Hubble law → Hubble-Lemaitre law?

THIRTIETH GENERAL ASSEMBLY

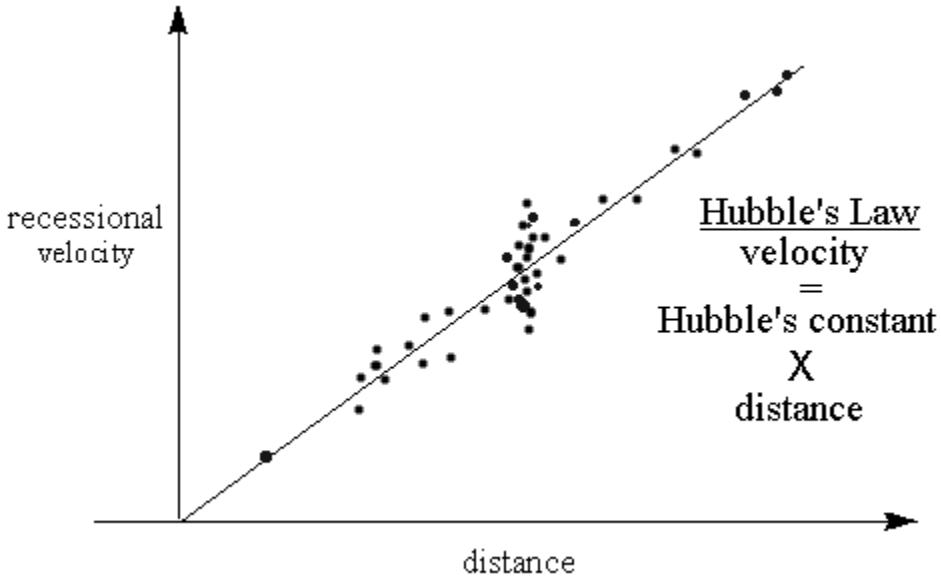
RESOLUTIONS PRESENTED TO THE XXXth GENERAL ASSEMBLY

RESOLUTION B4

on a suggested renaming of the Hubble Law

Proposed by the IAU Executive Committee

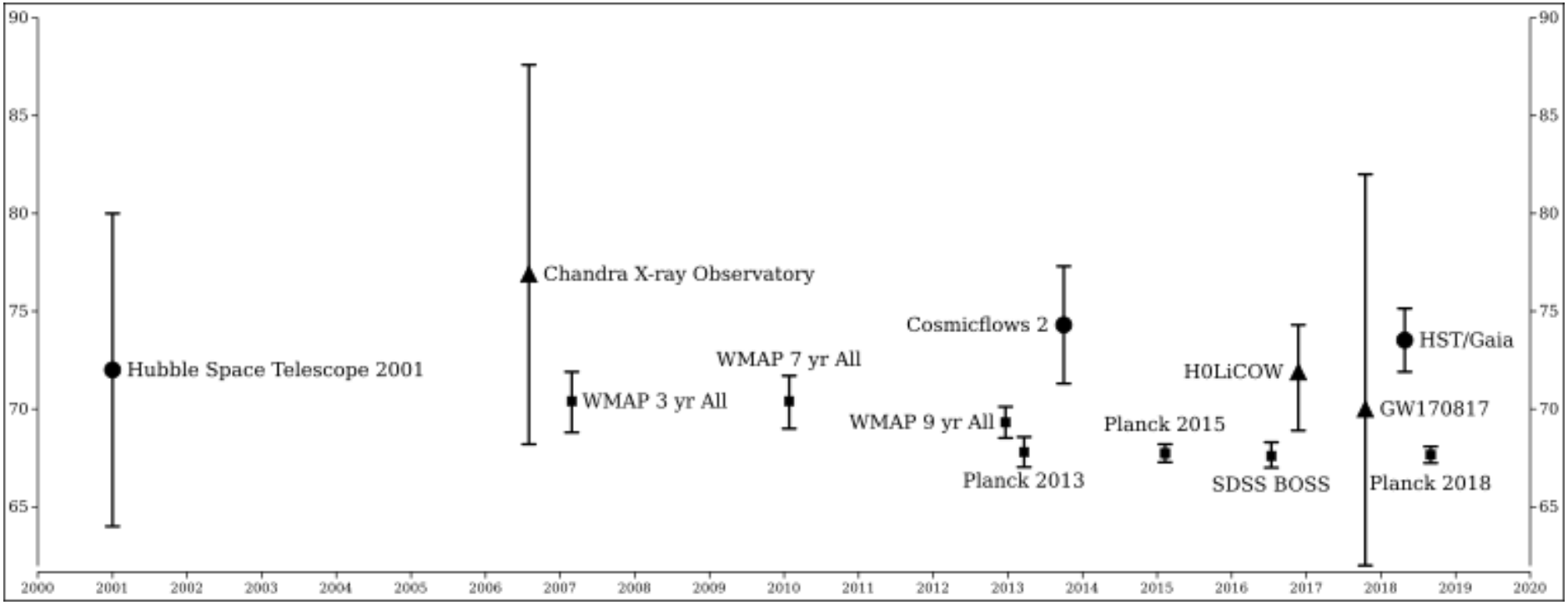
Hubble provided evidence that the recessional velocity of a galaxy increases with its distance from the earth, a property now known as "Hubble's law", despite the fact that it had been both proposed and demonstrated observationally two years earlier by Georges Lemaître.[10] Hubble's Law implies that the universe is expanding.[11] A



Hubble constant prior to 1996

prior to 1996	50–90 (est.)		[47]	
early 1970s	~55 (est.)	Allan Sandage and Gustav Tammann	[48]	
1958	75 (est.)	Allan Sandage	[49]	This was the first good estimate of H_0, but it would be decades before a consensus was achieved.
1956	180	Humason, Mayall and Sandage	[48]	
1929	500	Edwin Hubble, Hooker telescope	[50][48][51]	
1927	625	Georges Lemaître	[52]	First measurement and interpretation as a sign of the expansion of the universe

Hubble constant in recent years



THIRTIETH GENERAL ASSEMBLY

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RESOLUTION B4

on a suggested renaming of the Hubble Law

Proposed by the IAU Executive Committee

The XXX General Assembly of the International Astronomical Union,

considering

1. that the discovery of the apparent recession of the galaxies, which is usually referred to as the "Hubble law", is one of the major milestones in the development of the science of Astronomy during the last 100 years and can be considered one of the founding pillars of modern Cosmology;

2. that the Belgian astronomer Georges Lemaître, in 1927 published (in French) the paper entitled *"Un Univers homogène de masse constante et de rayon croissant rendant compte de la vitesse radiale des nébuleuses extra-galactiques"* [1]. In this he first rediscovers Friedman's dynamic solution to Einstein's general relativity equations that describes an expanding universe. He also derives that the expansion of the universe implies the spectra of distant galaxies are redshifted by an amount proportional to their distance. Finally he uses published data on the velocities and photometric distances of galaxies to derive the rate of expansion of the universe (assuming the linear relation he had found on theoretical grounds);

3. that, at the time of publication, the limited popularity of the Journal in which Lemaître's paper appeared and the language used made his remarkable discovery largely unperceived by the astronomical community;

4. that both Georges Lemaître (an IAU member since 1925 [2]) and the American astronomer Edwin Hubble (an IAU member since 1922 [3]) attended the 3rd IAU General Assembly in Leiden in July 1928 and exchanged views [4] about the relevance of the redshift vs distance observational data of the extragalactic nebulae to the emerging evolutionary model of the universe;

5. that Edwin Hubble, in 1929 published the paper entitled *"A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae"* [5] in which he proposed and derived

Hubble Law or Hubble-Lemaître Law? The IAU Resolution

Helge Kragh*

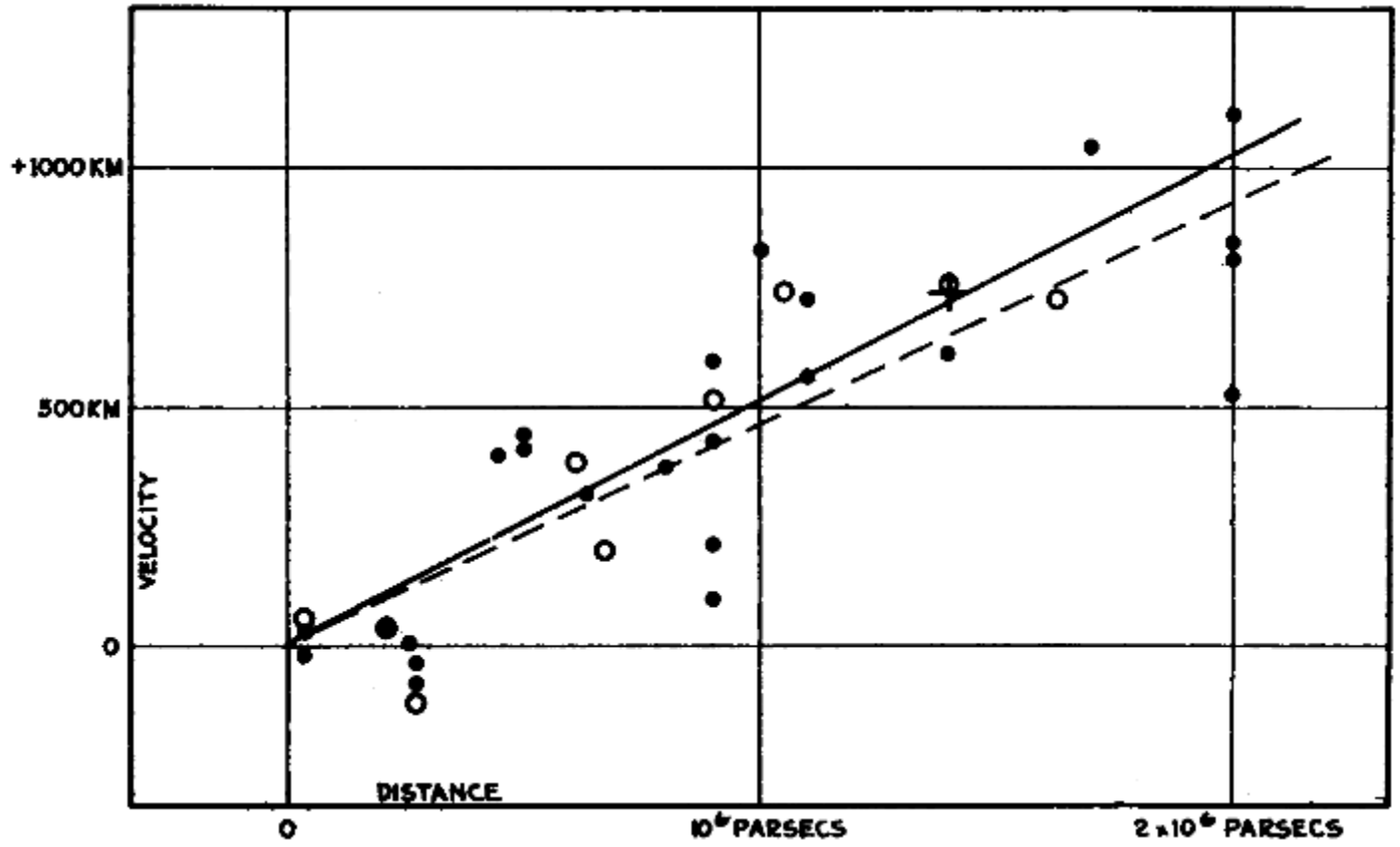
Resolution B4 argues its case primarily from considerations based on the history of cosmology, stating among the aims of the resolution not only "to honour the intellectual integrity of Georges Lemaître" but also "to inform the future scientific discourses with historical facts." The resolution consequently lists a number of such relevant facts or what are claimed to be facts. It is on the basis of the historical material appended to the resolution that the General Assembly supported it, and it is on the same basis that the astronomers will cast their electronic votes. It appears to me that at least some of the appended historical considerations are of dubious validity and hence that they provide a questionable and even illegitimate background for the voting. If the IAU wants to set "the historical record straight" – and this is what the General Assembly says in its electronic newspaper – the result is remarkably poor.

First, with regard to the name "Hubble law" it is not quite clear what the resolution refers to, as it seems to mix up the original Hubble law with later usage of the term. The resolution refers correctly to Hubble's "discovery of the apparent recession of the galaxies" but then switches to its current usage as an expression of the cosmic expansion. What became the Hubble law was established by Hubble in

It is worth mentioning that until about 1960 Humason's name often appeared together with Hubble's and that the term "Hubble-Humason law" can be found in several books and articles. Remarkably, Lemaître was one of the very first to refer to "Hubble's law," which he unambiguously credited to the American astronomer and not to himself. In a book review of 1950 he mentioned his calculation of the expansion constant dating from 1927 and then continued, "Naturally, before the discovery and study of galactic clusters, there could be no question of establishing Hubble's law, but only to determine the coefficient."[8] That is, he indirectly suggested that whereas he had more than a share in Hubble's constant, his role in the law was limited to a prediction without sufficient observational confirmation.

Hubble (1929)

$V_0 = K \times D$



the values. For instance, let $A = 277°$, $D = +36°$ (Gal. long. = 32°, lat. = +18°), $V_0 = 280$ km./sec., $K = +500$ km./sec. per million parsecs. Mr. Strömberg has very kindly checked the general order of these values by independent solutions for different groupings of the data.

Lemaitre (1927)

UN UNIVERS HOMOGÈNE DE MASSE CONSTANTE ET DE RAYON CROISSANT, RENDANT COMPTE DE LA VITESSE RADIALE DES NÉBULEUSES EXTRA-GALACTIQUES

Note de M. l'Abbé G. LEMAÎTRE

A Homogeneous Universe of constant mass and increasing size, taking into account of the radial speed of extra-galactic nebulaus

Utilisant les 42 nébuleuses figurant dans les listes de Hubble et de Strömberg (1), et tenant compte de la vitesse propre du soleil (300 Km. dans la direction $\alpha = 315°$, $\delta = 62°$), on trouve une distance moyenne de 0,95 millions de parsecs et une vitesse radiale de 600 Km./sec, soit 625 Km./sec à 10^6 parsecs (2).

Nous adopterons donc

$$\frac{R'}{R} = \frac{v}{rc} = \frac{625 \times 10^5}{10^6 \times 3{,}08 \times 10^{18} \times 3 \times 10^{10}} = 0{,}68 \times 10^{-27}\ \mathrm{cm}^{-1} \qquad (24)$$

At earlier times

Vesto Melvin Slipher (/ˈslaɪfər/; November 11, 1875 – November 8, 1969) was an American astronomer who performed the first measurements of radial velocities for galaxies, providing the empirical basis for the expansion of the universe.[1] [2][3][4]

Edwin Hubble is often incorrectly credited with discovering the redshift of galaxies;[8] these measurements and their significance were understood before 1917 by James Edward Keeler (Lick & Allegheny), Vesto Melvin Slipher (Lowell), and William Wallace Campbell (Lick) at other observatories.

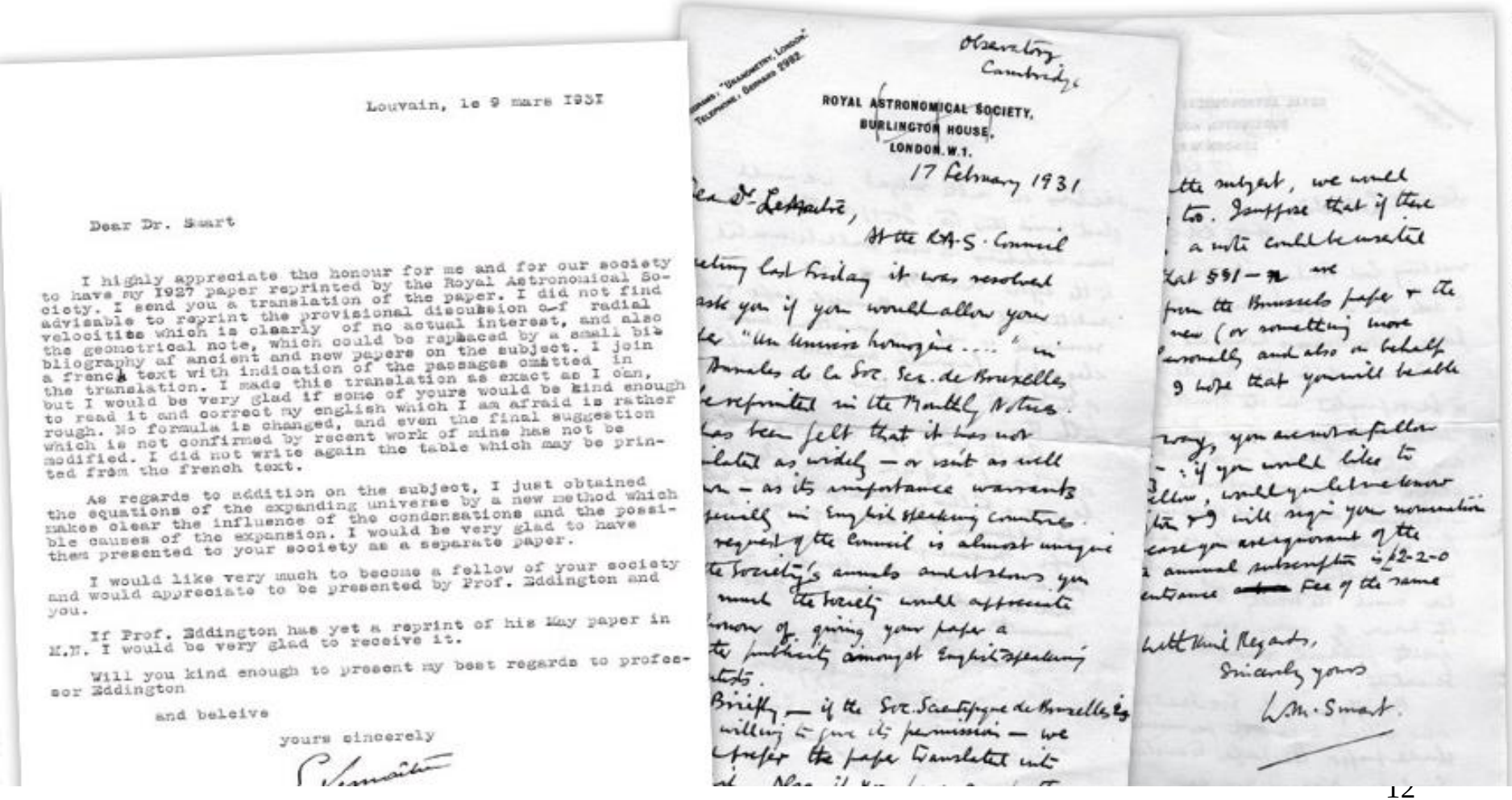
Friedmann in 1922 introduced the idea of an expanding universe that contained moving matter; Belgian astronomer Georges Lemaître would later independently reach the same conclusion in 1927.[4]

LOST IN TRANSLATION

The English translation of Lemaître's 1927 paper was published in the *Monthly Notices of the Royal Astronomical Society* in March 1931 (ref. 8). However, during the process, a few paragraphs from the original French version were deleted, notably the one in which Lemaître described Hubble's law and derived the expansion rate.

has suggested that the paragraphs may have been removed as part of standard editorial practice by the editor of the *Monthly Notices*.

Wanting to find out more, I examined original documents linked to the paper. With the help of Liliane Moens from the Archives Georges Lemaître in Louvain, Belgium, I obtained a copy of the letter sent by the then editor of the *Monthly Notices*, astronomer William Marshall Smart, to Georges Lemaître, concerning the translation and publication



Louvain, le 9 mars 1931

Dear Dr. Smart

I highly appreciate the honour for me and for our society to have my 1927 paper reprinted by the Royal Astronomical Society. I send you a translation of the paper. I did not find advisable to reprint the provisional discussion of radial velocities which is clearly of no actual interest, and also the geometrical note, which could be replaced by a small bibliography of ancient and new papers on the subject. I join a french text with indication of the passages omitted in the translation. I made this translation as exact as I can, but I would be very glad if some of youre would be kind enough to read it and correct my english which I am afraid is rather rough. No formula is changed, and even the final suggestion which is not confirmed by recent work of mine has not be modified. I did not write again the table which may be printed from the french text.

As regards to addition on the subject, I just obtained the equations of the expanding universe by a new method which makes clear the influence of the condensations and the possible causes of the expansion. I would be very glad to have them presented to your society as a separate paper.

I would like very much to become a fellow of your society and would appreciate to be presented by Prof. Eddington and you.

If Prof. Eddington has yet a reprint of his May paper in M.N. I would be very glad to receive it.

Will you kind enough to present my best regards to professor Eddington

and beleive

yours sincerely

G. Lemaître

Observatory, Cambridge

ROYAL ASTRONOMICAL SOCIETY, BURLINGTON HOUSE, LONDON, W.1.

17 February 1931

Dear Dr. Lemaître,

At the R.A.S. Council meeting last Friday it was resolved to ask you if you would allow your paper "Un Univers homogène ..." in Annales de la Soc. Sci. de Bruxelles to be reprinted in the Monthly Notices. It has been felt that it has not circulated as widely — or visit as well known — as its importance warrants, especially in English speaking countries. The request of the Council is almost unique in the Society's annals and it does you much honour. The Society would appreciate the honour of giving your paper a wider publicity amongst English speaking readers.

Briefly — if the Soc. Scientifique de Bruxelles is willing to give its permission — we should prefer the paper translated into

... the subject, we would be glad to. I suppose that if there is a note could be inserted [illegible] we could from the Brussels paper + the new (or something more personally and also on behalf of the Society I hope that you will be able to

... way, you are not a fellow ... if you would like to become a fellow, would you let me know and I will sign your nomination form and see you are informed of the amount of your annual subscription £2-2-0 and of the entrance fee of the same

With kind Regards,

Sincerely yours

W. M. Smart.

ARCHIVES GEORGES LEMAÎTRE/CATHOLIC UNIV. LOUVAIN/TECLIM

"Dear Dr. Smart

I highly appreciate the honour for me and for our society to have my 1927 paper reprinted by the Royal Astronomical Society. I send you a translation of the paper. I did not find advisable to reprint the provisional discussion of radial velocities which is clearly of no actual interest, and also the geometrical note, which could be replaced by a small bibliography of ancient and new papers on the subject. I join a french text with indication of the passages omitted in the translation. I made this translation as exact as I can,

This clearly ends speculation about who translated the paper and who deleted the paragraphs — Georges Lemaître did both himself.

Lemaître's letter also provides an insight into the scientific psychology of (some of) the scientists of the 1920s. Lemaître was not at all obsessed with establishing priority for his original discovery. Given that Hubble's results had been published in 1929, Lemaître saw no point in repeating his own more tentative earlier findings in 1931. Rather, he preferred to move forward and to publish his new paper, 'The expanding Universe', which he did later that year[11]. Lemaître's request to join the Royal Astronomical Society, at Smart's invitation, was eventually granted; he was elected as an associate on 12 May 1939. ■

The criticism

(i) Kragh's criticism is based on the distinction between the law (v=H*r) and the expansion

(ii) Hubble showed that the relation is linear

(iii) Lemaitre didn't have such a plot (but an equation) and focused more on expansion

(iv) I found his 2003 with Smith most useful!

Kragh+Smith (2003)

(i) Explains why Kragh is so dismissive

(ii) Lemaitre didn't show a plot

Lemaître showed that there exists a model of the universe that expands from the static Einstein state and he argued from astronomical data that this model probably reflects the real universe. Contrary to Friedmann, he derived theoretically a linear redshift–distance relationship and calculated the proportionality factor. However, although he explicitly predicted the expansion of the universe, he could not justify the prediction with observational data that convincingly supported the linear law he suspected. In so far as Lemaître did not establish observationally that the universe is in fact expanding, he did not make a discovery; but in so far as he gave theoretical as well as observational reasons for it, he did discover the expansion of the universe.

Kragh+Smith (2003) about Hubble

by a Doppler effect due to their recession.[57] We need to emphasize that nowhere in his 1929 paper did Hubble conclude that the galaxies recede from us or otherwise suggest that the universe is expanding. Words such as 'recession' and 'expansion' do not occur in the paper.

Hubble, then, was very anxious to protect his and Humason's priority in the discovery of the linear redshift–distance relation, but he did not engage in a debate on credit for the discovery of the expanding universe. Although Fritz Zwicky referred to it in 1929 as "Hubble's relation",[62] the redshift–distance relation was not seen by other astronomers in terms of "Hubble's law", at least not until over two decades after Hubble's initial 1929 paper. Around 1930, prominent authorities such as De Sitter, Eddington and Tolman, who all underlined the importance of the expanding universe, did not point to Hubble as its discoverer.

Eddington (1930)

Three years ago a very substantial advance in this subject was made by Abbé G. Lemaître (*Annales de la Société Scientifique de Bruxelles*, April 25, 1927). Until recently, this paper seems to have been almost unknown, and we can scarcely blame Dr. Silberstein for being unaware of it; but it is unfortunate that the new point of view does not appear in his book. In particular it renders obsolete the contest between Einstein's and de Sitter's cosmogonies. We can now prove that Einstein's universe is unstable. The equilibrium having been disturbed, the universe will progress through a continuous series of intermediate states towards the limit represented by de Sitter's universe. By Lemaître's analysis the history of this progress can be studied; and the intermediate stages (one of which must represent the present state of the world) can be treated in detail.

A. S. EDDINGTON.

(i) Focus on expansion

(ii) Mentioned Lemaitre in positive light

(iii) Hubble not mentioned

(iv) But: observations also not

Final comments

(i) In my view, the distinction (linear or not) is minor; his equation (24) gives linear relation

(ii) Both results (Hubble 500, Lemaitre 625) are based on earlier observations by Lundmark and Stromberg for radial velocities, and Hubble for apparent magnitudes → distances

(iii) Earlier observations in isolation not conclusive regarding distance and speed

(iv) Shortcomings both for Hubble (expansion not mentioned) and Lemaitre (no plot)

(v) Both must be acknowledged