Küre (111569)
MADDE YAYIMLANDIKTAN SONRA GELEN DOKÜMAN 16 Ekim 2016

other positions: *imām* and *khaṭīb* (preacher) of the *jāmiʿ* (congregational mosque) of the *qaṣaba* (citadel of Tunis) and professor in the Madrasat al-ʿUnqiyya, where he taught mainly *fiqh* (jurisprudence). He assisted Ibn ʿArafa in his teaching of the rational sciences, and substituted for him as *imām* and *muftī* (jurisconsult) of the *jāmiʿ* al-Zaytūna, in particular during his pilgrimage in 792–3/1390–1. He also counselled him on many occasions, such as for the appointment of judges or *shuhadāʾ* (witnesses in legal proceedings). After the death of his master, he appears as his main successor, benefitting from the support of the sultan Abū Fāris, who had followed his teachings. Many of Ibn ʿArafa's disciples became his students, and al-Ghubrīnī was appointed *imām, khaṭīb*, and *muftī* of the Zaytūna. After his death, he was buried in the Jabal al-Jallāz cemetery, and his many positions were assigned to some of his disciples, including the jurist and *muftī* al-Burzulī (d. 841/1438).

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DOMINIQUE VALÉRIAN

Globes (celestial and terrestrial)

The celestial **globe** is the oldest form of map, its origins having been traced to Greece in the sixth century B.C.E. The earth, known from early classical antiquity to be spherical, was imagined at the centre of the celestial globe, with the stars placed on the surface. Because this three-dimensional model of the skies presents the stars as seen from outside their sphere, the relative positions of the stars on a celestial globe are the reverse—east to west (or right to left)—of their appearance when viewed from the surface of the earth.

No celestial globes from antiquity have survived, but the basic principles of their design were maintained, with modification and elaboration, in the Islamic world. As early as the third/ninth century, Arabic treatises were composed on the design and use of celestial globes, including works by Ḥābash al-Ḥāsib al-Marwazī (fl. 214–50/829–64), Qusṭā b. Lūqā (d. c. 300/913), and Abū ʿAbdallāh Muḥammad b. Jābir al-Battānī (d. 317/929). Additional treatises were composed in the following centuries, including one by ʿAbd al-Raḥmān b. ʿUmar al-Ṣūfī (d. 376/986), whose better-known treatise on constellations became the model for the iconography of constellations in the Islamic world.

More than 285 Islamic celestial globes are known to be preserved today. The earliest dated globe was made in Valencia, in 478/1085, and globe production continued through the nineteenth century. The stars represented on Islamic globes, regardless of the globes' dates, are those listed in the mediaeval star catalogues, and only the forty-eight constellation outlines recognised in antiquity are shown. When constellation outlines are drawn around the stars, the clothing and faces of the human figures, such as Orion and Virgo, reflect the artistic conventions of the artisan's day. Because the positions of the stars as viewed from earth change over time with the precession of the equinoxes, their positions on a globe, correct when the globe was made, remain valid (within one degree) for only three-quarters of a century.

On every Islamic globe preserved today there is also a set of six great circles at right angles to the ecliptic. These circles,

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İSAM DN. 247016

و علی جارم، بیروت، ۱۴۰۳ق/۱۹۸۳م؛ همو، *البیان و التبیین*، به کوشش حسن سندوبی، قاهره، ۱۳۵۱ق/۱۹۳۲م؛ حمدالله مستوفی، *تاریخ گزیده*، به کوشش عبدالحسین نوایی، تهران، ۱۳۶۲ش؛ زرکلی، *اعلام*؛ سیوطی، *المزهر*، به کوشش محمد احمد جادالمولی و دیگران، بیروت، ۱۹۸۶م؛ *قرآن کریم*؛ قلقشندی، احمد، صبح *الاعشی*، قاهره، ۱۳۸۳ق؛ کلبی، محمد، *جمهرة النسب*، به کوشش ناجی حسن، بیروت، ۱۴۰۷ق/۱۹۸۶م؛ مفضل بن سلمه، *الفاخر*، به کوشش استوری، لیدن، ۱۹۱۵م؛ نجاشی، احمد، *رجال*، به کوشش محمد جواد نایینی، بیروت، ۱۴۰۸ق؛ یعقوبی، احمد، *تاریخ*، بیروت، دارصادر.

حسن یوسفی‌اشکوری

اَکْدَریّه، نک: عول و تعصیب.

اُکَر، عِلْم، یکی از شاخه‌های علم ریاضی که به بحث دربارهٔ کره و خواص آن می‌پردازد. حاجی‌خلیفه در این باره چنین آورده است: «علمی است که بدون توجه به بسیط یا مرکب بودن کره از لحاظ عنصری یا فلکی بودن آن، از احوالی که بر کره عارض می‌شود، سخن می‌گوید. یعنی موضوع این علم ذات کره است» (۱۴۲/۱). در این علم ویژگیهای کره به عنوان یک شکل هندسی بررسی می‌شود و در نتیجه همان‌گونه که ابونصر فارابی بدان اشاره کرده است (ص ۷۸)، باید آن را از فروع هندسه برشمرد. طاش کوپری‌زاده افزون بر آنکه دو مبحث «الاکر المتحرکة» و «تسطیح الکرة» را به صورت دانشهایی مستقل از علم الاکر دانسته (۳۱۸/۱-۳۱۹)، همهٔ این دانشها و مسائل مربوط به آن را از فروع علم هیأت شمرده است. حاجی خلیفه با اعتراض بر طاش کوپری‌زاده، بر آن است که مسائل مربوط به کرهٔ متحرک نیز باید در چارچوب علم الاکر مطرح گردد (همانجا).

مهم‌ترین آثار موجود در این باره و نیز شرحها و اصلاحات آنها بدین‌قرار است:

۱. *الکرة المتحرکة*، نوشتهٔ اطولوقس (آوتولوکوس) ریاضی‌دان یونانی (زنده در ح ۳۰۰ ق م) که مشتمل بر یک مقاله و ۱۲ شکل (= قضیه یا مسأله) بوده است. اسحاق بن حنین (۲۱۵- ۲۹۸ق/۸۳۰ - ۹۱۱م) این کتاب را به عربی ترجمه کرد (GAS, V/82؛ قربانی، *زندگی‌نامه*...، ۱۲۹). ابن ندیم تنها به اصلاح [روایت عربی] آن توسط یعقوب بن اسحاق کندی اشاره کرده (ص ۳۲۸)، و حاجی‌خلیفه افزون بر تکرار این سخن، از ترجمهٔ آن در زمان مأمون یاد کرده (همانجا)، هرچند نام آن را به صورت *الاکر المتحرکة* آورده است. در متن چاپی تحریر نصیرالدین طوسی از *الکرة المتحرکة*، اصلاح کتاب به ثابت بن قره نسبت داده شده است («تحریر الکرة المتحرکة...»، ۲؛ نیز نک: قربانی، همان، ۲۰۹)، اما به نظر می‌رسد که این تفاوت ناشی از خطایی باشد که در نسخ خطی پدید آمده است و یا شاید بر اثر خلط میان این کتاب و *الاکر* ثئودُسیوس[1] باشد که توسط ثابت بن قره اصلاح شده است. گراردوس کرمونایی[2] این کتاب را به لاتینی ترجمه کرده است (هاکسلی، 339).

۲. *الاکر*، نوشتهٔ ثئودسیوس (در مآخذ عربی اغلب ثاوذیوس و گاه به صورتهای تاودسیوس و ثیودورس) ریاضی‌دان یونانی (نیمهٔ دوم سدهٔ ۲ ق م). ابن ندیم این کتاب را دارای ۳ مقاله خوانده (همانجا)، و قاضی صاعد اندلسی از مؤلف با عنوان «صاحب *الاکر*» یاد کرده است (ص ۱۸۰). این کتاب از مشهورترین کتابهای «متوسطات» (آثاری که در برنامه‌های درسی قدیم پس از *اصول* اقلیدس و پیش از *مجسطی* بطلمیوس خوانده می‌شد) به شمار می‌آمد (حاجی خلیفه، همانجا). نصیرالدین طوسی در مقدمهٔ تحریر این اثر («تحریر الاکر...»، ۲) چنین آورده است: «۳ مقاله دارد و بیشتر نسخه‌های آن مشتمل بر ۹۵ شکل است، اما برخی نسخه‌ها یک شکل کم دارد». ابوالعباس احمد بن محمد بن معتصم (مستعین بالله) دستور داد که آن را ترجمه کنند. پس قسطا بن لوقا این کار را برعهده گرفت و در حدود سال ۲۵۰ق/۸۶۴م تا شکل پنجم از مقالهٔ سوم را ترجمه کرد. اما ترجمهٔ دیگر قضایا را کسی دیگر برعهده گرفت و ثابت بن قره آن را اصلاح کرد (قس: قربانی، همان، ۵۰۴). حاجی خلیفه از تحریر تقی‌الدین محمد بن معروف راصد (د ۹۹۳ق/۱۵۸۵م) نیز یاد کرده است (۱۴۲/۱).

۳. *الاشکال الکریة*، نوشتهٔ منلائوس اسکندرانی[3] (زنده در ح ۱۰۰م). اسحاق بن حنین این کتاب را به عربی ترجمه کرد (GAS, V/273؛ قربانی، همان، ۱۲۸، ۴۳۴). ابن ندیم (ص ۳۲۷) تنها به نام این اثر اشاره کرده است (نیز نک: صاعد اندلسی، همانجا). چند تن از ریاضی‌دانان دورهٔ اسلامی این کتاب را با عنوان *اصلاح کتاب مانالاوس فی الاشکال الکریة* تحریر کرده‌اند، از جمله:

الف ـ ابوعبدالله محمد بن عیسیٰ ماهانی (د ح ۲۷۵ق/۸۸۸م). به گفتهٔ ابوالفضل احمد بن ابوسعد هروی این اصلاح ناقص بوده است. از این اصلاح در حال حاضر نسخه‌ای در دست نیست (قربانی، همانجا).

ب ـ ابوالفضل هروی. نام اصلاح وی به شکل کتاب *مانالاوس مما اصلحه احمد بن ابی سعد الهروی* نیز آمده است. هروی در این کتاب دربارهٔ اصلاح ماهانی چنین آورده است: «در آنچه ماهانی اصلاح کرده بود، تأمل کردم و دریافتم که در گذر زمان خلل بسیار در آن وارد شده بود. پس آنچه را اصلاحش واجب بود، از نظر لفظ و معنی و برهان اصلاح کردم» (قربانی، *ریاضی‌دانان*...، ۶۷، ۱۱۸-۱۱۹، *زندگی‌نامه*، ۱۰۰، ۴۳۴؛ نیز نک: *آلوارت*، V/316).

از اصلاح ابوالفضل هروی دو نسخه یکی در لیدن و دیگری در استانبول (شم ۳۴۶۴/۵) موجود است. نسخهٔ استانبول ۳ مقاله دارد که به ترتیب دارای ۶۰، ۱۸ و ۱۰ شکل است (کراوزه، 466؛ قربانی، *ریاضی‌دانان*، ۱۱۸). نصیرالدین طوسی در تحریر خود بارها از این اصلاح نام برده است («تحریر کتاب مانالاوس»، ۲، جم). ماکس کراوزه گزیده‌ای از این کتاب را به زبان آلمانی ترجمه کرده که در ۱۹۳۶م

1. Theodosius 2. Gerardus Cremonensis 3. Menelaus of Alexandria

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TROIS ACTES DE VENTE DAMASCAINS DU DÉBUT DU IVe/Xe SIÈCLE

PAR

JANINE SOURDEL-THOMINE

ET

DOMINIQUE SOURDEL

Parmi les documents anciens provenant de la grande mosquée de Damas et actuellement conservés à Istanbul au musée des Arts turcs et musulmans [1]), documents que nous avons eu l'occasion de prospecter, grâce à l'obligeance des autorités turques compétentes [2]), au cours de récentes missions dans cette ville, figurent trois pièces d'archives que leur intérêt tout particulier pour l'histoire économique et sociale nous autorise à isoler de cet ensemble énorme, mais quelque peu disparate [3]).

Il s'agit de trois actes de vente, de formulaire et d'aspect comparables, dont l'ancienneté ne saurait faire de doute, bien que deux d'entre eux seulement soient datés, et dont le contenu se rapporte à des domaines ou maisons expressément localisés dans des villages des environs de Damas. Les deux textes datés sont consignés sur les deux faces d'une

1) Voir sur cet imposant ensemble, qui n'a encore été que partiellement inventorié, J. Sourdel-Thomine et D. Sourdel, *Nouveaux documents sur l'histoire religieuse et sociale de Damas au moyen âge*, dans *REI*, XXXII, 1964, pp. 2-25.

2) Nous remercions ici tout particulièrement M. Can Kerametli, conservateur du Türk ve Islam Eserleri Müzesi, ainsi que M. Hayrullah Örs, directeur général du Musée de Topkapî Saray, qui nous ont ouvert libéralement l'accès à ce fonds d'archives et se sont employés à toujours faciliter notre travail sur place. Qu'ils soient de nouveau assurés de toute notre gratitude.

3) Rappelons que la grande masse de ces documents est constituée par des fragments de Corans anciens sur parchemin, d'un extrême intérêt paléographique, au milieu desquels se trouvent dispersés les vestiges de quelques textes littéraires, de sujet principalement religieux ou juridique, et un nombre relativement restreint de pièces d'archives de dates et de natures diverses.

longue et étroite feuille de parchemin, actuellement de 50 sur 22 cm., dont un morceau fut anciennement coupé dans le bas et un côté sérieusement endommagé par le feu: toutes les lignes en sont donc incomplètes, le début en manquant sur une face et la fin sur l'autre, mais les dégâts ont été particulièrement graves pour les lignes 7, 15, 22 du texte n° 1 et pour les lignes 6-7, 16-17, 24 du texte n° 2 qui semblent correspondre aux trois pliures de la feuille de parchemin. Le troisième texte, non daté, avait été écrit sur une feuille de parchemin de dimensions comparables, mais dont il ne subsiste plus aujourd'hui que le quart supérieur droit (20, 5 sur 10 cm.): les parties manquantes paraissent en avoir été tout simplement coupées.

Ces divers fragments, également tachés et abîmés par l'humidité au point que par endroits l'encre de leurs caractères s'est effacée et qu'ailleurs leur fond noirci et bruni n'y laisse plus déchiffrer qu'avec peine quelques traces d'écriture, remontent visiblement à la même époque. Non seulement les formulaires de leurs actes font preuve d'une quasi-totale similitude — ce qui a permis d'en restituer certaines parties en les complétant les uns par les autres —, mais leurs styles d'écriture sont nettement apparentés. Des formes de lettres comparables, tracées avec la même encre sépia et le même calame susceptible de déliés extrêmement fins, s'y reconnaissent dans chaque cas.

On remarquera notamment les *alifs* effilés du bas et se prolongeant en finale au-dessous de la ligne, tout en débutant parfois par un mince crochet à la partie supérieure, les *ǧīms* et autres lettres de même catégorie descendant obliquement au-dessous de la ligne de base, les *dāls* triangulaires nettement posés sur la ligne, les *ʿayns* aux angles accusés, les *fāʾs* et *qāfs* aux têtes empâtées, les *ṭāʾs* allongés à hampe oblique finement dessinée, les *kāfs* parmi lesquels des spécimens de type anguleux très ancien (avec graphie voisine de celle des *ṭāʾs*) se maintiennent à côté de lettres finales au tracé plus simple, les *mīms* triangulaires et empâtés, les *hāʾs* dont le type médial reproduit exactement en cours de mot le type initial déjà classique, les *yāʾs* dont le retour se fait parfois encore vers la droite, en particulier dans les mots *fī* et *ʿalā*, les *lām-alifs* enfin de tracé souple et nettement incurvé vers la droite. Par ailleurs

JHA i (1970), 20–38

THE SOLAR ECLIPSE TECHNIQUE OF YAḤYĀ B. ABĪ MANṢŪR

E. S. KENNEDY* and NAZIM FARIS
The American University of Beirut

1. *Introduction*

Sometime early in the ninth century a certain astrologer known as Bizīst son of Fīrūzān read and interpreted the horoscope of one Māzyār, prince of Ṭabaristān under the overlordship of the Abbasid Caliph. Māzyār's domain just south of the Caspian was part of a region which had successfully resisted the Arab invaders long after the rest of Iran succumbed, and it remained a centre of Iranian culture after its eventual penetration by Islam. Sometime before 830, Bizīst turned Muslim, Arabized his Persian name into Yaḥyā bin Manṣūr (usually in the literature bin Abī Manṣūr), and became a *nadīm* (boon companion) of the Caliph al-Ma' mūn. In fact, he founded a sort of dynasty of boon companions, a son, two grandsons, and a great-grandson following the same calling. To historians of science he is known as an astronomer, having participated in the work of the Abbasid observations at Baghdad and Damascus. He wrote a famous zīj, an astronomical handbook extant in a single corrupt copy, Escorial MS Ar. 927. This document is of great interest as being one of the few surviving examples of the earliest Islamic astronomy. However, it is also a frustrating book, for some portions of it are the work of later scientists, sometimes interpolated without indication of authorship[1].

This paper discusses those parts of Yaḥyā's zīj which have to do with solar eclipses. There are three numerical tables and a set of cryptic directions for computing eclipses. Section 2 below describes the first table. It defines a periodic function resembling a somewhat distorted sine wave. Embedded in the function are two numerical parameters worthy of mention. One is a geographical latitude valid for Yaḥyā's native province of Ṭabaristān, and permitting the inference that he brought the table and its attendant doctrine south with him to Baghdad. The additional supposition, that he inherited his technique from earlier, perhaps Sasanian, practitioners seems reasonable. The other parameter is Ptolemy's value for the inclination of the ecliptic.

The second table, described in Section 3, turns out to be an approximation to lunar parallax in the altitude circle. This table names Yaḥyā in the title, and is in turn referred to in the explanatory text. Thus all the material is firmly tied to the author of the zīj. Section 4 discusses the third table, which gives eclipse magnitudes and durations. Sections 5 and 6 consist respectively of a translation of and a commentary upon the text's explanatory material.

Yaḥyā's directions give no rationale for his operations, much less proofs, and it would have been difficult to surmize the principles behind his rules had not an independent but related source been at hand for comparison. Ibn al-Shāṭir was a well-known astronomer of fourteenth-century Damascus. His zīj contains

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material on eclipse computations which follows the best theory of his day. In addition to this, however, he presents an alternative, archaic method, in a separate chapter which was put into English some years ago by Dr Adnan Ifram. We reproduce this translated chapter below in Section 7, with a commentary in Section 8, for it turns out that the technique preserved by Ibn al-Shāṭir is along the same lines as Yaḥyā's, but much better explained. What is more, as is pointed out below, both Yaḥyā and the chapter from Ibn al-Shāṭir exhibit close affinities with the eclipse material of Yaḥyā's contemporary al-Khwārizmī, who in turn is closely linked to Indian sources. Thus our study contributes, though infinitesimally, to solving the general problem of the origin and transmission of science in antiquity.

For easy reference, symbols used in the sequel are assembled below:

- A_ϕ denotes oblique ascensions at latitude ϕ, in particular
- A_o is for right ascensions,
- $\bar{a}_e$ is the length of the great circle arc drawn from the zenith normal to the ecliptic, in the medieval texts called the "latitude of visible climate", Arabic '*arḍ al-iqlīm l'il-rū'ya*.
- β terrestrial latitude, north being taken as positive,
- δ declination,
- e elongation of the Moon from the Sun, $\dot{e}$ rate of elongation,
- ϵ inclination of the ecliptic,
- ϕ terrestrial latitude,
- H the ascendant, horoscope,
- λ celestial longitude, $\dot{\lambda}$ rate of change of λ,
- M upper midheaven,
- m used as a subscript, stands for the Moon,
- μ eclipse magnitude,
- n the ascending lunar node,
- p parallax,
- r apparent radius of the Sun or the Moon,
- s used as a subscript, stands for Sun,
- t time in hours from first contact to the middle of an eclipse.

References to passages from the sources give the folio and line numbers separated by a colon.

2. *The Jadwal al-Samt*

The Arabic word *samt* in ordinary discourse means "way", "road", or "manner", but in a medieval astronomical context it has the standard technical meaning of "azimuth". In fact, the English word is derived from the plural *al-sumūt*. Hence an immediate impulse would be to translate the title as "azimuth table". As will be seen below, however, the table has nothing to do with azimuths, and no plausible explanation for the title presents itself.

The work appears on ff. 9v, 12r, and 12v of the Escorial text, in considerable confusion. For one thing, the gap of two folios between the parts of the table contains, in part, calendary material, a subject independent of eclipses. This situation is not explicable simply as a result of the folios having been bound in

watered-down notion of 'divinity' of a king was alien to the indigenous ESA culture.

In conclusion, I think it is inappropriate to envisage the polity at the head of which an ESA king stood as resembling in any way the modern, or even the medieval European, concept of a 'state'. Rhodokanakis' elaborate description of 'state organization' incorporated in the *Handbuch* is vitiated by his having taken as his model the bureaucratic, highly centralized administration of Roman Egypt. I venture to think that nobody who has seen with his own eyes (Rhodokanakis did not) the terrain of South Arabia could credit such a picture. Ancient South Arabia must have been what it always has been throughout history (until the automobile and the aeroplane revolutionized the means of communication): a cluster of relatively small areas, each with its own ethos and customary law, little affected by other areas. The sort of dominance which one area could impose on another can have amounted to little more than a matter of military policy and the exaction of tribute. The edicts which we have always specify a particular group or *ša'b* to which they apply, and are not of general application like the laws of a modern state.

N.B. Although it has been convenient in the footnotes to cite J. Ryckmans' *Institution monarchique* and my 'Problems ...' for certain factual data of the inscriptions, it should be clearly understood that neither he nor I would now adhere to all the interpretations of the data suggested in those works.

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BIENS FONCIERS CONSTITUES WAQF EN SYRIE FATIMIDE POUR UNE FAMILLE DE ŠARĪFS DAMASCAINS

PAR

JANINE SOURDEL-THOMINE

ET

DOMINIQUE SOURDEL

Peu nombreuses demeurent, pour la période de la domination fatimide, les pièces d'archives susceptibles de fournir quelques renseignements précis sur la vie économique et sociale en Syrie. C'est ce qui donne une valeur particulière au document incomplet, mais assez long néanmoins pour fournir de multiples détails descriptifs, que nous avons extrait de la collection de parchemins et papiers damascains conservés au Türk ve Islam Eserleri Müzesi d'Istanbul. On sait que cette collection, constituée après le transfert à Istanbul des fragments manuscrits de toute nature qui avaient été sauvés de l'incendie, en 1892, de la grande mosquée de Damas où on les avait accumulés pendant des siècles, fait de notre part l'objet d'un dépouillement qui est en cours [1]) et qui nous a déjà permis, soit de présenter quelques vues d'ensemble de son contenu [2]), soit de publier en leur entier des documents auxquels nous avons eu le temps de nous intéresser plus particulièrement [3]).

1) A ce propos nos remerciements s'adressent, une fois de plus, à M. Can Kerametli, directeur du Türk ve Islam Eserleri Müzesi, qui nous a libéralement ouvert l'accès à ce fonds d'archives et s'est toujours employé à nous faciliter sur place les conditions de travail avec une amicale obligeance dont nous lui restons particulièrement reconnaissants.

2) Voir J. Sourdel-Thomine et D. Sourdel, *Nouveaux documents sur l'histoire religieuse et sociale de Damas au moyen âge*, dans *Revue des Etudes Islamiques*, XXXII, 1964, p. 2-25, et *A propos des documents de la grande mosquée de Damas conservés à Istanbul, résultats de la seconde enquête*, dans *REI*, XXXIII, 1965, p. 6-85 et 4 pl. h.t.

3) Voir J. Sourdel-Thomine et D. Sourdel, *Trois actes de vente damascains du début*

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London 1971, 8). The navigation of the Kur has only once played a part in political history, at the time of the destruction of the town of Bardhaʿa [*q.v.*] by the Rūs in 332/943-4. Some 100 miles west of the Caspian Sea [see BAḤR AL-ḴAZAR], the Kur is joined by the river Aras [*q.v.*], and the "united waters find a double mouth along the sandy foreshore of the Caspian" (Allen, *loc. sit.*) in the Gushtāsfī district. Just east of the confluence with the Aras, the Kur is crossed by a bridge at Djawād. In Islamic times, the Kur formed the boundary between the province of Ḳarābāgh or Arrān [*q.vv.*], and the regions of Shīrwān [*q.v.*] and Georgia [see AL-KURDJ].

Bibliography: Given in the article.

(W. BARTHOLD - [R. M. SAVORY])

AL-KURA, the sphere.

1. The sphere itself. The Arabs studied the properties of the sphere, following Euclid, Archimedes and Theodosius. They also dealt with certain principles of spherical trigonometry, which form the foundations for astronomical theory, the principle of the transversal (*shakl al-ḳaṭṭāʿ*), the principle of the four magnitudes (*al-shakl al-mughnī*) and the principle of the shadow, i.e. of the tangent (*al-shakl al-ẓillī*) following Menelaus and Ptolemy. (On the translations cf. M. Steinschneider in *ZDMG*, i [1896], 161 ff.; the mathematical principles are discussed by H. Bürger and K. Kohl, *Axel Bjørnbo Thābits Werk über den Transversalensatz*, in *Abhandl. zur Gesch. der Naturwissenschaft und Medizin* [1924], part 7, pp. 1-91; references are given there to the earlier literature also).

2. *al-Kura dhāt al-kursī* (the globe mounted on a stand) is used in two senses:

(a) The globe of the heavens (instead of *al-kura* we also find *al-bayḍa*, the egg, in this sense, e.g. in *Mafātīḥ al-ʿulūm*, 235, in al-Battanī, *Opus astronomicum*, ed. C. A. Nallino, 1913, i, 138; cf. E. Wiedemann, *Beitr. iii*, in *SBPMS Erlg.*, xxvii, [1905], 239 ff.). The constellations are painted on a globe. It is placed in a ring which stands on 3 or 4 legs Such globes have been prepared and described. perhaps as early as by Hipparchus, at any rate by Ptolemy. Ptolemy's description is given in the Arabic translations of the *Almagest* and in separate treatises. One such globe, erroneously ascribed to Ptolemy, was seen in Cairo in 435/1043-4 by Ibn al-Sandbadī (cf. Ibn al-Ḳifṭī, 440). The globes were made of wood covered with paper or with different metals. Hollow globes could also be made of metal, which were then fastened to wooden spheres. ʿAlam al-Dīn Ḳayṣar al-Taʿāsīf used a gilt wooden globe (Abu 'l-Fidāʾ, *Annales*, ed. Reiske, iv. 497; H. Suter, *Mathematiker*, no. 358). The making of such globes and the errors that occur in them were fully discussed by al-Bīrūnī (*Beitrage zur Gesch. der Mathematik, etc.*, in *Abhandl. zur Gesch. der Naturwiss. und Medizin*, part 4 [1922], 79-93; cf. also H. Schnell, *ibid.*, in a later part).

The astronomical instrument prepared by al-Idrīsī for King Roger of Sicily was apparently an armillary sphere.

(b) *al-Kura dhāt al-kursī* is also an arrangement by which one follows the movements of the heavens. The horizontal ring is directed to the horizon; it is notched at right angles in two opposite points, a meridian ring is placed in the notches and allowed to go to its lowest position in a groove. The globe itself turns round an axis which is placed in round holes at two opposite points on the meridian ring. Divisions are marked on the horizon and on the meridian ring. By turning the meridian ring in its grooves, the axis of the globe can be inclined at will to the horizon and the instrument can thus be used for all latitudes. A quadrant with divisions which can be placed on the globe enables many kinds of measurements to be taken. With this globe, the magnitudes of importance in astronomy, *al-ṭālīʿ*, *al-maṭālīʿ*, the props of the earth etc., can be obtained.

The oldest Arabic work on the subject is by Ḳusṭā b. Lūḳā [*q.v.*] and exists in Arabic in several editions, e.g. that of al-Marrākushī; it may go back to classical originals, as is probable in view of the author's relation to the Greeks. It was also translated into Latin, and into Spanish by Alfonso of Castile (*Libros del Saber*, i).

If the globe is left out and a series of other rings is added to the horizon and meridian rings, which correspond to circles in the heavens, we get the armillary sphere (*ālat dhāt al-ḥalaḳ*), the instrument with the rings with which the ancients, the Arabs and notably Alfonso of Castile, occupied themselves a great deal.

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3. *al-Kura al-muḥarriḳa*, the burning-glass (lit. the strongly-burning globe). Even the ancients knew the property possessed by rock crystal and glass globes of concentrating sunlight falling upon them on one point and setting alight an inflammable material there. But we find no indications that any scholar of antiquity studied the theory of this phenomenon. Ibn al-Haytham and Ḳamāl al-Dīn al-Fārisī [*q.vv.*] investigated this theory very brilliantly. Ibn al-Haytham starts from the values, given in a table of Ptolemy's and collected by himself also, of the angle of incidence, angle of divergence and angle of refraction of a ray of light falling on a smooth surface of glass, and investigates the path of the rays when they strike the surface of the globe at different distances from the axis drawn between the sun and the centre of the ball. It is proved that after refraction they all meet on the opposite surface of the globe in a little section from which they emerge with their direction altered. They cut the axis at different distances from the ball: the majority, however, meet at a point distant less than half the radius of the ball, and this is the burning point. If drawings are placed in the cone of rays formed by the rays coming from it, for example a red circular surface with a black ring upon, it and this is looked at through the front of the ball, remarkable figures are seen; these were also studied very fully by Ibn al-Haytham and Ḳamāl al-Dīn; they were able even then to reach the same results as Schellbach at a later date.

Bibliography: J. Würschmidt, *Die Brennkugel*, in *Monatshefte für den naturwissenschaftl. Unterricht*, iv (1911), 98-113; E. Wiedemann, *Beitr. xix, Über die Brechung des Lichtes in Kugeln nach Ibn al-Haitam und Ḳamāl al-Dīn al-Fārisī*, in *SBPMS Erlg.*, xlii (1910), 15-58; cf. also the references in the article ḲAWS ḲUZAḤ.

(E. WIEDEMANN)

KŪRA, a term designating, in the geographers and in official documents, an administrative unit within a province. It was felt as being a loan