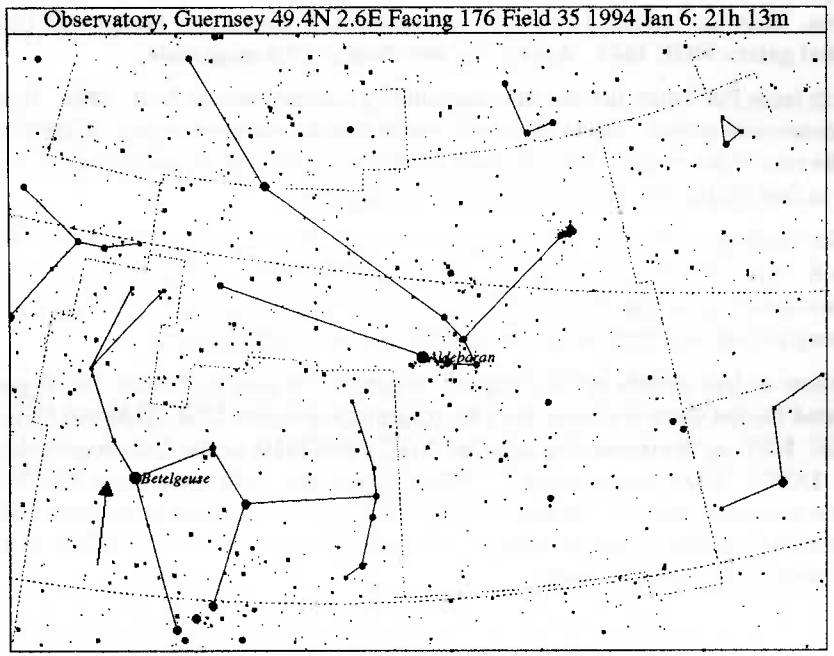
References

1. *Burnham's Celestial Handbook, Vol 3.* R. Burnham; Dover Publications,1978
2. *Deep Sky, Winter 1991/1992.* Kalmbach Publishing
3. *Deep Sky, Winter 1988/1989.* Kalmbach Publishing
4. *The Deep Sky Field Guide to Uranometria 2000.0.* Cragin, Lucyk and Rapport; Willmann-Bell Inc, 1993

Also suggest using both volumes of the *Uranometria 2000.0.* Further information on supernova remnants and nebulae can be found in *The Fullness of Space* by Gareth Wynn-Williams, published by Cambridge University Press. Further information on the dating and aging of Globular Clusters can be found in the second volume of *Burnham's Celestial Handbook*, pages 990 to 993, also page 416 of *The Astronomy Encyclopedia*, edited by Patrick Moore (published by Mitchell Beazley, 1987). ¤

The map below was plotted using the software NightSky, for the Archimedes computer. Taurus is best visible from December to March in the evening sky.



TAURUS - THE BULL

by Mark Humphrys

In the last newsletter I explored some of the sights to be found in Orion, now very prominent in the Winter sky. Rising slightly earlier than Orion is the target for this month's search: Taurus (Figure 1). Famous for its two bright star clusters - the **Pleiades, M45** and the **Hyades**, and the supernova remnant, the **Crab Nebula, M1**, the first object in the catalogue started by Charles Messier in 1758.

The brightest star of the constellation is the 0.83 magnitude, orange-red, **Aldebaran**; this forms the eye of the Bull. It seems to be a member of the Hyades cluster, but is in fact only 68 light-years away, while the cluster is thought to lie some 130 light-years from us, so its apparent association is purely an optical illusion. Aldebaran, **Alpha Tauri**, is a K5 star with a diameter some 40 times larger than our Sun, and a luminosity 125 times greater[1]. It exhibits a slight variability between magnitudes 0.78 to 0.93. It does have a 13th magnitude companion, a red dwarf, some 31.4 arc-seconds at a Position Angle of 112°.

The Hyades cluster contains at least 400 stars, the faintest detected at 16th magnitude. 132 stars shine brighter than 9th magnitude (Figure 2), and with an overall diameter of 5.5° it makes an ideal subject for binocular observations, the wide field of view giving the best image of this attractive cluster. The whole of the Hyades cluster is moving throuqh space at around 26 miles per second. By plotting the motion of the individual stars it can be shown that the cluster is heading for a point just to the east of Betelguese. If you are around in 50 million years you will see the Hyades cluster with only a 20 arc-minutes diameter[1]. Detailed observations of the cluster do not show any nebulosity, or any high temperature supergiants, both of which would indicate a young cluster. Another indication of its age is the presence of four yellow giants: Epsilon, Gamma, Delta and Theta-1. These are older stars and lie off the main sequence. The older the cluster the higher percentage of these stars will be present. It is thought that the Hyades is 400 million years old. This is in marked contrast to the next cluster, the Pleiades, M45, which reveals both extensive faint nebulosity and numerous young, bright supergiants.

The Pleiades, or the "Seven Sisters", is perhaps the most famous star cluster in the sky. Many cultures throughout the ages have had their own legends, wive's tales, religious beliefs and calendars attributed to this cluster and its appearance in the winter sky.

The challenge is to try to make out as many stars with the naked eye as possible. Most people can make out 5 or 6, some even claim to see 10 or more. How many can you make out? It is thought that there are at least 250 members in the cluster (Figure 3). Spectacular views can be obtained with binoculars or with low-power eyepieces; the wider field of view allows the whole cluster to be observed. Larger apertures will reveal the faint reflection nebula surrounding the cluster. The star **Merope (23 Tauri)** provides the illumination for the brightest part of the nebula, **NGC 1435** and **IC 349**. »»

In short exposure photographs these two nebulae appear to be separate, but in longer exposures it can be seen that these two are in fact joined together as part of the whole extensive nebula. The nine brightest stars of the cluster are B class giants, the brightest being **Eta Tauri**, **Alcyone**, some 1000 times more luminous than the Sun. It is thought that the Pleiades are around 20 million years old. Any older and the supergiant stars would have run out of fuel and evolved to the next stage of development, moving away from the main sequence. Perhaps in its earlier stages of formation the cluster may have been similar to the Trapezium region of the Orion Nebula, very dense clouds of gas and dust surrounding the newly formed stars. In 20 million years the stellar winds emanating from the supergiant stars pushed away and dispersed the remnants of these dust clouds, leaving faint, wispy nebulosity that is seen around the Pleiades at the present time. Perhaps in millions of years time the Pleiades will resemble the Hyades cluster as it is today, with no nebulosity and with a higher proportion of the older red or yellow giant stars.

Continuing the survey of Taurus with **NGC 1647**, a bright star cluster 3° northeast of Aldebaran, it contains around 200 stars in a compact group some 45 arc-minutes in diameter, with an overall magnitude of 6.4, while its brightest stars are magnitude 8.6. A low magnification will provide the best view. With 7 x 50 binoculars I was able to make out a faint splodge of light with several brighter stars. Further northeast lies **NGC 1746**, a loosely scattered cluster, with around 20 stars giving an overall photographic magnitude of 6.1. The New General Catalogue lists two other clusters in the same area: **NGC 1750** and **NGC 1758**. These are in fact portions of NGC 1746. North from Aldebaran about 9° lies **IC 2087**, a faint reflection nebula, associated with the dark nebula **Barnard 22**. It is about 4 arc-minutes in diameter, while the dark nebula is around 28 arc-minutes in size. North of the Hyades cluster lies the irregular variable star **T Tauri** which fluctuates between magnitude 9 and 13, sometimes covering its entire range in a few weeks, while at other times it will exhibit a constant magnitude for several months. Surrounding the star is a nebulous mass **NGC 1554,** the brightest portion of which is **NGC 1555**, also known as **Hind's Variable Nebula**, after its discoverer, John Hind. Phil Harrington, writing in *Deep Sky* [3] says that he has never seen this nebula in a 13.1-inch telescope; can it be seen with the 14-inch SCT?

The **Crab Nebula**, the remnant of the supernova documented by the Chinese astronomers in AD1054 can be found 1° northwest from **Zeta Tauri** (Figure 4). With binoculars it is no more than a small point of light; I cannot make out any detail, but with increasingly larger apertures more detail can be detected. With the 14-inch SCT can the spiny tendrils, which give the nebula its characteristic appearance, be seen? Within the nebula is the pulsar, a 16th magnitude neutron star spinning at around 30 times a second. 4° north from the nebula lie two open star clusters, **Dolidze-Dzimselejsvili (DoDz) 4** and **DoDz 3** (Figure 4). The larger and brighter of the two is DoDz 4. It contains around 15 stars within a diameter of 28 arc-minutes. DoDz 3 is smaller at 14 arc-minutes, and contains around 10 stars. To the northeast from these two clusters lies a very extensive, but very faint supernova remnant **Simeis 147, S147**. This has the aura of an impossible object to see visually and yet looks stunning in photographs. But despite its "impossibility" »»

portions of it have been seen using a 12.5-inch Newtonian with an O III filter [2]. The observer, Alister Ling, used a black cloth over his head and eyepiece to cut out all extraneous light! The supernova remnant is thought to be around 50,000 years old. Perhaps in a similar time span the Crab Nebula will be as extenuous as this is.

Another challange for you - on the southern edge of the nebula lies the variable star **RR Tauri**. It is mentioned in Burnham's Celestial Handbook (Vol 3, page 1888) as having its own patch of nebulosity. Can anybody spot it? No detaiIs are given as to how faint it is or its size, etc., and it is not indicated in the Uranometria 2000.0, which means it is going to be very faint!

Due east from Aldebaran, lie two bright open clusters: **NGC 1807** and **NGC 1817**. NGC 1807 is the brighter of the two at 7th magnitude. It contains some 20 stars within an area 16 arc-minutes across. Some observers had noted a cruciform shape to the cluster [3]. At a short distance northeast lies NGC 1817, 15 arc-minutes in diameter, containing some 60 stars. Although most are fairly faint at 11 - 14 magnitude, the overall brightness is around 7.7 magnitude.

Moving south near to the border with Eridanus lies a small group of four galaxies, about ½ to 1° north from the 5th magnitude star 45 Eridani. The brightest galaxy is the elliptical **NGC 1587** at 11.7 magnitude. **NGC 1588** lies close to NGC 1587, but is slightly fainter than its neighbour at 12.9 magnitude. It is also slightly smaller at 1.4 x 0.7 arc-minutes, compared with 1.8 x 1.7 arc-minutes. Slightly north of this pair lies **NGC 1589**, again very faint at 11.8 magnitude, but larger, being 3.1 x 1.0 arc-minutes in size. Further east lies **NGC 1608**, the faintest at 13.4 magnitude. Across the border into Eridanus lie two more galaxies, **NGC1620** and **NGC 1586**, which you may like to have a go at while in this area. They are indicated on Figure 5. Further east towards the border with Orion lies the spiral galaxy **NGC 1642**. Again, it is very faint at 12.6 magnitude.

2° north from **Psi Tauri** lies the llth magnitude planetary nebula **NGC 1514**. It is about 114 arc-seconds across. Some observers report that its northern edge is slightly brighter than the rest of the disk [3]. The planetary lies between two 8th magnitude stars, making it easier to find (Figure 6). Its central star is 9.4 magnitude.

Another challenge lies some 1¼° south of Psi Tauri, **DoDz 14**, an open cluster, shown in Figure 6. It is very close to the 5th magnitude star **41 Tauri**. The Deep Sky Field Guide [4] lists this cluster as having 18 members, but does not list a magnitude. Perhaps it would be necessary to keep 41 Tauri out of the field of view to see this cluster.

That more or less rounds up the brighter objects to be seen in Taurus, but if you have exhausted the list there is always the 14th magnitude galaxies **UGC 3128** and **UGC 3087**. Or **NGC 1497**, or the interacting galaxies **NGC 1409/1410,** or the 15th magnitude galaxy **NGC 1539**? Want some more? What about the 15th magnitude **PK174-14.1** a possible planetary nebula? Or there is **NGC 1517**, or **NGC 1590**, or perhaps **vdB 26,** a faint patch of nebulosity surrounding a 7.2 magnitude star. There are still more to find, but it's up to you to look for them. »»

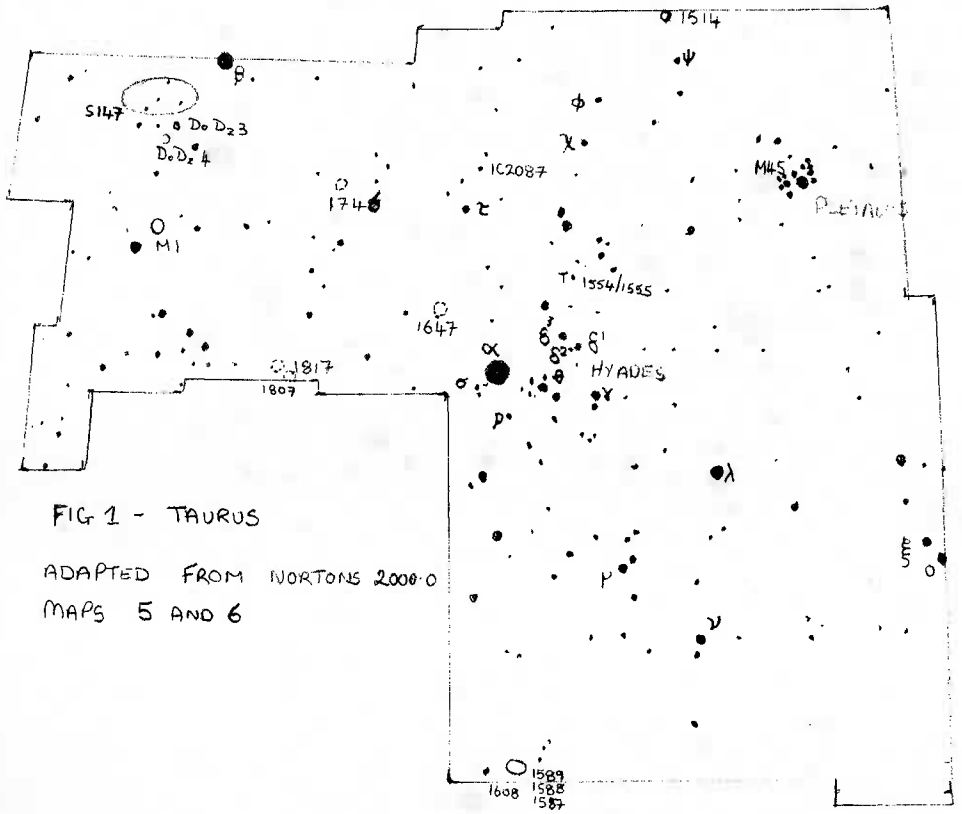


FIG 1 - TAURUS

ADAPTED FROM NORTONS 2000·0 MAPS 5 AND 6

FIG 2 - HYADES STAR CLUSTER

ADAPTED FROM A PHOTOGRAPH ON PAGE 1823 OF VOLUME 3 BURNHAMS CELESTIAL HANDBOOK.

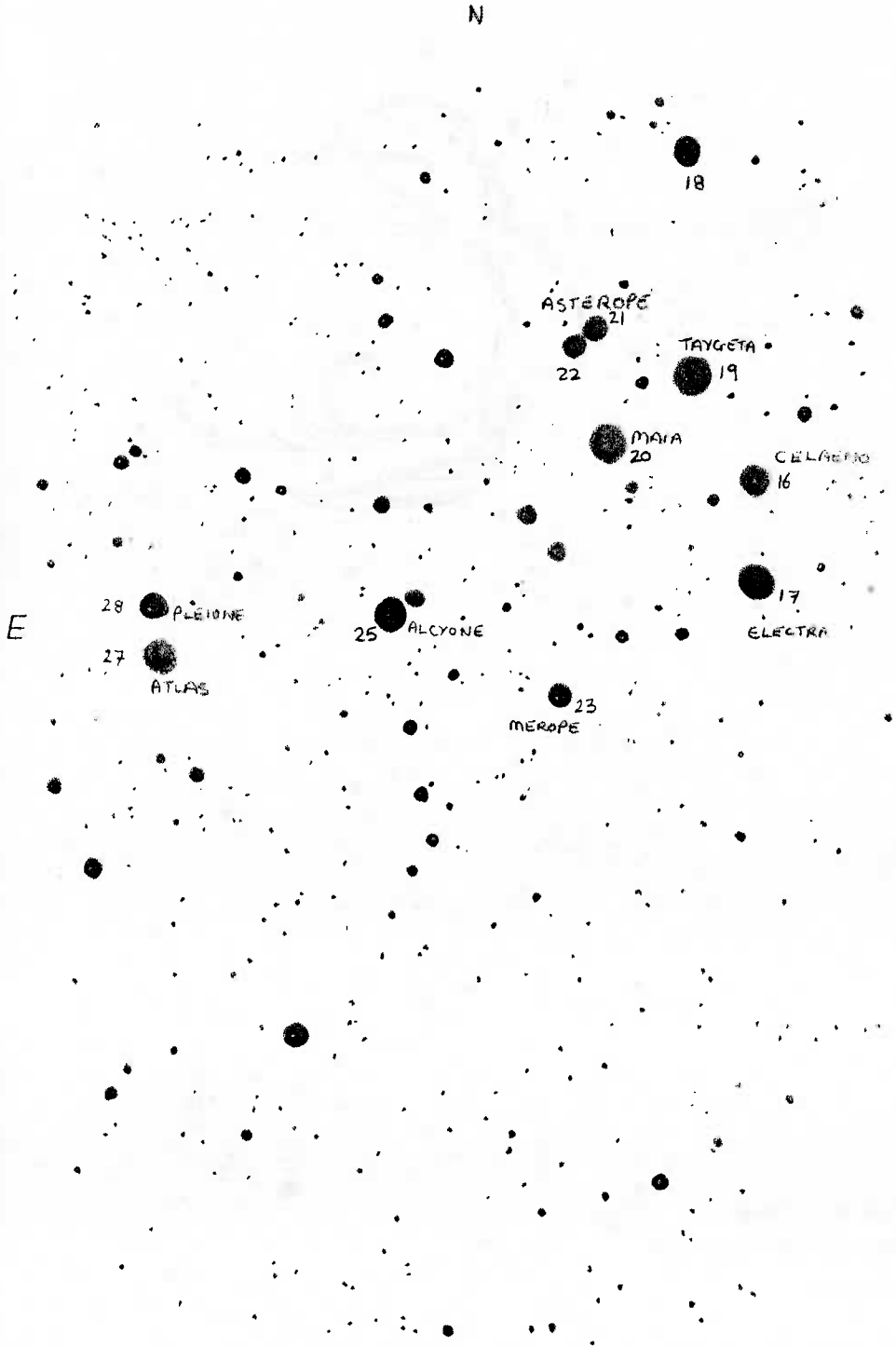


FIG 3 - PLEIADES STAR CLUSTER

ADAPTED FROM A PHOTOGRAPH ON PAGE 1870 OF

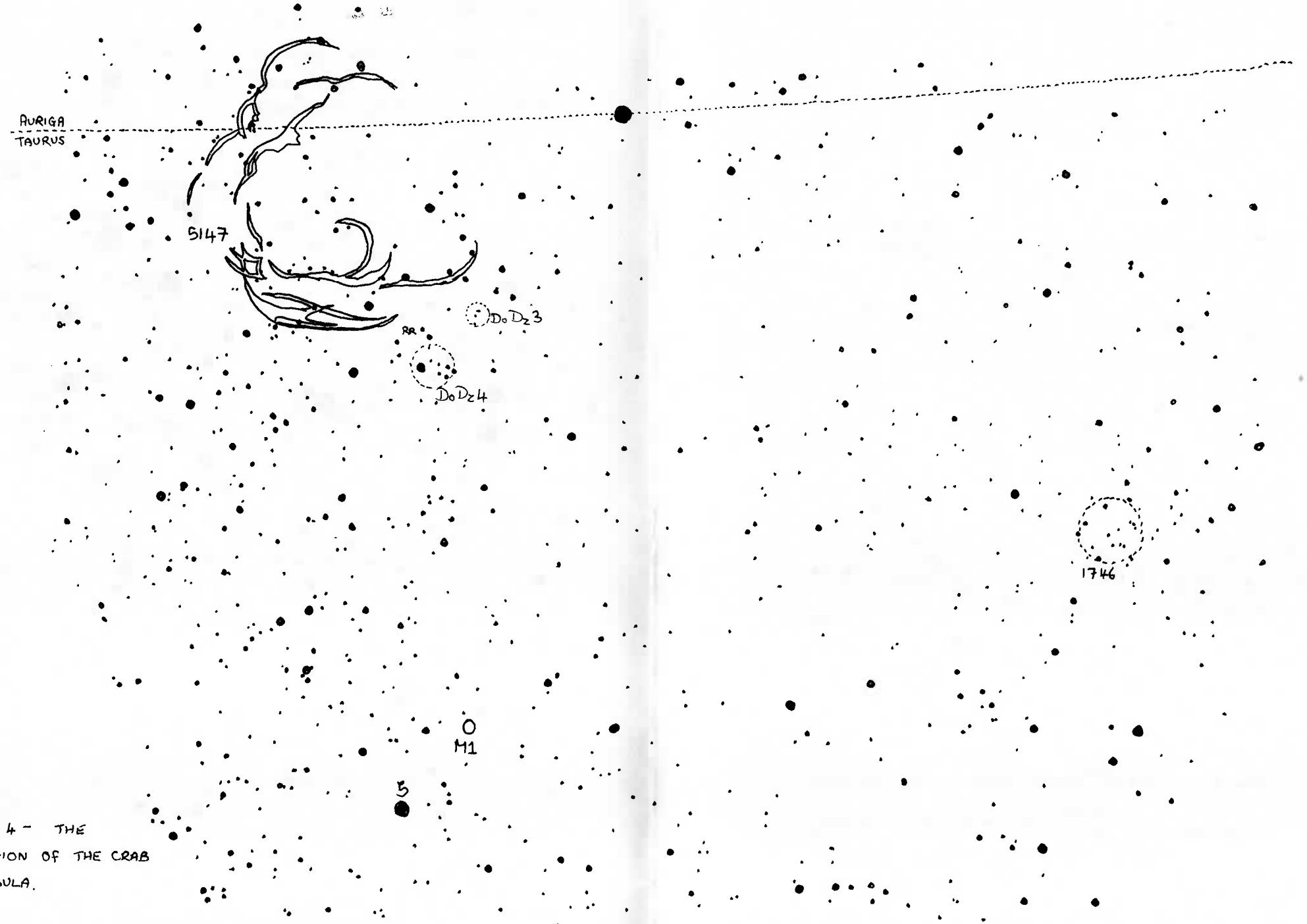


FIG 4 - THE REGION OF THE CRAB NEBULA.

ADAPTED FROM URANOMETRIA 2000·0 VOL 1. MAPS 98, 135, 136.

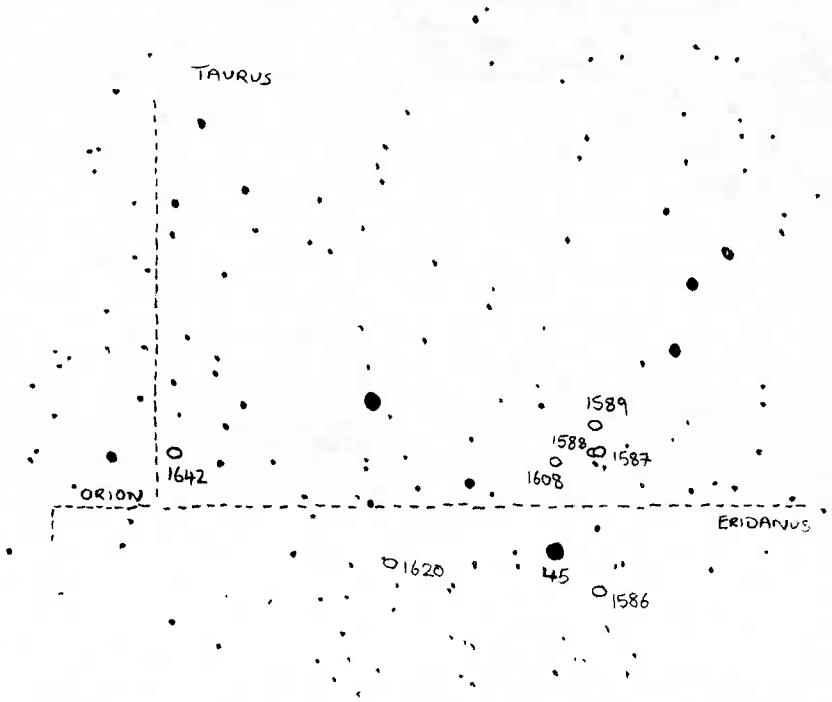


FIG 5 - GALAXY GROUP NEAR TO 45 ERIDANI

ADAPTED FROM URANOMETRIA 2000·0 MAPS 223, 224

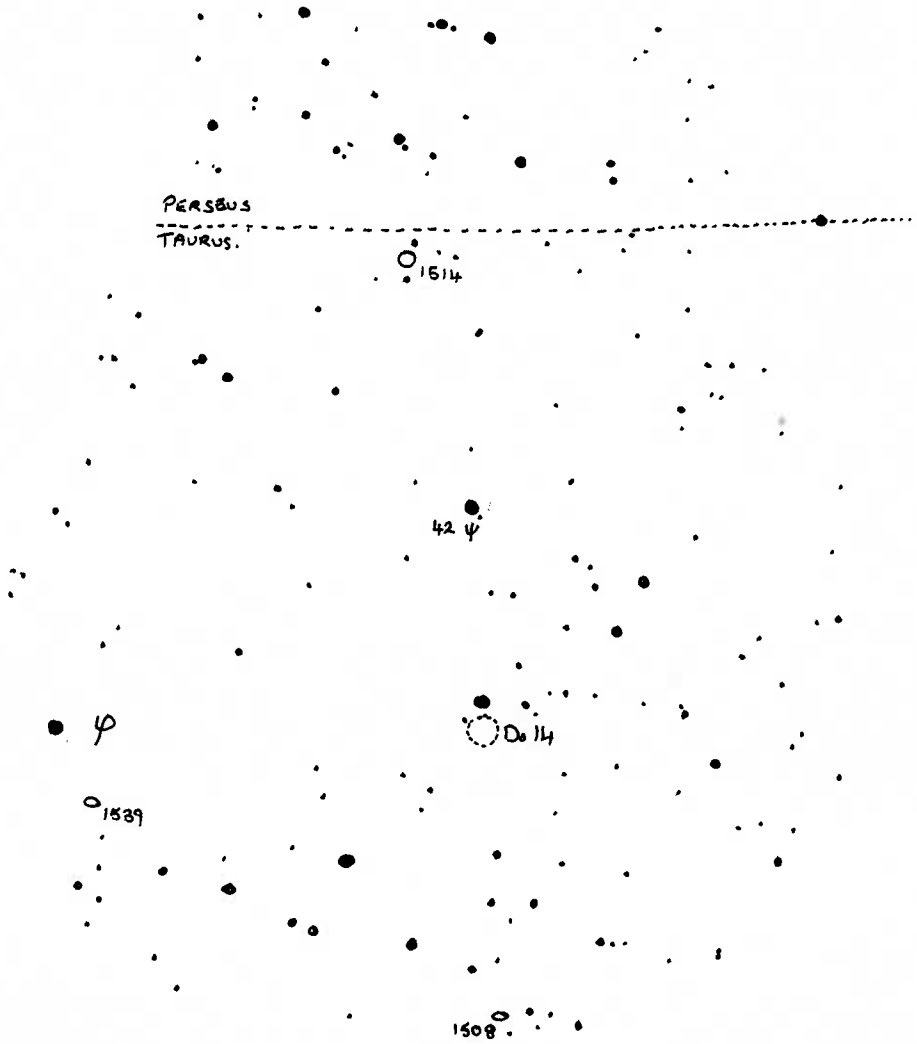


FIG. 6 - NGC 1514 AND D_0D_2 14

ADAPTED FROM URANOMETRIA 2000·0
MAPS 95 AND 133