contrivance, which, before he actually carried it out into practice, had already been fully indicated by him in his earlier book on the astrolabe (الكتاب في الأسطرلاب)

و في معرفة ذلك طريق قائم في الوهم صحيح بالبرهان، و الوصول إلى عمله صعب لصغر الأسطرلاب (أو الآلات)؛ و لفة مقدار الشبي الذي يبنى عليه فيه، و هو ان تصفد جبالاً مشترقاً على بحر أو برى مسماً، و ترصد غروب الشمس، فتخرج فيه ما ذكرناه من الانحاطات، ثم تعرف مقدار عمود ذلك الجبل و تضربه في الجيب المستوي لنظام الانحاطات الموجود، و تقسق المجتمع على الجيب المنكس لذالك الانحاطات نفسه، ثم تضرب ما خرج من القسمة في أثنا و عشرين ابذا و تقسق المبلغ على سبعة، فخرج

مقدار احاطة الأرض بالمدفع الذي به قدرت عمود الجبل

و لم يقع لنا بهذا الانحاطات و كمته في المواقع العاليه تجربة - و جزانا على ذكر

هذا الطريق ما حكة أبو العباس البشيري عن ارسلوس أن اطول اعمة الجبال خمسه أميل و نصف بالمدفع الذي به نصف قطر الأرض ثلاثه آلاف و مائتا ميل بالتقريب، فإن الحساب يقضي لهذه المقدمة ان يوجد الانحاطات في الجبل الذي عموده هذا القدر

ثلث درجات بالتقريب *

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1 This is quite a different book from Al-Biruni's another book on the same subject, a unique copy of which exists in Leyden (B.D., 1908, p. 67). I have quoted the whole passage in the above from Nallino (Lectures, pp. 289-292):

ان ذلك العالم الابل جبل في آخر كتابه في الاسترلاب فصل في معرفة مقدار استدارة الأرض، و لبد

وصف الطريق الاعتيدي المدقق لذلك (تانير) 0

و في الابل "الاب" 3

و الصواب "ضمن ما خرج" ان خارج القسمة هو نصف قطر الأرض، و لا النصر كله 3

(Nallino)
To know this method is quite conceivable in imagination, and it rests on sound deductions. It is difficult to carry it out in practice only owing to the smallness of the astrolabe (or other instruments) and the little size of the thing on which we have to base our solution. And that method is this: You climb a mountain situated close to the sea or a level plain, and then observe the setting of the sun and find out the dip of the horizon we have already mentioned, and then find the value of the perpendicular of this mountain. You multiply this height into the sine of the complementary angle of the dip, and divide the total by the versed sine of this dip itself. Then multiply (the double of) the quotient into 22 and divide the result of this multiplication by 7. You will get the length of the Earth's circumference (in the same terms or proportion) in which the height of the mountain has been fixed.

We have not so far been able to experiment with this dip, and its value in any high place. We were led to this method by Abul Abbas Al-Nairizi who states, that Aristotenes (?) has mentioned that the heights of the peaks of the mountains would be 5½ miles when the length of the radius of the Earth is 3,200 miles approximately.

For the solution of this problem it is necessary mathematically that the dip of the horizon in the mountain wherein the perpendicular is so high should be about ⅙ degree.

Such matters, however, need actual experiments, and could be verified only by testing.

The Almighty and Wise God alone can help me (in obtaining success in such ventures).

At the time of writing the 'Book on the Astrolabe' Al-Birūnī had not yet made any actual attempt to put his theory into practice owing to, what he thought, the smallness of the instruments of observations, and lack of suitable site, and competent helpers. The method required the presence of a mountain either situated on a level plain or adjacent to the sea, and on the peak of it the observations of the sun setting in the horizon.

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1 Al-Nairizi died shortly after 300 A.H. (early tenth century A.D.).
2 Nallino has demonstrated Al-Birūnī's methods on pp. 291-292 of his Lectures. See Appendix I of this book.