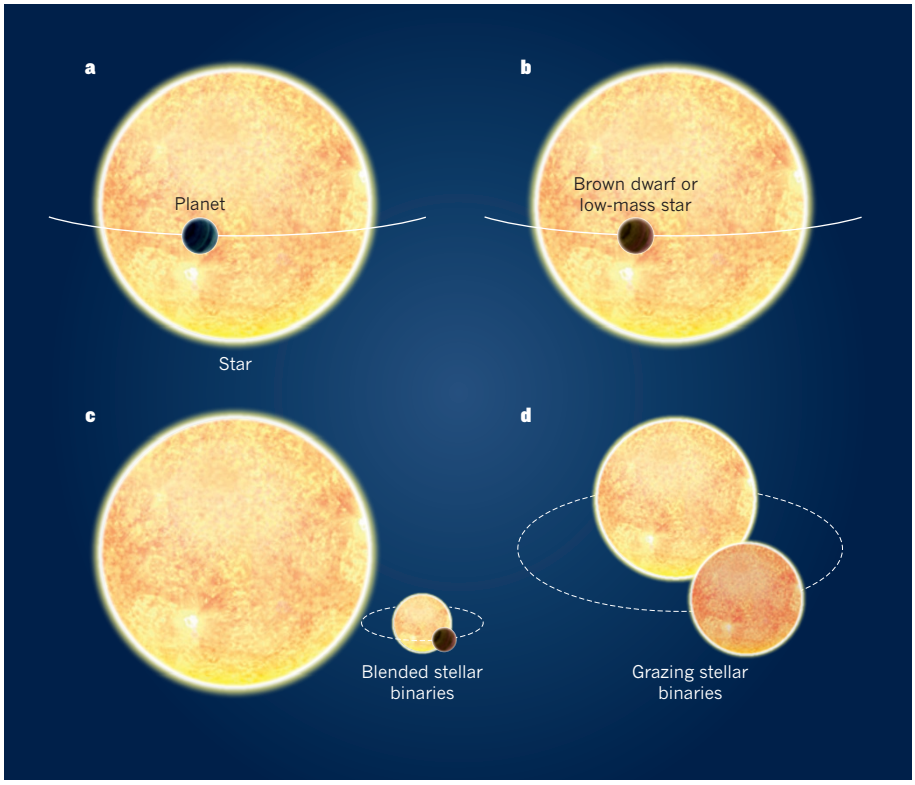

Figure 1 | Mimicking a planetary transit. **a**, A gas-giant planet blocks a small amount of starlight as it passes in front of its host star. The resulting drop in light is similar to that produced by other systems, as follows: **b**, an orbiting brown-dwarf or low-mass star, both of which have radii similar to gas-giant planets; **c**, blended stellar binaries in a triple-star system that have deep eclipses strongly diluted by a bright neighbouring star, mimicking the much shallower transits of a planet; **d**, grazing binary stars, in which the stars' disks overlap by only a tiny amount at each eclipse. The latter systems are the most common type of 'impostor' in Santerne and colleagues' sample of candidate planets[1].

First and simplest, brown-dwarf stars and stars with masses less than 10% that of the Sun have very similar radii to those of gas-giant planets such as Jupiter. As a result, planets can be distinguished from such eclipsing binaries only by determining their mass. A second type of impostor is a triple-star system, in which a bright single star dilutes the light of a nearby, dimmer, eclipsing binary pair to the point at which the eclipses seem to be as shallow as those caused by planets. A third possibility is grazing binary systems, in which the stars' disks overlap by only a tiny amount at each eclipse, so that the reduction in brightness is similarly small.

Some of these options can be easily eliminated. Kepler's high-precision imaging delineates the shape of a planetary transit clearly. The light from the host star changes rapidly when the planet (which is generally much smaller than the star) is moving on or off the edge of the star's disk, giving a characteristic 'U-shaped' light variation. Grazing stellar binaries have 'V-shaped' profiles. The duration of the transit is also a clue. It gives a direct dynamical measure of the host star's bulk density, which is closely related to its temperature. Therefore, a measurement of the density that is inconsistent with that inferred from the star's temperature is a good indicator that the system could be an impostor.

This and other validation tests are vital for confirming the planetary nature of Kepler candidates, and do not require expensive follow-up observations — they are simply based on stellar properties determined from existing ground-based surveys, and on the Kepler data.

For single-planet systems, confirmation requires follow-up measurements of the orbital reflex motion caused by the orbiting planet. But this approach is expensive because it requires a large amount of ground-based telescope time. The vast majority of Kepler small-planet candidates are simply too faint to be confirmed in this way. Santerne and colleagues' result, which is based on such follow-up measurements of giant-planet candidates, comes as a salutary lesson on the importance of checking, wherever possible, that individual Kepler candidates are not impostors. It also serves as a good example of the painstaking way in which science is advanced. The problem with Morton and Johnson's model was traced[3] quickly to an inadequate treatment of the population of grazing binaries. This has already led Morton to develop an improved validation method[3], which reproduces the rate of false positives in Santerne and colleagues' sample more reliably, by taking better account of the shape of the Kepler

50 Years Ago

Natural History of Infectious Diseases. By Sir MacFarlane Burnet — It is a pleasure to review this, the third edition, of such a well-known work, which now presents an up-to-date account of the ramifications of an important subject … Throughout it adopts a Darwinian attitude, often overstepping the realms of human pathology into all kinds of unexpected avenues … In its ambit it presents a picture of the ravages by bacteria, protozoa and viruses … He discredits the practical value of antityphoid inoculation and would rather attribute the favourable results obtained to military sanitation … The readers will find here important information about such diverse subjects as myxomatosis in rabbits, the common cold, plague, German measles, poliomyelitis, the sweating sickness of the Middle Ages and Q. fever (from personal experience). An epilogue on new diseases and the rather bleak outlook for the future finds the author in a gloomy mood in an appraisal of bacteriological warfare.
From *Nature* 8 December 1962

100 Years Ago

Mr. E. G. Bryant … asks a question regarding the effect of moonlight in "turning" fish. I have lived many years in South Africa, and have encountered the same belief, that moonlight will hasten the turning bad of fish … It seems curious, at first sight, that moonlight, which has so little effect on meteorological instruments, should have this effect on fish. I have thought it probably due to insects or some low form of life which would be abroad, or be stimulated to action, on moonlit nights and not on dark nights. The action of moonlight in stimulating the rise of sap in trees is widely believed in by practical wood cutters in almost every quarter of the world.
From *Nature* 5 December 1912