

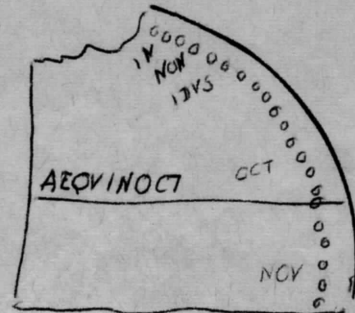
February 26, 1971

54 Rue de Tenbosch, Brussels

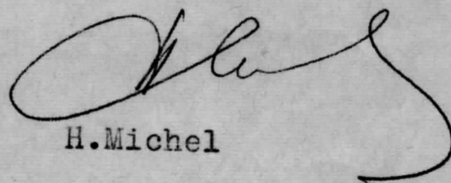
My dear Professor Price,

When Miss Sharon Gibbs was here on Feb.9, I advised her to meet Mrs Suzanne Young, who had been busy, years ago, with the American Archaeological Foundation in Athens and could advise her about greek sundials etc. Mrs Young was then in the States, but I have been informed to-day that she died, quite unexpectedly, in January last. I do not know whereto reach Miss Gibbs, and if you have an occasion to send her a word, please tell her that this source of informations is no more available.

I have better news for you and for Miss Gibbs. I was recently in Saint-Germain-en-Laye, near Paris, where I visited the Musée des Antiquités Nationales. I found there a fragment of a mechanical calender, gallo-roman, discovered in Grand (Vosges) and catalogued as Collection Hoffmann, n° 31433-53080. It can be found in the main room of the gallo-roman exhibition, where the large mosaic is displayed, in a side-show-case, and deserves a thorough study. It is a bronze circular plate, about 40 cm Ø, but the quarter part of which is there. The plate was certainly rotating, as some circular scratches demonstrate. Its rand is marked with small holes, which might have been a gearing moved by some tooth-wheel. As far as I could see, each hole corresponds to one day. There is a calenderic graduation, in months, nonae, idus etc., and a single (not diametral) line marked "AEQUINOCT". You shall certainly consider this as a very interesting document, and if Miss Gibbs goes to Paris during her trip in Europe, she could try to get more informations. The keeper of this Museum is Mr. Joffroy, to whom I wrote on Feb. 16, asking wether this calendar had already been studied or described.



With my best wishes for Miss Gibbs and my friendly greetings.


H. Michel

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

March 8, 1971

Monsieur Henri Michel
54, rue de Tenbosch
Bruxelles 5
Belgium

Dear M. Michel:

I have immediately sent a copy of your letter to Sharon Gibbs to tell her the sad news about Mrs. Young and to alert her to visiting the Musée des Antiquités Nationales in Saint-Germain-en-Laye. I am delighted at your finding the famous long lost disc from Grand. You will find it referred to in footnote 8 of my paper "Portable Sundials in Antiquity", Centaurus, Vol. 14, No. 1, pp. 252-266, 1969, page 264, "The disc was sold by auction 28,29 May 1888, being item 653 in the H. Hoffmann Collection at Hotel Drouot, Paris." It was published by L. Maxe-Werly, Memoires de la Societe Nationale des Antiquaires de France, 1887, vol. 48, pp. 170-178, see footnote 15 in my paper "On the Origin of Clockwork, Perpetual Motion Devices and the Compass", Contributions from the Museum of History and Technology, Smithsonian Institution, Washington, 1959, pp. 82-112, page 91.

I have written immediately for photographs of the dial which I think is either an anaphoric clock plate or equally probably a sundial where one sets a peg upright at the hole appropriate to the date of observation. For all the rest the Maxe-Werly publication is really very good except for the absence of a photograph at that early date. I suppose I must have written thirty or forty letters trying without success to find the present resting place of the fragment. Thank you very much.

Yours cordially,



Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

march 13, 1971

Dear friend,

Calendar of Grand.

Here is Price again, with his innumerable documents about everything. Thank you for the reference to MAXE-WERLY. I had the Compte-rendu de l'Académie des Inscriptions, 1888, p. 20, and the Revue Archéologique, 1887, p.236, where Heron de Villefosse refers to a paper by G. de la Noë, describing and explaining the Calendar of Grand; but I was unable to find this paper itself. Your reference to L. Maxe-Werly enables me to read de la Noë's paper, which is reproduced in this Mémoire de la Soc. Nat. des Antiquaires de France, 1887, p. 170.

Meantime, Mr. Joffroy, curator of Saint-Germain, has sent me two photographs (face and back) of the calendar. There is nothing on the back. The photos are somewhat dark, but can easily be deciphered. I made a sketch, of which I enclose a copy for you. The scale is that of the photograph, i.e. 64 %.

By comparing Mr. Joffroy's photographs with the article of Maxe-Werly, I see that there was another bit of this calendar. I cannot remember whether this part was in Saint-Germain; but anyhow, it adds very little to what we can see on the main part.

I do not need to tell that I do not agree with de la Noë's explanation. Here are my remarks:

- 1) The Grand Calendar cannot be a part of an anaphoric clock: its graduation is retrograd (clockwise); the ecliptic of an astrolabe must be graduated counter-clockwise, as visible on the Salburger clock.
- 2) How could the precise duration of the shortest day (which de la Noë fixes to 8 h 57 m at the latitude of Rome) be measured within one minute, in the III century? Even the hours were ill measured. Even if one admits 9 h for the shortest day, how could " la longueur du jour aux 1er octobre, 1er novembre, 1er décembre, 1er janvier, 1er février et 1er mars" (Maxe-Werly, page 177, foot-note) be known to a minute !
- 3) There must have been on the Grand Calendar an important rotating part, which is missing. I have drawn on my sketch a few of the numerous circular scratches, which extend from the center up to the rand of the disk. These scratches have the same center as the disk; there is no trace of a pivot or of anything like it, the crossing point of the aequinoctial line and the meridian, as is the case on the Salburger disk. The latter is certainly a part of an anaphoric clock; the Grand Calendar not.

Some other observations:

see page 2

4) According to Maxe-Werly and de la Noë, the dates of entry in the successive signs of the Zodiac are marked: VIII Kal... The photographs show that these points were marked VIII(Kal)... which is better: e.g. the autumn equinox at VIII Kal.Oct. corresponds to September 24, while VIII ante calendas Oct. would mean Sept. 25, thus somewhat late.

5) De la Noë is at a loss to explain "l'inégalité de la longueur des arcs qui correspondent aux différents mois" (p.173). This is quite normal for "concentric calendars" (my *Traité de l'Astrolabe*, page 174). We can thus admit that the calendar was concentric to a zodiacal graduation. But why should this zodiac be on a separate plate, turning on the calendar's center?

As you see, the Grand Calendar puts many questions, and I should be glad if one of your pupils could help to settle them. I am completely lost in this problem; so, as soon as you have an idea, let me know it, and liberate me of this nightmare.

Friendly yours

H.Michel

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

April 12, 1971

Monsieur Henri Michel
54, rue de Tenbosch
Bruxelles 5
Belgium

Dear M. Michel:

I send you at this time for your collection a re-drawing from your diagrams at exactly half size of the original all the extant Siun-Ki sorted according to type. In the list of extant specimens X is of course my own. The first sheet shows the four-lobed discs which I think are meaningless or faked. The second sheet shows the plain three-lobed variety. Sheet 3 shows the two irregular specimens which may be broken or unfinished, if not damaged. Sheet 5 under the headings K-Q shows the basic three-lobed variety with serrations and on sheet 6 under the letters R-W you have the complete Siun-Ki containing the lobes, serrations and the two engraved lines. Lastly, I present my disc which is by far the largest and most complete of all in which one can see, I think, exactly how the lobes, serrations and lines were intended to be placed.

As to the Gallo-Roman disc at the Musee des Antiquites Nationales in Saint-Germain-en-Laye you will be pleased to hear that it is now quite clear that the disc is engraved with a proper stereographic projection of the ecliptic, that is to say the space between the 182 ^{or} and 183 holes is exactly what it should be on this hypothesis. I think there was a radial pointer containing a disc of the sun which was pegged into place and the whole disc was then rotated about the pole of the ecliptic as the dial plate of an anaphoric clock.

Many thanks for your help on both these matters.

Yours very cordially,



Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

encl.

5 , April 18, 1971

54 Rue de Tenbosch

My dear Professor Price,

I am quite interested in your classification of Hsuan-chi, and shall be glad to see your conclusions. My compliments for your own purchase, which is exceptional.

As to the Grand Calendar, I do not immediately agree with your opinion. The projection certainly intends to be a stereographic one, but is wrong: In a good stereographic projection, the radius of the Aequator being taken as a unity: 1, the radius of the Capricorn should be 0,656: Oc = 0,656 OE = 0,656 OW

On the Grand Calendar, the radius of the Aequator OW ~~or~~ OE is 160 mm and the radius of the Capricorne OC 120 mm; the proportion is thus 0,75 instead of 0,656.

Now, you may tell me that even if the proportion is wrong, the principle may be right. But how do you explain that the calenderic graduation between C and E goes clockwise, while on an astrolabe, the graduation of the ecliptic goes counter-clockwise ?

Finally, what I consider as the most important point is that the scratches on the disk are circles, whose center is O', center of the Ecliptic, and not O, center of the Aequator. (Of course, O' is not the projection of the pole of the Ecliptic)

Since the rotating part moved on O', one might infer that the system was projected on the plane of the Ecliptic, and showed the movement of a planet (or planets) as on an aequatorium. Is that possible, and is this suggestion admissible on a gallo-roman instrument ? In this case, O' would be the projection of the pole of the Ecliptic.

Very truly yours

H.Michel

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

May 3, 1971

Monsieur Henri Michel
54, rue de Tenbosch
Bruxelles 5
Belgium

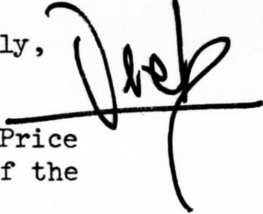
Dear M. Michel:

How nice to get a letter from you that I can argue with! Usually I can only wonder that we have done everything so much in the same way with the same results.

Now about the Grand Calendar, I do not believe you! In the first place it is no argument at all to say that it cannot be part of an anaphoric clock because its graduation is retrograde [clockwise]. First, we may have the back of the disk instead of the front and, second, there is no reason whatsoever why they would not have laterally inverted the whole design.

What is more important, and I say with glee that you haven't discovered it, is that the sun could only be about $2/3$ of the way along the radius from the center of the plate to the circle of holes. This must be true if we are to suppose that the declination of the ecliptic should be about 24° . If one assumed that the sun were plugged into the holes directly, the stereographic projection would correspond to a declination of only 16° which would be absurd and is, of course, suggestively near to exactly $2/3$ of the right value. So there was a radial arm fixed in position by plugging into the hole but carrying a disk of the sun $2/3$ of the way along from the center. This is, of course, the missing part that has caused the circular scratches. I am puzzled by your being puzzled about the measurement of the length of the shortest day. The conventional value of shortest day and longest day go back to Ptolemy and before that to the Babylonian tradition which divides the world into various zones or regions of longitude by day lengths rather than by latitude. There was a well-known relationship and conversion table and, what is more important, a well-known canonical system so that everybody knew day length of important places as we know latitudes of important places today.

Yours very cordially,


Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

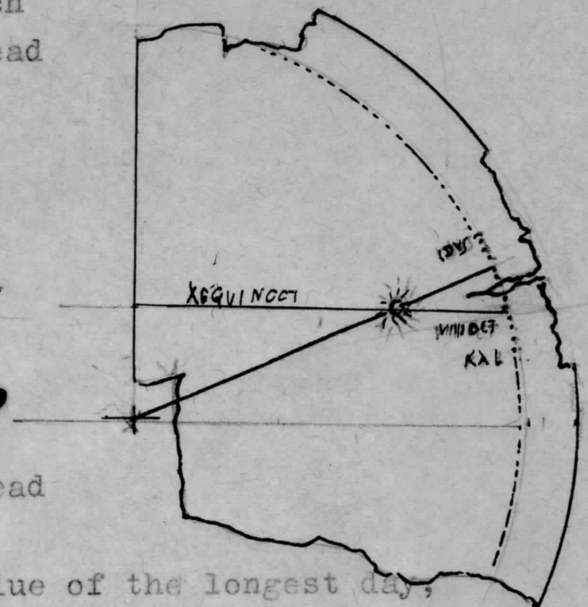
11 May 1971

My dear Dr. Price,

I am sorry, but I cannot agree with your suggestion about the Grand Calendar. Let us set aside the question of the retrograde or direct graduation. Your reasons are plausible. But one cannot admit that the sun was fixed on a radial arm at say $2/3$ of the way along from the center. If the instrument is a stereographic projection of the path of the sun, and if the circle showing this path has a radius $2/3$ of the circle of the holes, these two circles can not be concentric. You just look at the drawing hereunder: When the sun which you suggest is on the equinoctial line, the end of the radial arm would point to IDVS Sept (my sketch is not very carefully drawn) instead as to VIII (ante) Kal. which is right.

My belief is simply that the equinoctial line has been drawn wrongly. Such mistakes happen very often. Let me remind the splendid astralabes by Habermel, where a confusion has been made in the graduation of the zodiac (AR instead of longitudes !)

As regards the conventional value of the longest day, I have re-read Ptolemy (Ed. Halma, L.II, chap.VI p.79) and see that Ptolemy considers various zones according to day lengths, measured in hours and $1/4$ hours, and calculates the diurnal arc in consequence. But nothing says that he has observed these times. He may easily have measured them on any stereographic projection of the sphere. Besides, (see Maxe-Werly page 174) to speak of the duration of the shortest day as being 8h 57m is one of the absurdities which our modern precision ascribes to Ptolemy !



Very truly yours

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

May 21, 1971

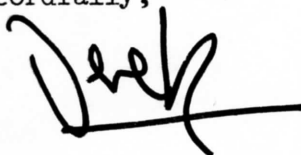
Monsieur Henri Michel
54 Rue de Tenbosch
Bruxelles 5, Belgium

Dear M. Michel:

Please re-read my last letter carefully for you have missed both of the points that I make in it. The circle of holes must not be taken as the ecliptic but they are a circle 1.5 times as large as the ecliptic should be. I conjecture that a radial arm was pivoted at 0', the center of the ecliptic circle. The other end of the radial arm was plugged into the correct hole for the date and the body of the sun was then mounted at a point $2/3$ of the way from 0' to the line of holes.

Thus, I think you will find that the proportion becomes correct and also the scratches on the disk are explained by the radial arm. The instrument is then a very simple anaphoric clock disk.

Yours cordially,



Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

May 28, 1971

Monsieur Henri Michel
54 Rue de Tenbosch
Bruxelles 5, Belgium

Dear M. Michel:

Further to my letter to you I enclose a diagram. Do you agree with this conjectural restoration?

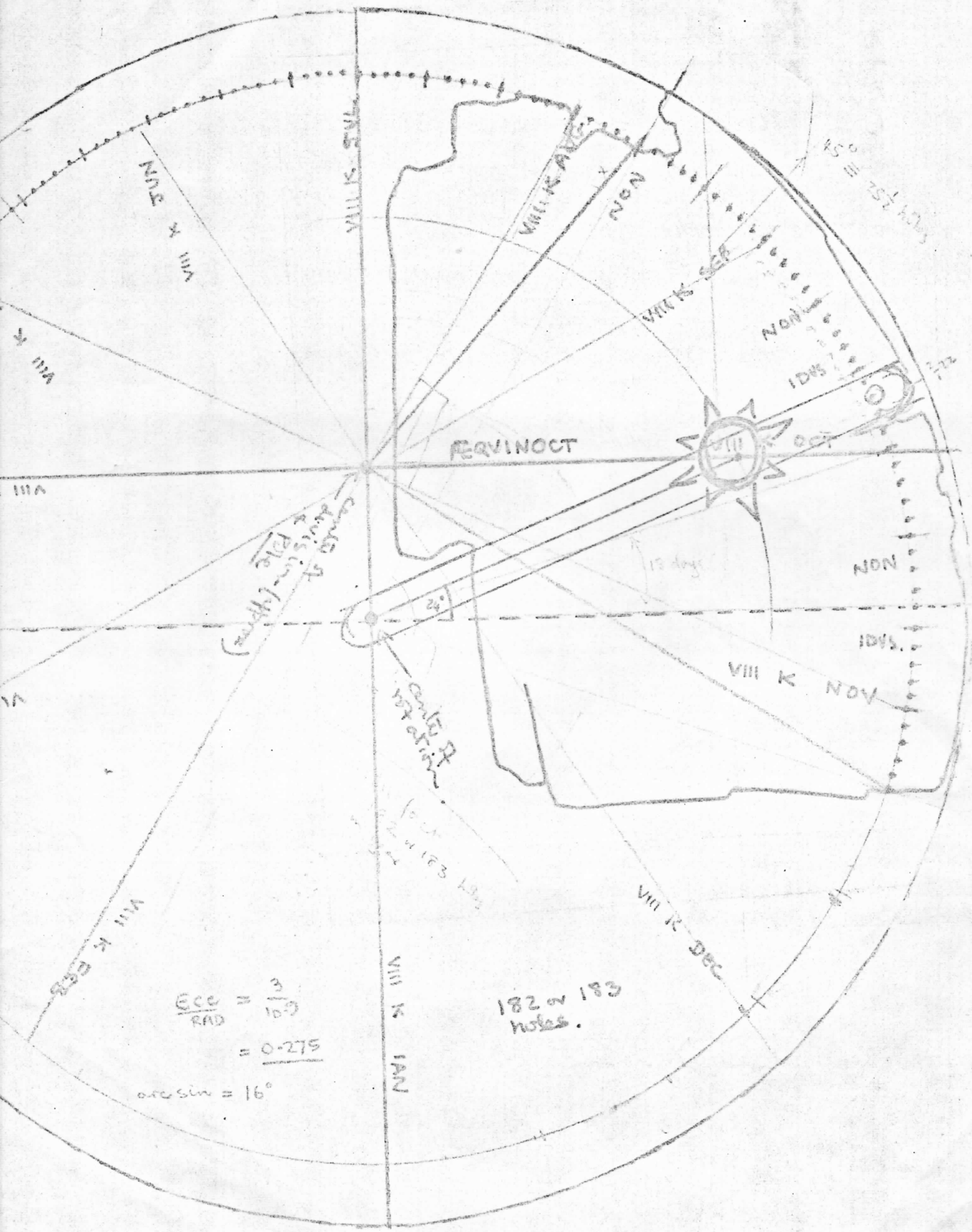
Yours cordially,

A handwritten signature in black ink, appearing to read 'Derek', written over a horizontal line.

Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

encl.



$$\frac{Ecc}{RAD} = \frac{3}{10.9}$$

$$= 0.275$$

$$\arcsin = 16^\circ$$

182 or 183 holes.

Yale University *New Haven, Connecticut 06520*

DEPARTMENT OF
HISTORY OF SCIENCE AND MEDICINE

Box 2036, Yale Station

June 17, 1971

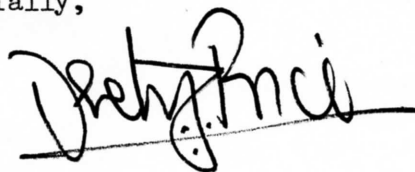
Monsieur Henri Michel
54, rue de Tenbosch
Bruxelles 5, Belgium

Dear M. Michel:

We can agree then that the question of retrograde or direct graduation can be set aside and I suppose you can also agree with my suggestion that the scratches are caused by something being pivoted from the geometrical center of the disk. Very reluctantly I have to agree with your saving me from the error of supposing that a smaller circle could transform the 16° inclination of the stereographic projection into the 24° which we would expect for the ecliptic. I have to agree with you that the labeling of the aequinoctial line makes this quite impossible for all the dates would then be wrong. I am still most reluctant to accept your suggestion that this is merely an error. 16° is simply too small to have been taken by accident and I have a strong inclination to suppose that the men who did these things were more or less right most of the time. If they make a mistake it has to be a plausible one and 16° is simply not plausible. Moreover, it is far too suspicious that it is exactly $2/3$ of the right value. I have been playing with the idea that somehow the disk was designed to work with a straight line horizon rather than the usual arc of a circle that you would get at stereographic projection but I cannot see a way to get it in this way.

I am quite sure that the figures for longest day and shortest day are not observed at all. They are partly traditional, partly computed, and the observational basis is comparatively unimportant. Neugebauer has written splendidly on this topic but, of course, Maxe-Werly could know nothing of this ancient tradition in astronomy.

Cordially,



Derek J. de Solla Price
Avalon Professor of the
History of Science

DJP:al

July 13, 1971

Professor D. de Solla Price
Yale University, Box 2036
New Haven, Conn. 06520

My dear Price,

I have been away for a few weeks, and could not answer immediately your letters of May 21, May 28 and June 17 about the calendar of Grand. I am still at a loss to explain this riddle, and as I am leaving again up to the end of July, I hasten to send a simple suggestion, which you could study until a better idea is found. There are two unquestionable points: 1° something was turning on a pivot in the center of the disk; 2° the small holes around the disk mark the days. Nothing gives a proof that a stereographic projection was used. May be the limb was marked with the successive days, and the line marked "aequinoct" was simply traced afterwards by joining the days of the equinoxes.

Is it possible to think that the instrument was a kind of equatorium, and that the missing part was a disk showing the position of a planet, admitting that this planet was moving on the plane of the ecliptic ? I know that in this case, the eccentricity of the equinoctial line should be much smaller, but the maker of this instrument might have made a mistake.

I hope that by now, you may have obtained a photo of the plate and that Miss Sharon Gibbs has seen the object. It must be very carefully studied; but we must never forget that big mistakes were often made by the ancient constructors !

Very friendly yours

H.Michel