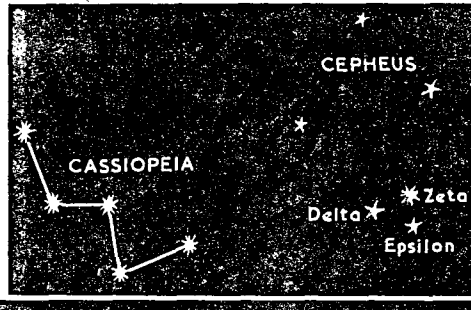


# Lighthouses in Space!



## COCKNEY BIRDS

London's rich bird-life is described in the latest survey of the London Natural History Society. This tells us that the city's most remarkable post-war colony of "bomb-site" birds, the black redstarts, are being dislodged by building. But others, such as magpies, kingfishers, jays, and goldfinches, are increasing in numbers.

Birds recorded for the first time in London include three kinds of tern—the whiskered, whitewinged black, and the Caspian. Other rarities included two grey wagtails that raised families in a brewery at Whitechapel.

Altogether, 184 varieties of birds are noted in the survey.

## Young Choirmaster



At 16, Patrick Smith of Erith Grammar School, Kent, is choirmaster and organist of St. Mary's at Horton Kirby. He hopes to have a cathedral appointment one day.

**O**UR star-system, or Galaxy, contains about a hundred million stars. Each is a sun, but not all are alike. Some are huge and red; some are bluish-white, and many thousands of times more luminous than our Sun. Some are smaller than the Earth, but with a density equivalent to the weight of a whole truckload of coal packed inside a thimble.

Most of the stars shine steadily, and remain unaltered for centuries at a time. Our Sun, for instance, has certainly not altered much since the first men appeared on Earth. This is lucky for us, since any startling change in the Sun's output would mean that we would be either boiled or frozen. Some stars, however, brighten and fade over short periods. These are the Variable Stars, of which many are known.

### Triangle of stars

One of the most famous Variables in the sky lies in the constellation of Cepheus, not far from the Pole Star. The diagram shows where to find it. It is not difficult to locate because the prominent W-shape of Cassiopeia is such a good guide to it.

But it is not brilliant: in fact, never brighter than the faintest of the seven stars of the Great Bear. But fortunately it is one of a triangle of stars, and will be recognised without much trouble. The other members of the triangle are Zeta and Epsilon Cephei. The Variable itself is known as Delta Cephei.

Delta Cephei behaves in a completely regular fashion. At maximum it is not much fainter than its neighbour, Zeta. But it brightens and fades, taking a little over five days to pass from one maximum to the next.

We can draw a light-curve of it. In curves of this sort, brightness is plotted against time. Delta Cephei repeats its changes week after week, year after year, century after century. It is as regular as clockwork.

### Varying brightness

You can easily follow its changes if you look at it on several successive nights. When you first look, it may be almost the equal of Zeta; then it will fade, until two or three nights later it is much inferior to Zeta and comparable with Epsilon; then it will brighten up again.

Astronomers reckon a star's brightness by its *magnitude*. The lower the magnitude, the brighter the star. Zeta Cephei is of magnitude 3.6 and Epsilon 4.3, while Delta, at maximum, is 3.7—that is to say, very slightly fainter than Zeta.

There are many other variables which behave in the same way as Delta Cephei, and they have become known as "Cepheids." One or two are visible to the naked eye, but most are fainter,

we know how brilliant a Cepheid really is, and we also know its apparent brightness, we can calculate its distance from us.

There are plenty of everyday comparisons. Suppose, for instance, that you are staying at the seaside, and see a light shining from across the water when darkness has come. It may be a faint light close to you, or it may be a powerful lamp a long distance off. But if you know for certain whether it is bright or faint, you

may be observed across vast distances.

The greatest triumph came in 1923, when the American astronomer E. E. Hubble was studying the famous Great Nebula in Andromeda, which is made up mainly of stars. At that time it was not known whether the Nebula was contained in our Galaxy, or whether it was a separate system.

Using the 100-inch reflector at Mount Wilson, Hubble was able to find some Cepheids inside the Nebula. As soon as he had measured their periods, he was able to calculate their distances—and at once he found that they were so far away that they could not possibly be members of our Galaxy. The Cepheids in the Andromeda Nebula have now shown us that the nebula is two million light-years away, and is a system decidedly larger than ours.

### Useful information

We do not know why the Cepheids behave in this strange way. All we can say is that the Cepheids alternately expand and contract, so that their real brightness changes. At least they must be regarded as some of the most useful stars in the whole sky, and they have given us information which would have been hard to obtain in any other way.



**LOOKING AT THE SKY** with Patrick Moore

and can be studied only with telescopes.

The extraordinary thing about Cepheids is that their periods are linked with their real luminosities. For instance, it is known that Delta Cephei itself, with a period of just over five days, is about 600 times as bright as our Sun. And any other Cepheid with the same period will have the same luminosity of 600 Sun-power. A Cepheid of longer period will be more brilliant, while if the period is shorter the luminosity will be less.

In other words, we can tell a Cepheid's real brightness simply by watching it with our telescopes and timing the interval between one maximum and the next.

This "period-luminosity law" has never been properly explained, but it is remarkably useful. If



The huge 100-inch reflector at Mount Wilson, California.

can tell whether it is near or remote. This is what astronomers do with the Cepheids, which act as "standard candles" in space. Since all are very luminous, they

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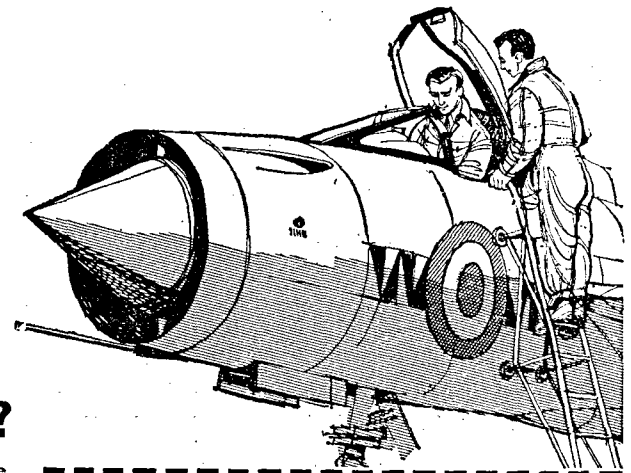
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