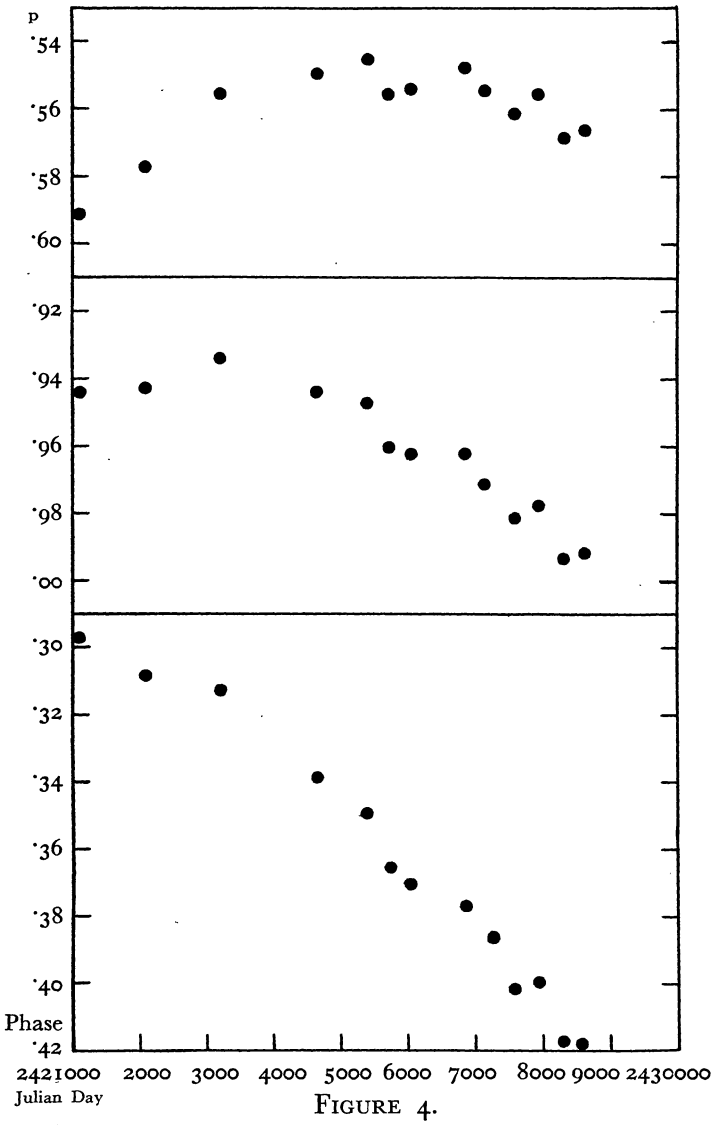



FIGURE 4.

Epochs of minima. Middle diagram: epochs observed. Upper and lower diagrams: epochs reduced to the centre of gravity for negative and positive inclination respectively.

the inclination of the visual orbit is positive. To obtain the period reduced to the centre of gravity a least squares solution has been made for a straight line through the points of the lowest diagram (positive inclination) of Figure 4. The result is:

$$\text{Period} = {}^{d}\cdot 2678082 \pm {}^{d}\cdot 0000006 \text{ (m.e.)}.$$

The $O - C$'s of this solution (column 10) show that there is some deviation from linearity caused by the first two epochs. The mean error of an epoch is found to be $\pm {}^{d}\cdot 0058$ for a unit of weight or three times the estimated internal mean error given in column 2 of Tables 7 and 8. A second solution of the same kind has been made with $\frac{M_A}{M_A + M_B} = \cdot 50$. The new $O-C$'s (column 11) show less deviation from linearity. An attempt to find the mass ratio from the fact that, if the true mass ratio is used in the reduction of the epochs to the centre of gravity, there should be no deviation of the epochs from linearity, had no success. After some fifteen years, as already mentioned by STRAND, it will be possible to obtain in this manner an accurate value of the mass ratio.

It should be mentioned that from meridian observations B. Boss has derived a mass ratio $\frac{M_A}{M_A + M_B} = \cdot 209$ (*General Catalogue*, Vol. 1, App. II, 1937)

For further observations an ephemeris of the primary minimum may be computed from the formula:

Primary minimum
$= \text{J.D. } 2428635\cdot 435 + {}^{d}\cdot 26780800 \text{ E.}$

I wish to express my thanks to Prof. HERTZSPRUNG for many suggestions during the preparation of this paper.

## Photographic observations of six minima of 44 i Bootis B, by *P. Th. Oosterhoff.*

During the years 1928, 1929 and 1930 a number of photometric observations was made at the Leiden Observatory of the faint component of 44 i Bootis (Σ 1909), with the special purpose to derive accurate epochs of minimum. As the distance between the components at the time of the observations was about 3″ only, a Barlow lens was used in combination with the 33 cm photographic refractor. The equivalent focal length obtained in this way amounted to 22·7 metres, the distance between the components on the plate being one third of a millimetre.

A photometric scale was provided by the use of an objective grating constructed from card-board and wooden bars. The grating constant, $(d + l)$, was 29·3 mm, and the distance on the plate between the first order spectra two thirds of a millimetre; $d$ and $l$ were practically equal.

Under favourable seeing conditions the photographic images thus obtained are well adapted for photometry, but with poor seeing the images of the two components and the central and first order images partly overlap. A change in the seeing during the observations may result in an asymmetric light curve which in its turn will impede the determination of

the epoch of minimum. Therefore two plates were rejected on account of rapidly changing seeing.

The following plates were measured by the writer and Mr. C. J. KOOREMAN in the Schilt microphotometer.

| plate | date | hour angle of first and last exposure | | exposure time | number of exposures |
|---|---|---|---|---|---|
| | | h m | h m | s | |
| 1477 | 31 May 1928 | — 0 21 | + 1 17 | 90 | 37 |
| 1634 | 28 Febr. 1929 | — 2 36 | — 0 53 | 90 | 40 |
| 1682 | 1 May 1929 | — 1 51 | + 0 7 | 90 | 45 |
| 1698 | 27 May 1929 | — 0 41 | + 1 17 | 90 | 46 |
| 1900 | 8 Febr. 1930 | — 2 16 | — 0 24 | 60 | 50 |
| 1974 | 29 April 1930 | — 1 41 | + 0 17 | 60 | 54 |

Eastman 40 plates, 9 cm × 12 cm, were used. The diameter of the projected image of the diaphragm on the plate in the photometer was ·13 or ·16 mm.

The Julian Day, the phase computed with the formula:

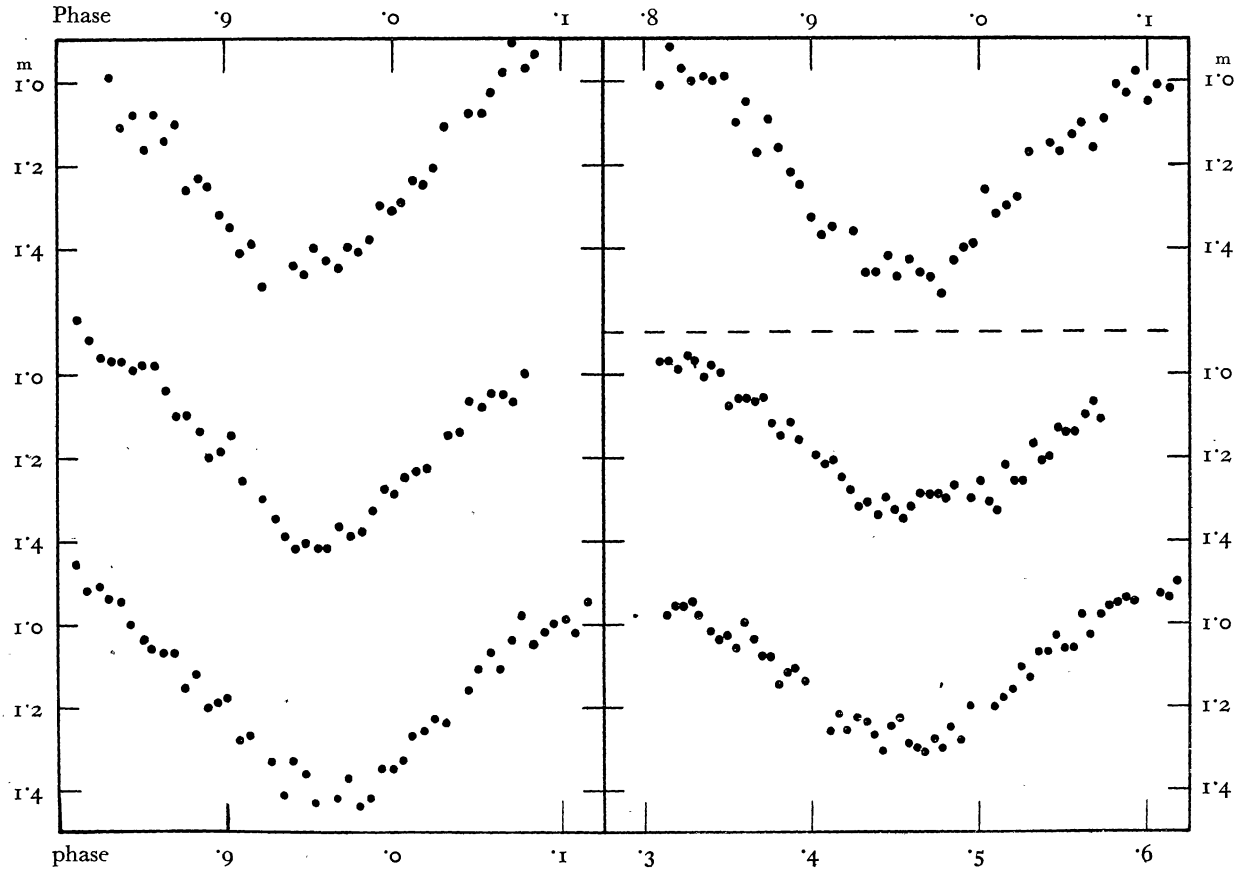
$$\text{phase} = 3^{d\,-1}\cdot7340321\ (\text{J.D.} - 2420000)$$

and the difference in magnitude between the two components are given for each exposure in the table. For the magnitudes the difference between the central and the first order images is taken as unit. The minima are graphically represented in chronological order in the accompanying figure. The first four are primary, the other two are secondary minima. The difference in depth is found to be ·13 magnitude. The internal mean error of a single observation derived for all individual plates from the differences in magnitude between succeeding observations is $\pm\ ^{m}\cdot034$.

The epochs of minimum computed with the method of *B.A.N.* No. 147, 179 are:

| d |
|---|
| 2425398·4398 |
| 5671·6061 |
| 5733·4712 |
| 5759·4464 |
| 6016·6777 |
| 6096·4810 |

The first of these epochs has been used by G. P. KUIPER in *B.A.N.* No. 165, 33. The mean error given there was estimated from the inclination of the branches of the minimum and from the number of observations and their internal mean error. The true mean error will be larger on account of systematic errors. Although the observations do not allow an accurate determination of the systematic errors,



| J.D. Hel. M.A.T. Gr. —2420000 | phase | Δm |
|---|---|---|
| d | p | m |
| 5398·4085 | ·831 | ·99 |
| ·4106 | ·838 | 1·11 |
| ·4123 | ·845 | 1·08 |
| ·4141 | ·852 | 1·16 |
| ·4158 | ·858 | 1·08 |
| ·4175 | ·864 | 1·14 |
| ·4193 | ·871 | 1·10 |
| ·4210 | ·877 | 1·26 |
| ·4227 | ·884 | 1·23 |
| ·4244 | ·890 | 1·25 |
| ·4262 | ·897 | 1·32 |
| ·4279 | ·903 | 1·35 |
| ·4296 | ·909 | 1·41 |
| ·4314 | ·916 | 1·39 |
| ·4331 | ·922 | 1·49 |
| ·4380 | ·941 | 1·44 |
| ·4397 | ·947 | 1·46 |
| ·4414 | ·953 | 1·40 |
| ·4431 | ·960 | 1·43 |
| ·4449 | ·967 | 1·45 |
| ·4466 | ·973 | 1·40 |
| ·4483 | ·979 | 1·41 |
| ·4501 | ·986 | 1·38 |
| ·4518 | ·992 | 1·30 |
| ·4535 | ·999 | 1·31 |
| ·4553 | ·005 | 1·29 |
| ·4570 | ·012 | 1·24 |
| ·4587 | ·018 | 1·25 |
| ·4604 | ·024 | 1·21 |
| ·4622 | ·031 | 1·11 |
| ·4660 | ·045 | 1·08 |
| ·4677 | ·052 | 1·08 |
| ·4695 | ·058 | 1·03 |
| ·4712 | ·065 | ·98 |
| ·4729 | ·071 | ·91 |
| ·4747 | ·078 | ·97 |
| ·4764 | ·084 | ·94 |
| 5671·5668 | ·812 | ·87 |
| ·5685 | ·819 | ·92 |
| ·5703 | ·826 | ·96 |
| ·5720 | ·832 | ·97 |
| ·5737 | ·838 | ·97 |
| ·5755 | ·845 | ·99 |
| ·5772 | ·851 | ·98 |
| ·5789 | ·858 | ·98 |
| ·5807 | ·864 | 1·04 |
| ·5824 | ·871 | 1·10 |
| ·5841 | ·877 | 1·10 |
| ·5859 | ·884 | 1·14 |
| ·5876 | ·890 | 1·20 |
| ·5893 | ·897 | 1·19 |
| ·5910 | ·903 | 1·15: |
| ·5928 | ·910 | 1·26 |
| ·5962 | ·922 | 1·30 |
| ·5980 | ·929 | 1·35 |
| ·5997 | ·935 | 1·39 |
| ·6014 | ·942 | 1·42 |
| ·6032 | ·948 | 1·41 |
| ·6049 | ·955 | 1·42: |
| ·6066 | ·961 | 1·42 |
| ·6084 | ·967 | 1·37 |
| ·6101 | ·974 | 1·39 |
| ·6118 | ·981 | 1·38 |
| ·6135 | ·987 | 1·33 |
| ·6153 | ·994 | 1·28 |
| ·6170 | ·000 | 1·29 |
| ·6187 | ·006 | 1·25 |
| ·6205 | ·013 | 1·24 |

| J.D. Hel. M.A.T. Gr. —2420000 | phase | Δm |
|---|---|---|
| d | p | m |
| 5671·6222 | ·019 | 1·23 |
| ·6257 | ·032 | 1·15 |
| ·6274 | ·039 | 1·14 |
| ·6291 | ·045 | 1·07 |
| ·6309 | ·052 | 1·08 |
| ·6326 | ·058 | 1·05 |
| ·6343 | ·065 | 1·05 |
| ·6360 | ·071 | 1·07 |
| ·6378 | ·078 | 1·00 |
| 5733·4298 | ·811 | ·86 |
| ·4316 | ·817 | ·92 |
| ·4333 | ·824 | ·91 |
| ·4350 | ·830 | ·94 |
| ·4368 | ·837 | ·95 |
| ·4385 | ·843 | 1·00 |
| ·4402 | ·850 | 1·04 |
| ·4420 | ·856 | 1·06 |
| ·4437 | ·863 | 1·07 |
| ·4454 | ·869 | 1·07 |
| ·4471 | ·876 | 1·15 |
| ·4489 | ·882 | 1·12 |
| ·4506 | ·889 | 1·20 |
| ·4523 | ·895 | 1·19 |
| ·4541 | ·901 | 1·18 |
| ·4558 | ·908 | 1·28 |
| ·4575 | ·914 | 1·27 |
| ·4610 | ·927 | 1·33 |
| ·4627 | ·934 | 1·41 |
| ·4645 | ·940 | 1·33 |
| ·4662 | ·947 | 1·36 |
| ·4679 | ·953 | 1·43 |
| ·4714 | ·966 | 1·42 |
| ·4731 | ·973 | 1·37 |
| ·4748 | ·979 | 1·44 |
| ·4766 | ·986 | 1·42 |
| ·4783 | ·992 | 1·35 |
| ·4800 | ·999 | 1·35 |
| ·4818 | ·005 | 1·33 |
| ·4835 | ·011 | 1·27 |
| ·4852 | ·018 | 1·26 |
| ·4870 | ·024 | 1·23 |
| ·4887 | ·031 | 1·24 |
| ·4922 | ·044 | 1·16 |
| ·4939 | ·050 | 1·11 |
| ·4956 | ·057 | 1·07 |
| ·4974 | ·063 | 1·11 |
| ·4991 | ·070 | 1·04 |
| ·5008 | ·076 | ·98 |
| ·5026 | ·083 | 1·05 |
| ·5043 | ·089 | 1·02 |
| ·5060 | ·095 | 1·00 |
| ·5077 | ·102 | ·99 |
| ·5095 | ·108 | 1·02 |
| ·5112 | ·115 | ·95 |
| 5759·4066 | ·809 | 1·01 |
| ·4083 | ·815 | ·92 |
| ·4100 | ·822 | ·97 |
| ·4118 | ·828 | 1·00 |
| ·4135 | ·835 | ·99 |
| ·4152 | ·841 | 1·00 |
| ·4170 | ·848 | ·99 |
| ·4187 | ·854 | 1·10 |
| ·4204 | ·861 | 1·05 |
| ·4221 | ·867 | 1·17 |
| ·4239 | ·874 | 1·09 |
| ·4256 | ·880 | 1·16 |
| ·4273 | ·887 | 1·22 |

| J.D. Hel. M.A.T. Gr. —2420000 | phase | Δm |
|---|---|---|
| d | p | m |
| 5759·4291 | ·893 | 1·25 |
| ·4308 | ·899 | 1·33 |
| ·4325 | ·906 | 1·37 |
| ·4343 | ·912 | 1·35 |
| ·4377 | ·925 | 1·36: |
| ·4395 | ·932 | 1·46 |
| ·4412 | ·938 | 1·46 |
| ·4429 | ·945 | 1·42 |
| ·4446 | ·951 | 1·47 |
| ·4464 | ·958 | 1·43 |
| ·4481 | ·964 | 1·46 |
| ·4498 | ·971 | 1·47 |
| ·4516 | ·977 | 1·51 |
| ·4533 | ·984 | 1·43 |
| ·4550 | ·990 | 1·40 |
| ·4568 | ·996 | 1·39 |
| ·4585 | ·003 | 1·26 |
| ·4602 | ·009 | 1·32 |
| ·4620 | ·016 | 1·30 |
| ·4637 | ·022 | 1·28 |
| ·4654 | ·029 | 1·17 |
| ·4689 | ·042 | 1·15 |
| ·4706 | ·048 | 1·17 |
| ·4724 | ·055 | 1·13 |
| ·4741 | ·061 | 1·10 |
| ·4758 | ·068 | 1·16 |
| ·4776 | ·074 | 1·09 |
| ·4793 | ·081 | 1·01 |
| ·4810 | ·087 | 1·03 |
| ·4827 | ·093 | ·98 |
| ·4845 | ·100 | 1·05 |
| ·4862 | ·106 | 1·01 |
| ·4879 | ·113 | 1·02 |
| 6016·6352 | ·309 | ·97 |
| ·6366 | ·314 | ·97 |
| ·6380 | ·319 | ·99 |
| ·6394 | ·325 | ·96 |
| ·6408 | ·330 | ·97 |
| ·6422 | ·335 | 1·01 |
| ·6436 | ·340 | ·98 |
| ·6449 | ·345 | 1·00 |
| ·6463 | ·350 | 1·08 |
| ·6477 | ·356 | 1·06 |
| ·6491 | ·361 | 1·06 |
| ·6505 | ·366 | 1·07 |
| ·6519 | ·371 | 1·06 |
| ·6532 | ·376 | 1·12 |
| ·6546 | ·381 | 1·15 |
| ·6560 | ·387 | 1·12 |
| ·6574 | ·392 | 1·16 |
| ·6602 | ·402 | 1·20 |
| ·6616 | ·408 | 1·22 |
| ·6629 | ·413 | 1·21 |
| ·6643 | ·418 | 1·25 |
| ·6657 | ·423 | 1·28 |
| ·6671 | ·428 | 1·32 |
| ·6685 | ·433 | 1·31 |
| ·6699 | ·439 | 1·34 |
| ·6713 | ·444 | 1·30 |
| ·6726 | ·449 | 1·33 |
| ·6740 | ·454 | 1·35 |
| ·6754 | ·459 | 1·32 |
| ·6768 | ·464 | 1·29 |
| ·6782 | ·470 | 1·29 |
| ·6796 | ·475 | 1·29 |
| ·6810 | ·480 | 1·30 |
| ·6823 | ·485 | 1·27 |
| ·6851 | ·495 | 1·30 |
| ·6865 | ·501 | 1·26 |

| J.D. Hel. M.A.T. Gr. —2420000 | phase | Δm |
|---|---|---|
| d | p | m |
| 6016·6879 | ·506 | 1·31 |
| ·6893 | ·511 | 1·33 |
| ·6906 | ·516 | 1·22 |
| ·6920 | ·521 | 1·26 |
| ·6934 | ·526 | 1·26 |
| ·6948 | ·532 | 1·17 |
| ·6962 | ·537 | 1·21 |
| ·6976 | ·542 | 1·20 |
| ·6990 | ·547 | 1·13 |
| ·7003 | ·552 | 1·14 |
| ·7017 | ·557 | 1·14 |
| ·7031 | ·563 | 1·10 |
| ·7045 | ·568 | 1·07 |
| ·7059 | ·573 | 1·11 |
| 6096·4427 | ·313 | ·98 |
| ·4441 | ·318 | ·96 |
| ·4455 | ·323 | ·96 |
| ·4469 | ·328 | ·95 |
| ·4483 | ·334 | ·98 |
| ·4496 | ·339 | 1·02 |
| ·4510 | ·344 | 1·04 |
| ·4524 | ·349 | 1·03 |
| ·4538 | ·354 | 1·06 |
| ·4552 | ·359 | 1·00 |
| ·4566 | ·365 | 1·04 |
| ·4580 | ·370 | 1·08 |
| ·4593 | ·375 | 1·08 |
| ·4607 | ·380 | 1·15 |
| ·4621 | ·385 | 1·12 |
| ·4635 | ·390 | 1·11 |
| ·4649 | ·396 | 1·14 |
| ·4690 | ·411 | 1·26 |
| ·4704 | ·416 | 1·22 |
| ·4718 | ·421 | 1·26 |
| ·4732 | ·427 | 1·23 |
| ·4746 | ·432 | 1·24 |
| ·4760 | ·437 | 1·27 |
| ·4773 | ·442 | 1·31 |
| ·4781 | ·447 | 1·25 |
| ·4801 | ·452 | 1·23 |
| ·4815 | ·458 | 1·29 |
| ·4829 | ·463 | 1·30 |
| ·4843 | ·468 | 1·31 |
| ·4857 | ·473 | 1·28 |
| ·4870 | ·478 | 1·30 |
| ·4884 | ·483 | 1·25 |
| ·4898 | ·489 | 1·28 |
| ·4912 | ·494 | 1·20 |
| ·4953 | ·509 | 1·20 |
| ·4967 | ·514 | 1·18 |
| ·4981 | ·520 | 1·16 |
| ·4995 | ·525 | 1·11 |
| ·5009 | ·530 | 1·13 |
| ·5023 | ·535 | 1·07 |
| ·5037 | ·541 | 1·07 |
| ·5050 | ·546 | 1·03 |
| ·5064 | ·551 | 1·06 |
| ·5078 | ·556 | 1·06 |
| ·5092 | ·561 | ·98 |
| ·5106 | ·566 | 1·03 |
| ·5120 | ·572 | ·98 |
| ·5134 | ·577 | ·96 |
| ·5147 | ·582 | ·95 |
| ·5161 | ·587 | ·94 |
| ·5175 | ·592 | ·95 |
| ·5217 | ·608 | ·93 |
| ·5231 | ·613 | ·94 |
| ·5244 | ·618 | ·90 |