Pope Gregory's calendar

Keeping up with time

from David W. Hughes

WHEN astronomers use the term 'year' without any qualifying adjective they are referring to the tropical year, Y, the time between successive passages of the Sun through the vernal equinox. Unfortunately $Y = 365.24219879 - 0.000013T$ mean solar days, where T is the number of centuries that have passed since 1900.00. I say 'unfortunately' because it is obvious that a calendar year, for all practical purposes, must contain an integral number of days. So calendar years do not agree with astronomical years and to stop dates getting further and further out of step from year to year the number of days in a calendar year must be occasionally varied.

Julius Caesar introduced the so-called julian calendar in 45 BC. Every year that was exactly divisible by four was regarded as a leap year and thus contained 366 as opposed to 365 days. Unfortunately, the tropical year is not 365.25 days long but is 11 minutes and 14 seconds shorter; and this difference gradually mounts up.

By 1582 the julian system was about 10 days out. Easter in the Christian church is celebrated on the first Sunday after the first full Moon that occurs on or after the vernal equinox. This equinox was assumed to be 21 March. By 1582 the equinox was actually occurring on 11 March while Easter was still being reckoned from 21 March. If the julian calendar had been adhered to, Easter would eventually have been celebrated in the summer.

In 1576 Pope Gregory assembled a commission of astronomers, mathematicians and clergy to study methods for correcting the calendar. They eventually adopted a plan put forward by a Calabrian physician Luigi Lilio. The work of Lilio is discussed in a recent paper by Gordon Moyer in *Sky and Telescope* (**64**, 418; 1982). On 24 February 1582 Gregory XIII issued the papal bull *Inter Gravissimas*. Thursday, 4 October 1582 was to be followed by Friday, 15 October. And from then on every year that begins a new century must be exactly divisible by 400 to be a leap year. Thus 2000 and 2400 are leap years; 1900, 2100 and 2200 are not.

The change was immediately adopted by all the Catholic countries, but the Protestant and Greek Orthodox countries would have none of it. The furore eventually died down. Norway and Denmark changed their minds in 1700. Great Britain and its colonies (including America) followed suit in 1752. The bill passed by Parliament states in part ". . . and that the Natural Day next immediately following the said second Day of September shall be called, reckoned, and accounted to be the fourteenth Day of September omitting for that Time only the Eleven intermediate Nominal Days of the Common Calendar. . .". At the same time the beginning of the year (commencing with 1752) was changed from 25 March to 1 January. The 18 March 1751 Act of Parliament introducing these changes caused rioting in the streets and shouts of 'give us back our eleven days', the eleventh day having accumulated since Pope Gregory's proposal. Japan changed in 1873 and the Orthodox Church in Russia, Rumania and Greece in 1923.

Problems still exist, and Charles Kluepfel has investigated the accuracy of the gregorian calendar in *Sky and Telescope* (**64**, 417; 1982). By AD 13000 the vernal equinox will again be occurring around 10 March. The 'new' gregorian calendar will then be just as much in error as the julian calendar was in 1582. Correcting the gregorian calendar appears, however, to be a bit premature. The length of the tropical year in terms of mean solar days depends on the Earth's spin rate. This is slowing down but the way in which this retardation is occurring is not accurately known. Also, the calculations depend on the determination of the tropical year at epoch 1900 made by the American astronomer Simon Newcomb. That needs to be recalculated. So all in all the gregorian calendar is at about the limits of its possible accuracy and the system will just need to be recalibrated every few thousand years. □

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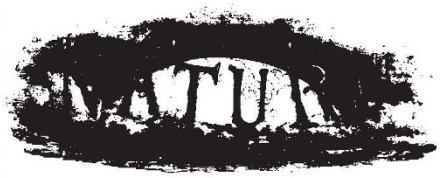

100 years ago

NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY

THE ONE-WATTLED CASSOWARY (*Casuarius uniappendiculatus*). The Cassowaries of the Moluccas and Papuan Islands, together with the Emeu of Australia, constitute a very well-marked division of the Struthiones, or ostrich-like order of birds, and occupy a large area of the Australian region. But while the Emeu (*Dromceus*) is spread over the whole of the Australian continent, the Cassowary is only met with in the northern parts of Queensland and in the peninsula of Cape York, and we must cross Torres Straits into New Guinea and its adjoining islets before we arrive at the true metropolis of the Cassowaries. Here we shall find them scattered over the different islands to the number of nine, as indicated in Count Tommaso Salvadori's recent essay on the group, and but one, or at most two species being ever found exactly within the same area.

A characteristic of the Cassowaries is the large horny casque which covers the head, and is devoid of feathers. In one division of the genus this is much elevated and laterally compressed, in the other the casque is pyramidal in shape, and flattened cross-ways behind. The One-wattled Cassowary belongs to the second division, and is further distinguished by having (in common with its near ally *C. occipitalis*) but a single wattle in the middle of its throat.

This Cassowary was first made known to science in 1860 by Blyth, from an example brought alive to Calcutta, of which the exact origin was uncertain.

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