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TAHDÎDÜ NİHÂYÂTÎ'I-EMÂKİN

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- 144 - تحديد نهايات الأماكن.
أبوريحان البيروني.
تصحيح: أحمد آرام.
جامعة طهران: 1353 هـ. ش.
(منشورات جامعة طهران، 1392).

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(د. ت. ، القاهرة)

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Not: Bu Mahale *Taḥdīd Nihayetu'l-Emākin* posetin credit.

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MADE YAYINLANDIKTAN
SONRA ÇIKILAN DOKÜMAN

(Tahdid nihayat al-amakin li tashih masafat al-masakin)

تحديد نهاية الأماكن لتصحيح مسافات المساكن /

تأليف أبو الريحان محمد بن أحمد البيروني : توثيق

و تقديم محمد تاويت التنجي - انقرة : يعقوب

قازدال الريزوي ، ١٩٦٢

294 p.: ill.; 24 cm.

Includes bibliographical references

1. Astronomy I. Altuncı, Muhammad b. Tawit (ed.) II. Author (Arabic) III. Title IV. Title (Arabic)

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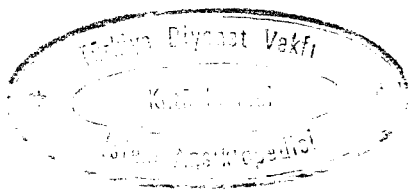
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٢ - تحديد نهايات الأماكن لتصحيح مسافات المساكن

نشره : بولجاكوف

طبعة جديدة .

(مجلة معهد المخطوطات ، القاهرة ، ١٩٦٢)



178 EYLUL 1991

لجنة التأليف والترجمة والنشر

اغناطيوس يوليانو قشتش كراتشكو شسكي

تاريخ

الأدب الجغرافي العربي

نقله إلى اللغة العربية

صلاح الدين عثمان هاشم

قام بمراجعته

إيفور بلبايف

القسم الأول

اختارته

الأكاديمية اللبنانية للدراسات والتاريخ

في

جامعة الدول العربية

Moskova 1957

الفصل التاسع

البيروني وجغرافيو القرن الحادي عشر بالمشرق

بدأ القرن الحادي عشر مشرقاً بالنسبة للعلم العربي ؛ ففي عام ٣٩٠ هـ = ١٠٠٠ م تم تأليف كتابه 244 المشهور « الآثار الباقية » علامة شاب هو البيروني ، وهو كتاب لا مثيل له في جميع آداب الشرق الأدنى . وفي خلال نصف قرن تقريباً من هذا التاريخ لم يتوقف البيروني عن تزويد مختلف فروع العلم بمؤلفاته العديدة التي يمكن القول بأنها بلغت ذروتها بكتابه عن الهند ، ذلك الكتاب الذي وصفه روزن منذ أكثر من خمسين عاماً بأنه « أثر فريد في بابه لا مثيل له في الأدب العلمي القديم أو الوسيط سواء في الغرب أو الشرق »^(١) . وقد أحس العلماء بسمو شخصية البيروني العلمية منذ بزوغ فجر الاستعراب العلمي ، فكاتريمير Quatremère قد لفت إليه الأنظار قبل روزن بنصف قرن تقريباً^(٢) . وكلما توسع العلم وتعمق في التعرف عليه وعلى مصنفااته كلما بدت شخصيته أكثر عظمة وسمواً . وفي أيامنا هذه أطلق سارطون على الفترة التي تشمل منتصف القرن الحادي عشر ، وذلك بالنسبة لتاريخ العلم العالمي ، اسم عصر البيروني لأنه أكبر شخصية علمية عاشت في ذلك الوقت . ولا تزال شخصيته العلمية آخذة في النمو ، فقد تم العثور على مواد جديدة تؤكد أحقية هذا العالم الذي ينتمي إلى بلاد ما وراء النهر لكل ما ناله من تقدير وإجلال :

وحياة البيروني أبعد من أن توصف بالهدوء والاستقرار ؛ ولا نملك إزاء هذا إلا الانحناء في خشوع واحترام أمام النتائج العلمية الباهرة التي توصل إليها والتراث العلمي الحافل الذي أنتجه في ظروف الزمان الذي عاش فيه . ولد البيروني في الثاني من ذي الحجة عام ٣٦٢ هـ = ٤ سبتمبر ٩٧٣^(٣) بضاحية من ضواحي خوارزم ، ومنها أخذ نسبه البيروني التي تنطق في العربية بكسر الباء ولكن في الفارسية تنطق الباء بمالة بعض الشيء (أي تليها e ممدودة) . ويمكن أن نجد إشارة إلى هذا في إحدى النسخ التي كتبها بخط يده حيث يشكل اسمه بالعربية البيروني أي بفتح الباء تليها ياء مسكّنة^(٤) ، يريد بذلك على ما يظهر أن يبين الصوت الممدود e الذي لا يوجد في الكتابة العربية . أما في الاستعمال العربي العادي فقد سرى 245 عليه اسم البيروني بكسر الباء ، وهو الذي سنسير عليه أسوة بما حدث مع اسم المؤرخ الدينوري . والنسبة نفسها غير مستعملة كثيراً ، ولعله إلى جانب المعنى المعروف الذي يشير إليه السمعاني^(٥) وهو « رجل الضاحية » ، تختص إشارة ما إلى أصل مغمور لمؤلفنا . وعلى ضوء هذا فقد لا يكون من قبيل المزاح والفكاهة أبيات البيروني التي حفظها لنا ياقوت والتي يقول فيها^(٦) :

البيروني (محمد بن أحمد أبو الريحان)
 BIRŪNĪ (Abū al-Rayḥān Muḥammad ibn Ahmad al-)

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 بولجاكوف، راجعه . . . ! امام إبراهيم أحمد . . .
 - Le Caire, Matba'at
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 fig., fac sim., tableaux. [A. 23643].

Ms. or. [8° Impr. or. 6810

(Tabḥīd nihāyāt al-amākin li-taṣḥīḥ masāfāt al-masākin Edité par P.G.
 Bulgakov et Imām Ibrāhīm Aḥmad.)

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BIRŪNĪ

البيروني (أبو الريحان
 محمد بن أحمد)

(Abū al-Rayḥān Muḥammad ibn Ahmad al-)

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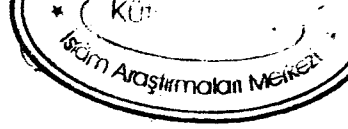
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 الريحان محمد بن أحمد البيروني الخوارزمي . . . حقيقه . . . ب.
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-(Kitāb taḥdīd nihāyāt al-amākin li-taṣḥīḥ masāfāt al-
masākin . . . Établi par B.Poljakoff, revu par Imām
 Ibrahim Ahmad.)

Monde musulman.Astronomie.
 Topographie.X°

A.77277



The Determination of the Coordinates of Positions for the Correction of Distances between Cities

a translation from the Arabic

of

AL-BİRÜNİ'S

Kitāb Taḥdīd Nihāyāt al-Amākin
Litaṣṣih Masāfāt al-Masākin

Türkiye Diyanet Vakfı İslâm Araştırmaları Merkezi Kütüphanesi	
Demirbaş No:	47030
Tasnif No:	910-4/ BİR-T

by

JAMIL ALI

1967 - Beirut.

Madjallat al-Tarih al-Ulūm al-Arabiyya
e. 2 (s. 1) 3. 137-142, 1978 (HALEP)

A Coincidence of Pappos' Book VIII with al-Bīrūnī's Tahdīd

J. L. BERGGREN*

In the early fourth century of our era Pappos of Alexandria wrote his work *The Mathematical Collection*¹ as an aid for those who studied mathematics. Book VIII of this work contains Pappos' account of theoretical and practical mechanics and it includes four problems which the editor of the Greek text, F. Hultsch, characterized as "composed by a mediocre writer according to a mathematical method taught at a time ... later than that at which Pappos lived".²

The purpose of this paper is to draw attention to a coincidence of these problems with methods used by al-Bīrūnī to determine the latitude of a place on the earth's surface. This suggests a context within ancient science for what has hitherto been a rather pointless sequence of problems in Pappos' work. In addition we shall see that Hultsch was mistaken in his remarks about the mathematical method of these problems.

We first translate these four problems of Book VIII following the Greek text established by Hultsch, where they occur as Propositions 15-18.³ We also translate the proofs of 15 and 17.

Proposition 15: First it will be described how, given a suspended circle not in a plane perpendicular to an assumed plane, to find the common section of the two planes and the inclination (Figure 1).

Let there be a suspended circle and choose on it three points A, B, G , and let perpendiculars be drawn from these to the assumed plane. They are drawn thus: Let the line GD falling from G onto the plane be rotated and let it touch the plane at two other points E, Z , and let the centre K of the circle through DEZ be taken. Then the perpendicular from G falls on K , and K is

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1. Pappos of Alexandria, *Collectionis quae supersunt*, ed. F. Hultsch, (Berlin, 1878), vol. III.

2. Pappos, p. 1085, n. 1.

3. Pappos, pp. 1084-96.

11th century treatise on mathematical geography. xx, 270 pp. Beirut: American University of Beirut, 1973. \$10.

Abū Rayhān al-Bīrūnī wrote this book in Ghazna after he had been taken there as a political prisoner by Sultān Maḥmūd in 409/1018 when the latter captured Khwarizm where al-Bīrūnī was friend and counsellor to Abū 'l-Abbās al-Ma'mūn. A copy of the work, at one time thought to be an autograph, exists in Istanbul (MS Sultan Fatih 3386) dated at Ghazna in 416/1025. The aim of the book was to determine the geographical position of the city of Ghazna, in order to calculate the direction of the *qibla*. The ultimate aim was probably to gain the favour of Sultān Maḥmūd, and if this was so, it was successful for al-Bīrūnī retained the favour of Maḥmūd and also that of his successor Mas'ūd to whom he later dedicated his famous *al-Qānūn al-Mas'ūdi*.

The *Tahdīd nihāyat al-amākin* is excellently planned. Al-Bīrūnī begins, after an introductory section on certain aspects of geography, with the determination of the latitude of a place. He follows on with determinations of the obliquity of the ecliptic and with problems connected with the relationships between local latitude and various co-ordinates of the sun's position. Then he discusses determinations of the differences in longitude between two places and so, having found the co-ordinates of several places, leads up to the calculations of the azimuth of one place from another. The final achievement is the azimuth of Mecca, i.e. the direction of the *qibla*, from Ghazna. This was achieved with notable precision. Each section of the text is itself planned effectively and all possible alternative methods known to al-Bīrūnī are given including some of which he does not approve. All the necessary permutations and combinations of two places with respect to each other, or of a place with respect to the sun's position, or the position of a lunar eclipse when calculating longitude, are taken into account. These are more numerous than are necessary for a modern scholar, for al-Bīrūnī was ignorant of negative numbers and positions south of the equator or south of the ecliptic had to be dealt with as separate problems from examples in the north, and examples with one place in each hemisphere had yet different treatment.

Al-Bīrūnī's manuscript is accompanied by numerous figures to elucidate the text. Although al-Bīrūnī is on the whole clear in his description, there are places where he fails to make sense and the fact that he is unable to draw spherical diagrams in perspective makes the need of a commentary by a modern mathe-

matician imperative for the understanding of the text. Al-Bīrūnī himself describes how he made diagrams on a large sphere but he could not transfer these to the flat page, at least so as to make them intelligible to us today.

The Istanbul manuscript was edited by Dr. P. Bulgakov and published by the Cultural Department of the Arab League in Cairo in 1962. Bulgakov then published a Russian translation with notes and commentary in Tashkent in 1966 (*Abu. Reihan. Bīrūnī Izbrannye proizvedeniya*, III). In 1967 Professor Jamil Ali produced a translation in English published by the American University of Beirut and now an English commentary appears under the name of Professor E. S. Kennedy also of the American University of Beirut.

The great importance of Kennedy's work is its clarification of al-Bīrūnī's mathematics with the aid of excellent diagrams which really explain these problems of spherical geometry. In this particular they are a great improvement on the diagrams in the Russian commentary which are often no clearer than those of al-Bīrūnī. For instance Kennedy's diagrams show a circle in perspective as an ellipse and the Russian produces a figure like a bi-convex lens. However Kennedy's book is written by a mathematician for mathematicians: the section numbering, the index of parameters, the use of colons, semicolons, and commas with numbers for various purposes like separating the digits of sexagesimally based numbers, as well as the general style and language make it a frightening book for the ordinary Arabist, or even geographer to delve into. To the non-mathematician some of these idiosyncrasies seem unnecessary like $42:0.35^\circ$ for what is normally expressed as $42^\circ 0' 35''$. The latter system becomes impossible when it comes to eighth parts, but at least some explanation should be given. The Russians use I II III IV V, etc., but this is very cumbersome.

Once the reader has gained the courage to involve himself in the mathematical complexities, this side of the work and the allocation and drawing of the diagrams are excellent and there is no doubt that Kennedy is an expert at interpreting this medieval scientific method. Only a few minor points need be mentioned as leaving the reader in doubt. The reviewer would have liked a more helpful diagram for the Fakhri sextant, sect. 28, p. 48. On p. 54 he cannot see that the equations $\phi = \delta + h$ and $\phi = \delta - h$ are correct from the sequence of equations shown—surely $\bar{\phi}$ is implied in both cases but even then the equations are not clear. Finally on p. 216 'KEL is a right angle' should read 'KLE', but this may be only a typing error.

Now to take a look at the book as a whole and its usefulness as a research tool. It is

arranged as a set of notes to the text with frequent page and line references to the Cairo edition so that it can be used with this edition, with the English translation of Jamil Ali, or even with the Russian translation. The notes, however, are arranged under sections which are consecutively, but arbitrarily numbered and given headings corresponding to the contents of the relevant portion of the text. The difficulty—which to the reviewer is a great one—is that one cannot see where one note ends and the next one begins and hence refer back again from the text or translation to the notes. Usually each new note begins a new paragraph, but when one note carries on into a second paragraph, or as in p. 184 two notes appear to be in one paragraph, confusion reigns. It is very difficult to find if a note exists on a point in the text for which the reader needs clarification.

There are many notes which do not seem to be worthwhile in a work on geographical mathematics—the biographical note on Khālid ibn al-Walid is irrelevant: any reference work will give this if the reader is interested. There are also a few relevant things on which this reviewer would have welcomed a note, e.g. a brief comment on Indian mathematics and its relationship to the work of al-Bīrūnī, a comment on the various types of miles—is al-Bīrūnī and the commentary using Ptolemaic, Arabic, Indian, or English nautical miles? Al-Bīrūnī himself speaks of an Indian mile as if it were different from what he normally used. But there is no explanation of all this anywhere. 1 mile (which?) is 4,000 cubits, 3 miles are 1 farsakh and yet elsewhere 16,000 cubits are 1 farsakh. Another interesting phenomenon unexplained is al-Bīrūnī's strange numbering of the stars of the Great Bear (66:3); the 18th, 19th and 26th stars of the Great Bear. The commentary gives UMa. δ (surely δ UMa. is usual), UMa. γ , and UMa. ζ respectively but for what reason and on what authority? One would like this followed up. Finally what is 'the Yezdegirdian year' and what is 'the motion of a plumb line towards the center' (36:8). Notes on these would have been far more useful than the date of Khālid b. al-Walid's death.

An Arabist would like to see attached to such a book as this, adequate notes on the technical terms. There is no systematic attempt at the technical vocabulary in either Jamil Ali's translation or the Kennedy commentary. Thus *libna* appears in Kennedy's index at 90:15 but is not mentioned in the commentary at all. Terms like *mayl*, *majra al-kawkab* which are explained by Kennedy (p. 119) are not in the index and the explanations are therefore lost for ever. If there could not have been a separate appendix on technical vocabulary at

E. S. KENNEDY: *A commentary upon Bīrūnī's Kitāb tahdīd al-amākin*, an

RSOAS. 38. c, s. 145-147,
1975 (HERTFORD)

ISIS 67.c (s. 239) s. 634-637; 1976
(WASINGTON)

to work in the Goodyear-Zeppelin Corporation of Akron, Ohio, Robinson mentions only one and seems totally unaware that others were later to make significant contributions to air development in the United States. But then his concern is with airships—first and last with structural and flight details. This will delight airship buffs. It certainly will not satisfy historians, however. Time and again the historical dimension is swept aside with such phrases as “for a variety of reasons,” with no attempt at analysis of the political, diplomatic, or economic conditions which underlay many crucial developments. Two glaring examples: Robinson never makes it clear why or by whom the Friedrichshafen sheds were spared after World War I, nor does he explore the U.S. decision to deny helium to Nazi Germany. More significant still is the lack of consistent financial treatment throughout; occasional cost and even less frequent fare figures do not prepare one for the financial obstacle of his concluding passages.

The wealth of economic data provided by Peter Brooks in his contemporaneously published *Historic Airships* is thus one of the advantages possessed by this much shorter but more pointed book over Robinson's. Further, for all of Robinson's attention to flight details, he provides nothing approximating Brooks' tables on “Operating Statistics of Rigid Airships.” Other appendices in *Historic Airships* also contain information either unavailable or at least not readily accessible in Robinson's work.

Both works are well illustrated, the rarity of some of Robinson's photographs being offset by Brooks' inclusion of sixteen beautiful color plates. Between the two books one can acquire a most adequate picture of the manufacture and operation of rigid airships over a forty-year period. But there remains much to anticipate in the forthcoming study of Henry Cord Meyer.

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■ ISLAMIC CULTURES

E. S. Kennedy. *A Commentary upon Bīrūnī's Kitāb Tahdīd al-Amākin, An 11th Century*

Treatise on Mathematical Geography. xx + 270 pp., tpls., indexes. Beirut: American University of Beirut, 1973. \$10.

The works of the unique medieval polymath al-Bīrūnī (973–1048)¹ always deserve the special interest of historians of science. After H. Ritter rediscovered the only existing manuscript of the *Tahdīd* in 1930, extensive excerpts thereof were published for the first time by Z. Velidi Togan in *Bīrūnī's Picture of the World* (Delhi, 1940). An excellent critical edition was published in Cairo in 1962 by P. Bulgakov, who also translated the work into Russian and accompanied this with an elaborate commentary touching mainly on philological and historical questions (Tashkent, 1966). The independent English translation by Jamil Ali (Beirut, 1967) was, however, limited to a literal reproduction of the text alone. Now we have, at last, the indispensable commentary thereon which was announced in the preface of Ali's translation.

The present work testifies once more to the mathematical and astronomical skill and experience of E. S. Kennedy. All formulas have been transcribed into modern symbols and derived exactly; the hundreds of calculations have been recomputed and calculating errors indicated. All figures have been redrafted in a most striking manner. The personalities and books mentioned by Bīrūnī are identified as far as possible, and the observations reported by him have been checked and compared with other sources. Thus the author has excellently filled in the framework set by himself.

As the title implies, Bīrūnī's work is a monograph on the determination of the geographical position of localities. In the first part the principal methods and formulas are derived; in the second (later ?) part, as a sort of worked example, the coordinates of Ghazna, the capital of Bīrūnī's unloved patron Maḥmūd are deter-

¹ The death year 1048 established by E. Sachau (1878) was usually thought to be incorrect from the time of Meyerhof's publication of the introduction to the *Pharmacology* (Max Meyerhof, *Das Vorwort zur Drogenkunde des Bērūnī* (Berlin: J. Springer, 1932); cf. E. S. Kennedy, *Dictionary of Scientific Biography*, Vol. II (New York: Scribner's, 1970), p. 15]. Recently, however, good reasons for its validity were provided by U. Karimov [cf. Bērūnī, *Izbrannye Proizvedeniya*, IV: *Farmakognoziya* (Tashkent, 1973), p. 140].

KITABUT - TAHDID

(An unpublished masterpiece of Al Biruni on Astronomical Geography)

SAYYID HASAN BARANIY*

THE UNIQUE MANUSCRIPT DESCRIBED

MANUSCRIPTS written at Ghaznah in the reign of Sultan Mahmud are extremely rare. Even the archaeologists' efforts have not so far succeeded in discovering more than a few fragments of the decorative Kufic inscriptions from the tower of Mahmud's cathedral mosque, his father Subukutigin and his son Mas'ud's tombs and the famous wooden doors, once wrongly supposed to belong to some Somnath temple, but really pertaining to Mahmud's own mausoleum. Mons. S. Flury has rendered in the review 'Syria', 1925 a valuable account of the few finds recovered by the French mission from the ruins of Ghaznah. From the illustrations published along with the article we can easily judge of the very high standard achieved by the contemporary artists in their epigraphic decorations. But the destruction of Ghaznah, 'the bride of the East', on the embellishment of which its great rulers of the Subuktigin dynasty had so lavishly expanded their treasures, was so complete at the hands of 'Alauddin of Ghur, nicknamed as 'Jahan Soz'', the world burner, in the middle of the sixth Hijrah century, and other subsequent invaders, including Chingiz Khan's Mongols, that the traces of the great monuments, dressed in marble in imitation of India's models, and decorated by the Iranian artists with their best motifs, have all been obliterated. The few remains so far recovered remind us of an original Ghaznavid art, in which for the first time the two great traditions of India and Iran were harmoniously combined.

But my real interest at the moment lies in a manuscript on Astronomical Geography, probably written in the hand of Al Biruni or at least under his supervision. The full title of the book is '*Kitab fi Tahdid-i-*

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