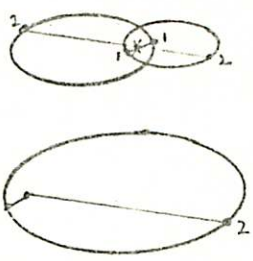
ORBIT LANGUAGE

While not absolutely wrong, it is not quite right to say that the earth goes around the sun, the moon around the earth, or one star around another. In each case, both objects are in orbit around a point in space between them called the center of mass (less correctly, center of gravity; or if you want a word to show off with, barycenter). For earth and sun, and even earth and moon, the difference is not very important; the earth-sun barycenter is only about 300 miles from the center of the sun, and the earth-moon one well inside the earth. For double and multiple stars, however, the difference is large, as the figure here shows; the upper diagram is the "true" representation. The x locates the barycenter; the stars move so that the line connecting them always passes through x. When they are closest to it they are said to be at periastron (corresponding term for earth-sun=perihelion, for moon-earth=perigee; general term for all orbits, periapsis). (Far point: apastron, apoapsis)



Even with stars, however, it is usually convenient to draw the orbit as though one of them were motionless (lower diagram). This is called the relative orbit, and is no more wrong than talking about sunrise, or putting north at the top in maps; just a convenience. The relative orbit has the same shape as the "absolute" ones, and the size of the two of them taken together (it doesn't look like this in the diagram, but remember they are overlapping above).

25.8 – MIN RATIO of MASS for TROJAN solutions to WORK

THE NEXT DOOR NEIGHBORS

The two main suns of the Alpha Centauri system are similar enough to our own to possess Earthlike planets; whether they actually have any is another matter. We don't know how or why planetary systems form, and even Jupiter would be indetectable at a parsec and a third--4.3 light years--to any instruments we have now (though keep your fingers crossed for IRAS).

We can be sure that neither of the two has planets very far out; the dotted circled on the orbit diagram indicate roughly the distance from each star at which the gravity of the other would make a planet orbit unstable, so we can expect planets only inside those circles.

The smaller, solid circles indicate the distance at which a planet like our own would have an Earthly temperature; so if you are writing a story which calls for the characters to be human and walk around in shirtsleeves or less, both Alpha A (the brighter) and Alpha B could provide you with a scenario.

The planet's distance from A would be about 1.07 A. U, and the length of its year about 390 Earth days; for B, about 0.57 A. U. and 160 days. One can see from these figures that A is just a trifle larger and brighter than our sun, while B is only about a third as bright.

You can have a Mars and perhaps a few asteroids for each sun, but no Jupiters or Saturns; these would be too far out to have stable orbits.

You could put planets very far out indeed, going around both stars at once (but no figure 8 orbits, please). In that case, the minimum distance for stability would be about 200 a. U., which would correspond to a year length of a little under two thousand Earth years and an average temperature of about 25°K--about -250°C.

Neither A nor B would have any significant effect on the temperatures of the other's planets; at periastron, a little over 11 A.U. away, A would raise the temperature of an Earth-like planet of B by less than 1°C.

PROXIMA

Strictly speaking, Alpha Centauri is a triple rather than a double star system; but Alpa C, also called Proxima because just now it seems to be a trifle closer to us than the other two, is so far from them that natives of their planets would have to become fairly good astronomers to discover that it belonged to their system.

It is about one sixteenthousandth (not sixteen one thousandths!) as bright as our sun; seen from a planet of A or B it would be visible to the human eye but unimpressive--about 4.5 magnitude. No one doubts that it is in orbit around A and B, but it hasn't moved far enough since its discovery to let us calculate the details of the orbit--and don't hold your breath waiting for it to do so. It is currently at least 10,500 A.U. from the main pair, and even if it is now at the outer end of the longest, skinniest, most eccentric orbit believable, its period would have to be at least a quarter of a million years.

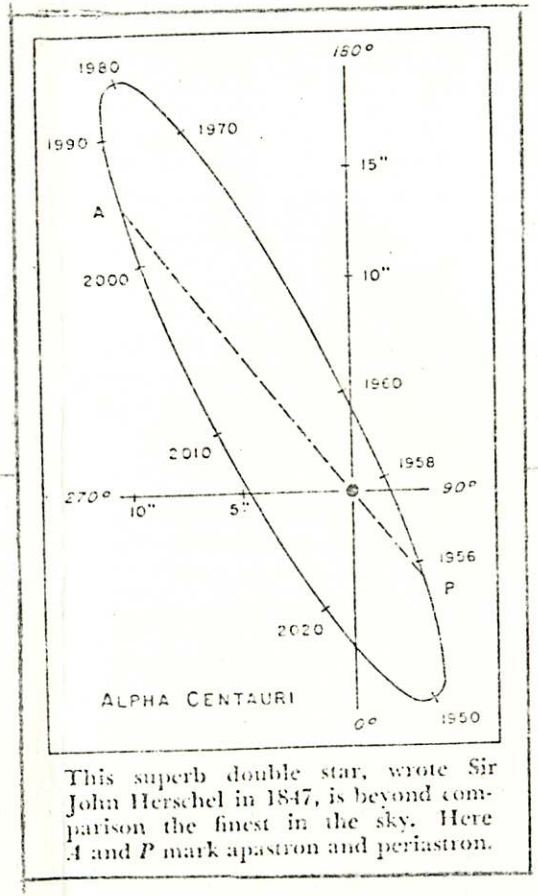
To be as warm as Earth, a planet would have to be about 3 times as far from Proxima as our moon is from Earth. We don't know the little star's mass, but making a reasonable guess, this would give the planet a year of about twenty-five hours. It would pretty certainly be in locked rotation--that is, keep one hemisphere constantly toward its sun--which will provide more complication when you figure out its climate in the planet-building workshop.

There could be Jupiter-type planets in this system which, like our own Jupiter, don't depend on their sun for their heat and weather; one could write a reasonable story about active trade going on between Jupiter and Proxima's gas giants, with the traders completely uninterested in the solid planets close in to their stars!

One complication: Proxima is a flare star, sometimes brightening up by a factpr of two or more for fifteen or twenty minutes. What it radiates at such times besides light we don't know, but our solar flares emit x-rays and energetic protons...

True relative orbit
of Alpha Centauri

Inset: Apparent relative
orbit, seen from Earth



This superb double star, wrote Sir John Herschel in 1847, is beyond comparison the finest in the sky. Here *A* and *P* mark apastron and periastron.