Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

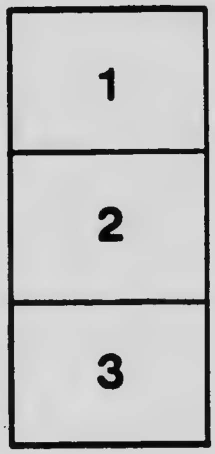
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

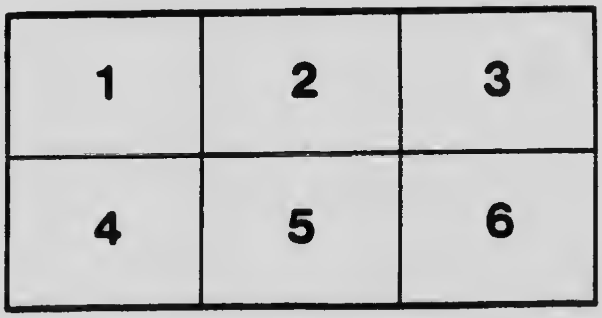
- [x] Coloured covers / Couverture de couleur
- [x] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [ ] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [ ] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [ ] Showthrough / Transparence
- [x] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary material / Comprend du matériel supplémentaire
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- [ ] Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.
- [x] Additional comments / Commentaires supplémentaires: Pagination is as follows: p. [349]-353. La pagination est comme suit: p. [349]-353.

This item is filmed at the reduction ratio checked below / Ce document est filmé au taux de réduction indiqué ci-dessous.

10x	12x	14x	16x	18x	20x	22x	24x	26x	28x	30x	32x
							✓				


1
2
3


1
2
3


1
2
3
4
5
6

With the Writer's Compliments.

Reprinted From The Journal Of
The Royal Astronomical
Society Of Canada,
September-October, 1911

FROM THE DOMINION OBSERVATORY

THE DIAMETERS OF THE STARS

BY

J. B. CANNON

THE DIAMETERS OF THE STARS

BY

I. P. CANNON

The question of the diameters of the stars is one which can be answered only by means of assumptions which are more or less plausible, and the results thereby arrived at can only be looked upon as being, to a large extent, very uncertain.

In order to be able to say anything about the diameter of one of the stars it is necessary to have some knowledge of three things:—(*a*) parallax, (*b*) magnitudes and (*c*) surface intensity—to say nothing of absorption in space. From the parallax we get the distance of the star from us, distance and magnitude give luminosity, and luminosity and brightness give the surface area of the star. The sun is taken as unit in each case. Thus, having the surface of the star in terms of the sun's surface, we have at once the ratio of the radii of the star and the sun.

Now in three cases, viz.:—Algol, β Aurigæ and u Herculis which have been attacked spectroscopically, the radii, masses and densities have been computed from the data thus obtained. From these results we obtain the surfaces of the stars and hence, having the luminosity, we arrive at a probable value for the intrinsic brightness or surface intensity. An example may, perhaps, be the best way to make clear the method of arriving at the luminosity of any star.

α Orionis has a parallax of $0''\cdot 03$.

$$\text{Its distance from the earth therefore} = \frac{3\cdot 26}{\cdot 03} \text{ light years.}$$

$$= 109\cdot 00 \text{ light years.}$$

The magnitude of α Orionis is $0\cdot 91$.

Now we know that the light-ratio between successive magnitudes is $\sqrt[5]{100}$, or the number whose logarithm is $\cdot 4$.

We have, therefore,

$$\log b_n - \log b_m = -\frac{4}{10}(n - m),$$

where b_n and b_m are the brightnesses, respectively, of stars of the nth and mth magnitudes. Taking a tenth magnitude star as the unit, we get

$$\log b_n = -\frac{4}{10}(n - 10).$$

$$= 4 - 0\cdot 4\, n.$$

Using this formula, we get for the light of α Orionis

$$\text{log of brightness of } \alpha \text{ Orionis} = 4 - 0\cdot 4\,(0\cdot 91)$$

$$= 3\cdot 636.$$

Now the luminosity is equal to the light multiplied by the distance squared.

Hence, in terms of the sun's luminosity, we have

$$\text{Luminosity of } \alpha \text{ Orionis} = \frac{\log^{-1} 3\cdot 636 \times [109 \times 365 \times 24 \times 60]^2}{\log^{-1} 14\cdot 52^* \times [8]^{2*}}$$

$$= 670 \odot$$

where $\odot$ denotes the luminosity of the sun.

* These are obtained from taking $-26\cdot 3$ for the sun's magnitude and 8 light-minutes for its distance from the earth.

The luminosities used in the table which follows were taken from Kapteyn and Weersma's publication mentioned hereafter. They obtained them from the formula

$$\log L = 0{\cdot}200 - 0{\cdot}4\, m - 2 \log \pi.$$

This is the same as that used above as will be seen from the formula,

$$\log L = \log \left(\frac{\text{brightness of star}}{\text{brightness of sun}} \right) \times \left(\frac{\text{distance of star}}{\text{distance of sun}} \right).$$

$$\text{or } \log L = (4 - 0{\cdot}4\, m) - (4 - {\cdot}4\, m \text{ of sun}) \times \left(\frac{\text{distance of star}}{\text{distance of sun}} \right).$$

Now the sun's magnitude was taken as 5·5 at a distance at which the parallax is 1″.

Hence the formula becomes

$$\log L = (4 - 0{\cdot}4\, m) - [4 - 0{\cdot}4\,(5{\cdot}5)] + \log \left\{ \frac{\frac{3{\cdot}26}{\pi''}}{\frac{3{\cdot}26}{1''}} \right\}^{2}.$$

$$= 0{\cdot}22 - 0{\cdot}4\, m - 2 \log \pi.$$

Having then a star of any type whose surface intensity is known and whose radius is known we are in a position to speculate as to the radii of other st.. · of the same type. For other types we have to assume some relation between the surface intensity of the various types and that of the sun. That is what has been done here.

The star which was taken as a standard to work from is β Aurigæ, discussed by Stebbins in the *Astrophysical Journal*, Vol. XXXII., p. 185, October, 1910. He has classed it as belonging to *Ap*, and has obtained the following results from the assumption of a parallax of 0″·03 :—

Radius of each component		2·58 ⊙.
Mass of 1st		2·38 ⊙.
Mass of 2nd		2·34 ⊙.
Density of each		0·14 ⊙.
Total light	greater than	80 ⊙.
Surface intensity	greater than	12 ⊙.

In the following, the classes have been grouped very liberally, *A* and *B* being taken together, as having the same surface intensity, viz., that given by Stebbins above for β Aurigæ, namely, 12 ☉; *F* has been taken as 3 ☉; *G* equal to ☉ and *K* and M one-half ☉.

The luminosities were taken from the *Publications* of the Astronomical Laboratory at Groningen, No. 24, (being a list of parallax determinations compiled by Professor Kapteyn and Dr. Weersma). In three cases, Algol and α and β Orionis, the luminosities were not given by them, these stars having parallaxes 0″·03 or lower, from which Kapteyn and Weersma consider no reliable values can be obtained. In these three cases the luminosities have been computed from the magnitude and parallaxes and expressed in terms of the sun.

CLASS I (TYPES *A* AND *B*) SURFACE INTENSITY = 12 ☉

Star	Luminosity	Radius
α Aquilæ (Altair)	12·3	1
α Canis Majoris (Sirius)	48·1	2
α Crucis	{ 122·0 { 76·6	3 } 2.4 }
α Eridani (Achernar)	350	5·4
α Leonis (Regulus)	423	6
β Leonis (Denebola)	12·2	1
α Lyræ (Vega)	158	3·6
β Orionis (Rigel)	20614	41·5
ζ Ursæ Maj. (Mizar)	{ 159 { 39	3·6 } 1·8 }
β Persei (Algol)	238	4·5

CLASS II. (TYPE *F*) SURFACE INTENSITY = 3 ☉

Star	Luminosity	Radius
α Canis Minoris (Procyon)	9·68	1·8
α Ursæ Min. (Polaris)	102	5·9

CLASS III. (TYPE *G*) SURFACE INTENSITY = ☉

Star	Luminosity	Radius
α Aurigæ (Capella)	300	17·3
α Centauri	2·03	1·4
β Geminorum (Pollux)	127	11·2

CLASS IV. (TYPES *K* AND *M*) S[illegible] INTENSITY [illegible]

Star	Luminosity	Radius
α Bootis (Arcturus)	230	21.4
α Tauri (Aldebaran)	224	15·0
α Orionis (Betelgeux)	524·3	32·4

A very interesting article appears in *Comptes Rendus* for January 9, 1911, in which M. Chas. Nordmann computed the values of the ratio $\frac{R_*}{R_\odot}$ from the following formula

$$\log \frac{R_*}{R_\odot} = \log \frac{d_*}{d_\odot} - \tfrac{1}{5}(G_* - G_\odot) + \tfrac{1}{2}\log \frac{E_*}{E_\odot},$$

where R_* and $R_\odot$ are the semi-diameters of a star and the sun, G_* and $G_\odot$ their magnitudes, d_* $d_\odot$ their distances from the earth and E_* and $E_\odot$ their intrinsic brightness. He finds the following values :—

Star	$\frac{R_*}{R_\odot}$	Value given above
Sirius	1·13	2
Procyon	1·35	1·8
Aldebaran	13·50	15·0
Capella	8·26	17·3
Vega	1·57	3·6
γ Cygni	0·92	. . .
α Persei	1·83	. . .
Polaris	1·93	5·9
β Andromedæ	13·00	. . .
ζ Persei	1·29	4·5

Considering the assumptions that were employed, the agreement between the results above must be regarded as very fair.

J. B. CANNON.