The Stars in their Courses

I.Asimov

July 12-13, 2018

Asimov is known as a science-fiction writer but he also had a bread-winning career as a biochemist, but his academic career took second place to his passion for writing and already by the late fifties he could opt out of teaching but as his position was tenured he could keep it anyway, and in view of his reputation as a writer was eventually promoted to a full professor. The book to be reviewed, a simple mass paperback, is however not about science fiction but consists of a collection of popular science articles written in 69/70 and published in a science-fiction magazine. They cover subjects in astronomy, physics and chemistry, and then in a final section named 'sociology' appears maybe the most interesting. The style is very light and personal revealing a certain naivety on the part of the author.

Asimov is, hardly surprising, a staunch champion of science versus superstition (and makes a point of drawing a distinction between superstition and religion, usually not made by the modern foes of the latter) and his first piece he writes against astrology. He does however acknowledge that astrology started as science but failed to develop as such. One may argue that astrologers may not have believed in astrology but the interest of the mighty and prosperous provided them with a possibility of making a living. Kepler himself supported himself as an astrologer and the pressures to scientists of making themselves useful and provide applications have not eased in modern times. But is it really true that the stars do not have any influence on our lives? The sun itself, as the most prominent star, undoubtedly has a most crucial one and the movements of the large planets may have had consequences as to the tilt of the earth's axis as well as the form of its orbit, which according to some meta-meteorologists can explain the period appearance of ice-ages in modern geological times, although Asimov does not bring that up, instead he speculates on the tidal effects the inner planets and Jupiter may have had on the sun and its connections with solar flares and its consequences on modern communication. He also treats the Moon and the naming of craters, provides a debunking of Velikovsky. As to physics he discusses gravitation and makes the wrong statement that the Moon's orbit consists of wavy perturbations due to the orbiting of the Earth, in fact the orbit of the Moon is in effect convex[1], but this is marginal. He discusses the precession as a consequence of the Moon acting on the equatorial bulge of the Earth (as an oblate ellipsoid) but of course with no details[2]. He also finds occasion to discuss the Three-body problem. This is followed by a discussion of force and Newton's second and third law, as well as that of gravitational attraction built on proportionality. He is not shy of using formulas and even manipulating them be it on a very elementary level, this is followed by an account of how Cavendish 'weighed' the earth by experimentally determining the gravitational constant

[1] or more exactly it bounds a convex set

[2] the axis of a planet may change its direction anyway without the presence of a Moon

G. In the process he is making a point of the fundamental distinction between mass and weight and that we are linguistically sinning against it when we are 'weighing' in order to find out the mass, and speaking about 'weights'. In a space cabin there is weightlessness but not masslessness. Although a hefty piece of iron may be weightless and you do not have to worry about it falling on your toes it nevertheless affords resistance would you try to move it, i.e. imparting some acceleration (but admittedly we do not have to worry about friction) and would an iron ball be hurled against you you would suffer serious damage as it would not be easier to stop. As to G it is remarkable in a sense that this 'simple' weighing would in one go weigh all those celestial objects. On the other hand what is the use of knowing the mass of the Earth in terrestrial units? One may for one thing deduce its density (which is actually higher than you would surmise from that of the accessible crust), but otherwise it is of limited interest, just as knowing the astronomical distances in terrestrial units, apart from the fact that they are very large[3]. Then there is a speculative chapter on a world on the other side of the boundary where superluminar speeds reign, all based on the formula of Lorentz and what it could mean when masses become imaginary. Of more interest is the discussion of red-shift although he unnecessarily slurs a bit on the issue of Cepheids and measuring intergalactic distances. It is meant as a moral lesson on doing science as it means sticking to the rules and effecting a revolution from the inside (meaning that you need a thorough understanding of what you will eventually reject). The chapter is appropriately called 'Playing the Game'.

The chapters on Chemistry concentrates on the discovery of the rare-earth metals incidentally with a definite Swedish connection geographically and scientifically and set in the more general context of the Periodic system. From a point of view of reducing your ignorance this is the most interesting of the chapters. When Mendeleev set up his system he relied mostly on his intuition as to chemistry and its real significance only emerged decades later when atomic numbers were discovered in a rather round about way by Moseley which truly effected a revolution in chemistry. The story of Moseley was tragic indeed, sent as a volunteer to the First World War (the stupidest of all major wars according to Asimov) and coming to grief at Gallipoli[4]. There was no Nobel prize award in physics in 1916, not because of the War, Asimov muses. It should have gone to Moseley or at least posthumously (after all his predecessors got it in the surrounding years).

Science was a rather marginal activity at the time of what in retrospect is referred to as the Scientific Revolution in the 17th century as far as it impinged on the quotidian life until the 19th century when a hoist of practical applications were developed, Asimov on

[3] This means that in actual relevant calculations one does not need the value of G. One should know that the distance to the Moon is 60 Earth radii, while that to the Sun there are 400 Moon orbital radii a so called an astronomical units (1 A.U.=24'000 Earth radii) and a light-year is approximately 60'000 A.U., that the ratio between the speed of light and that of the orbital speed of the Earth is 10^4 follows from Roemers original estimation of the speed of light using the 'Doppler' effect of the periods of the Jovian satellites, or also from Bradley's discovery of aberration.

[4] Rutherford had tried to prevent him to go thinking it was a waste, his desire for a war-effort could have been channeled in better ways. In the following World War people of value were not drafted. Implicitly there is an admission that certain superior people should be saved the risks to life and limb while others are more disposable.

the other hand points to 1752 as a crucial year in that regard. That was when Benjamin Franklin established the nature of lightening and its relation to the Leyden flask and its electrical releases. This lead to the lightening rod that drastically reduced the number of lightning fires, especially sparing many a church steeple.

Then can a scientist sin? Sin against the spirit of science and sin against the welfare of mankind? Not through errors and mistakes, who does not commit them, but to willfully and maliciously abuse the power of science. He finds the example, the German chemist Haber who invented poison gas with no other object than to cause havoc and destruction, and the excuse of patriotism does not hold water, as it would sanction the same initiative by the opponents.

The last two chapters deal with the Malthusian vision which the author exemplifies with many a computation. How long would it take at the present increase before the entire universe is turned to human flesh and blood. Only a few thousand years in fact. To ignore those problems and rely on human ingenuity to remedy the problems as we go along, he considers madness. He also points out that it is not only a matter of populations per se, but also the resources which are involved per capita, that the United States which boasts only a small part of the total population consumes a major part of the planet's resources, and that the ambition that everyone should reach that level of standard of living is untenable. This was written almost fifty years ago and is even more acute now than it was back then, but now people are not aware of it in the same way, too many experts tell them what they want to hear, and besides talk about doomsday is boring, especially when felt to be abstract and non-tangible. And after all, so far things seem to go well, and Malthus is after all discredited. And one is reminded of the man that jumped from the Empire State Building and when he had fallen ninety stores exclaimed: So far, so good.

July 14, 2018 **Ulf Persson:** *Prof.em, Chalmers U.of Tech., Göteborg Sweden* ulfp@chalmers.se