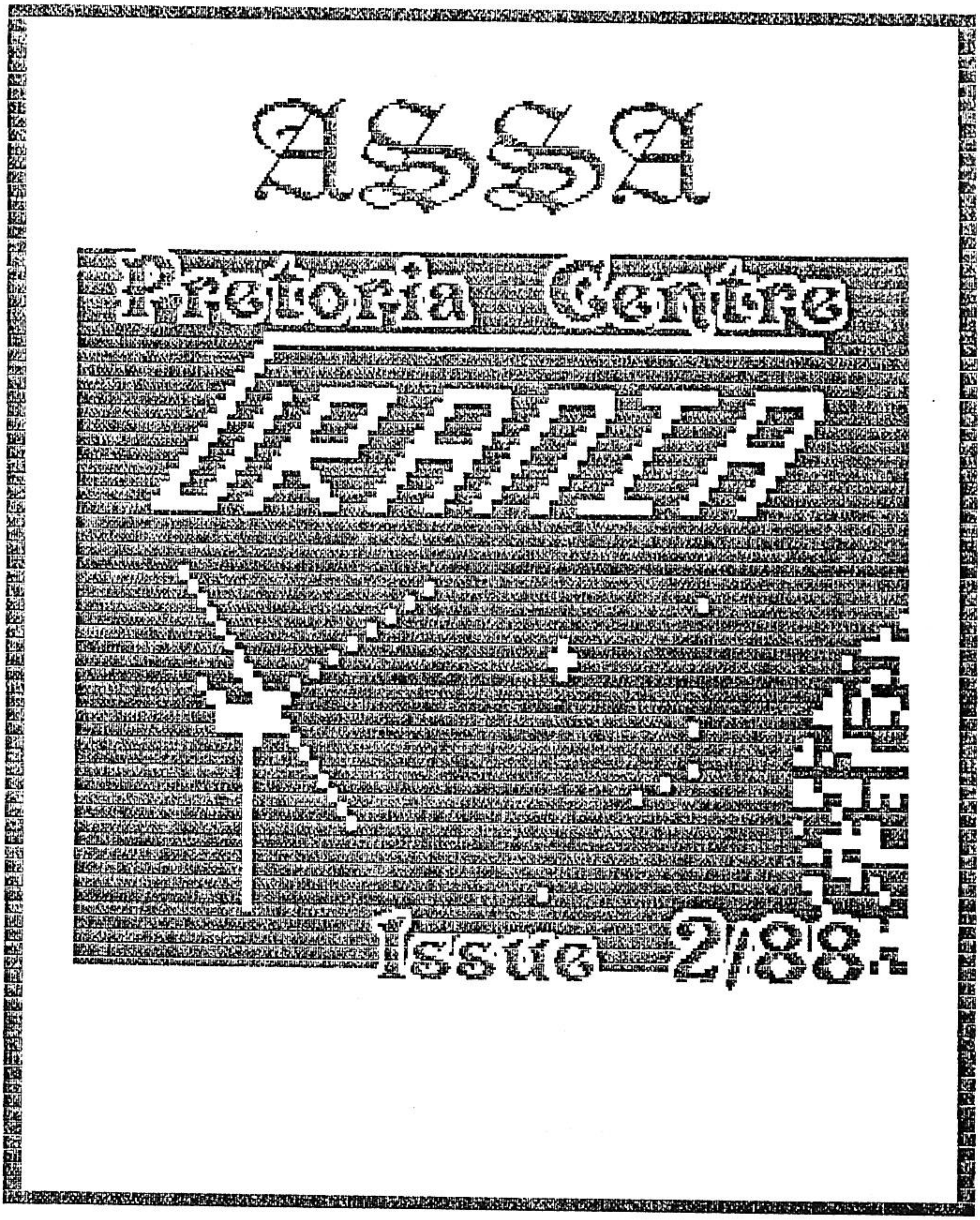

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The ASTRONOMICAL SOCIETY of SOUTHERN AFRICA PRETORIA CENTRE

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Editorial

With this issue, no. 3 of Urania, I feel that at last Urania is beginning to stand on it's own feet. I most heartily thank those who contributed articles for this issue and also the Centre's committee for their encouragement.

Entries for the frontsheet competition currently stand at one! I am sure we must have some artistic members somewhere and to enable them to use pen and paper and still have the opportunity to win a bottle of wine, I hold back from awarding the prize until next issue. To the one and only entrant (so far) I hope you will not be too sorely dissapointed.

I am still looking for members to submit their own observational papers. The work being done on the Mars project will be published in due course but someone somewhere must have something they have seen. Please, members, help your own Centre's journal. CONTRIBUTE!

Spectra Spectroscopy and Spectoscopes.

A series contributed by Michael Poll - Part 2.

The Nature of Spectral Lines.

By the late 19^{th} Century it was known that spectral lines were caused by atoms, that bands were caused by molecules, and that each element had several lines. (The lines for each element were labelled α, β etc, from the red end towards the blue end of the spectrum.)

In 1885 Balmer discovered a formula to determine the position of hydrogen lines in the visible spectrum. Later Lyman showed a series of lines in the ultra-violet region and Paschen a series in the infra-red region.

The lines get closer together at lower wavelengths and then in each case, the series (and the formula) reaches a limit and the series ends.

A general formula for all the three series was devised. Thus a general law had been uncovered, but there was no explanation for it until 1913 when Niels Bohr showed that it was due to the structure of the atom.

Structure of the atom.

An atom consists of a nucleus, composed of protons and neutrons, and electrons which orbit the nucleus. For the purpose of this discussion the electrons can be imagined to be orbiting the nucleus in concentric "shells" each shell having a limited number of electrons. The outer shell of any atom may not necessarily contain it's maximum number of electrons. The further out from the nucleus an electron is, the greater potential energy it has.

If an electron is in it's "normal" orbit the atom is said to be in it's "ground state"

Absorption and Emission of energy by an Atom.

1) If an electron moves inwards from a high energy orbit to a lower energy orbit, the excess energy is emitted as a "packet" (quantum) of radiation. This produces a bright-line (emission) spectrum.

2) If an electron moves outwards from a low energy orbit to a higher energy orbit, due to a collision and subsequent absorption of energy, the atom produces a dark line (absorption) spectrum. This atom is now said to be in an "excited" state. Note that the electron may have jumped outwards by more than one orbit depending on the amount of energy absorbed.

Atoms that have absorbed energy do not usually remain in an excited state, the electron(s) quickly lapse into their original orbits.

If the electron falls back in one jump all the energy is liberated at once. If the electron jumps back by stages, each jump downwards will produce an emission line in the spectrum.

The line series corresponds to these jumps from the highest energy level to the ground state. When the atom has returned to the ground state it contains no excess energy, no energy is being given out and the line series ends.

If an atom absorbs an excessive amount of energy an electron (or electrons) can leave the atom. Because an atom is normally electrically neutral, the nucleus, having a positive charge and the electron having a negative charge, the loss of an electron will give an atom a net positive charge and the atom is now said to be ionised.

Ionisation will be discussed in part 3.

Book Review.

A science fiction novel about SETI. "CONTACT" by C.SAGAN

Contributed by Pierre Lourens.

For those of you who are interested in SETI (Search For Extra-terrestial Intelligence), I recommend the New Science fiction novel by Carl Sagan. Yes, Carl Sagan. It concerns a SETI project near the turn of the century. An artificial signal is detected coming from an unlikely direction: from the young star Vega.

Bit by bit, astronomers here on earth discover that the signal contains several levels of information, the last level being the key to deciphering of the contents. They decipher it and find a message, which is soon referred to as the MESSAGE, and which is crystal clear. The purpose of it, however, is a mystery.

Religious groups on earth react in widely different ways as the Message and it's contents become widely known. Some consider it as a new revalation from God, while others consider it as coming from the Devil himself.

The nations of the earth are drawn together in their response to the Message, for a while at least. An astounding sequence of events follow as their response reaches it's conclusion.

I have been deliberately vague, so as not to spoil the reading of the book for you. I found it un-put-down-able. The characters are convincing and the story is imaginative, yet well within the bounds of the possible. I was left with the feeling that things might turn out this way someday: that our first contact with intelligent extraterrestrials will not be face to face, but via radio communication. At the end of the story there is a profound message to the reader.

Some Notes on Observing for Tyro Astronomers.

by

Henry Welsh, FRAS.

All of you who have used a telescope at night will have noticed that a very brilliant night is often worthless for planets and double stars, from it's blurred or tremulous definition. Such nights, however, will serve for grand views of bright groups or rich fields, or for irresolvable nebulae, which have no outline to be deranged.

A hazy or foggy night will blot out nebulae and minute stars, but sometimes define bright objects admirably. One should never condemn such a night untried.

Twilight and moonlight are often advantageous, from the diminution of irradiation. Secchi, the great Italian observer, found the detail of the great nebula in Orion much more visible in moonlight, which is also known not to obliterate even such objects as the satellites of mars or Uranus, or some of the minuter comites of double stars. But I look for nothing near the horizon.

In planetary observation daylight or twilight views are sometimes very effective. Mercury and Venus are often splendidly defined an hour before sunrise or sunset. The best telescopic pictures of detail on Mercury, Venus, Mars and Jupiter have been obtained by Denning with the sun above the horizon. But the sun must be low, it's light moderated, and the telescope protected from it's rays, or currents, ruinous to it's performance, will be set up in the interior of the tube. In daylight or twilight, planetary markings often appear to stand out with livid distinctness, whereas after dark some of the more delicate lineaments and spots are effaced on the glare, especially when large apertures are used. In viewing Jupiter the most perfect telescopic vision is sometimes obtained under unlikely circumstances - such as fog, twilight and moonlight.

Every object is best seen under certain proportions of light and power and contrast, which are a matter of experience; and in such experience lies much of the observer's skill.

Under certain atmospheric conditions, not fully understood, a light mist certainly improves the definition of Jovian markings similar to reducing the aperture by stops, thus cutting off an excess of light. For planets and the moon, the power should be high enough (if the weather is suitable), to take off the glare, but low enough to preserve sufficient brightness and sharpness.

As a rule, comets and nebulae will bear little magnifying.

Most of you will have noticed that there is often a fringe of violet or blue around luminous objects in focus under high powers, especially Venus in a dark sky. This, contrary to what one might have been lead to expect, denotes, other things being equal, a first class objective.

As a rule then, the best seeing is experienced on still cold nights in winter, when there is just sufficient mist to blot out stars of the 5th and 6th magnitude to the unaided eye. As previously said, on a foggy night , it is hopeless to apply very high powers, say, on the planets, as the available light in the image is so much reduced by the fog. In some areas excellent seeing is often obtained just after a gale; and high wind, although it shakes the telescope, is often no detriment to good images. On brilliant nights, when there is much scintillation, detail may be invisible and star images hopeless with high powers, but star clusters are then to be seen at their best, requiring, as they do, low powers and light rather than definition.

At this stage I had better define certain terms often wrongly used in connection with telescopic images and equally often, wrongly applied.

The most commonly used is that caused by atmospheric disturbances, as they affect telescopic definition. These disturbances are lumped together under the heading "the seeing". It is usual when one is recording ones observations to quote the quality of the seeing by employment of a scale say zero to twelve, the lowest figure denoting the worst seeing and the highest, the best.

Next we have "transparency", and this has nothing to do with the seeing or quality of the image, but simply denotes the clarity of the atmosphere as it affects the visibility of faint objects.

Next on the list is "atmospheric dispersion". As you know, at low altitudes the atmosphere not only displaces objects by refraction, but also acts like a prism in dispersing their light into a spectrum. The effect is to give a blue fringe to the upper limb and a red fringe to the lower, of a bright object.

Then there is "glare", which is a loose term applied to the embarrassing effect of the brightness of a planetary disc. This effect can, however, largely be overcome by the use of screens of suitable colour for the planets, sun and moon. (Yellow, amber, green: planets; orange, green : sun, green : moon). (Note. Always be careful when observing the sun. The use of special sun filters such as advertised to reduce radiation at all frequencies should be used, not just a green filter - Ed.)

"Coma" is the one-sided projection from a star image produced by faulty squaring-on of the object glass. In all good telescopes provision is made for rectifying this trouble.

Lastly we have "irradiation", which is the apparent enlargement of a bright object, due to the spreading of the light in the retina or in the emulsion of a photographic plate.

Before describing a method or two of using the circles for finding objects invisible to the naked eye, let me say this. In my humble opinion a telescope is not much the worse for not possessing finely divided and accurate circles. An equatorial's circles are not used for defining the exact position of an object. This is done by a transit instrument, a micrometer or a photograph. Occasionaly circles are useful for picking up objects by day or by night when invisible to the naked eye. But at night there should seldom be the need for then by anyone who knows the size of his telescopic field and can read a star map such as Norton's. It is saddening to hear people discussing the ability to read so many minutes or seconds of arc on their circles. They would seem to enjoy dazzling themselves while they poke and peer about with a torch and a reading microscope at circles so finely engraved that, unless they are kept speckless, they cannot be read at all, and if they are used out of doors and frequently polished, their divisions are rubbed away. When I started observing, a famous observer gave me this advice: "Never use the circles for finding any object that can be found just as well and as quickly in the finder, otherwise you will never memorize where the objects are, and will not be able to find them again if you have to use an alt-azimuth. All the objects in Norton's star atlas can be found with the finder alone." Incidentally the advantages of an equatorial over an alt-azimuth is not of an academic but a practical nature, that is to say, primarily for ease of following an object and secondarily for finding in certain cases. One method that I use is the so-called "differentiation" method. The steps employed are as follows:

1) Write down the difference of RA between the required and some known object, noting whether additive or subtractive, remembering that RA is less to the West.

2) Seek some known object in the finder, and place it in the centre of the largest field of the main telescope.

3) Clamp the RA.

4) Set the telescope to the declination of the object sought.

5) Read the RA circle from the index of the moving vernier, and write down the amount.

6) Unclamp the RA circle and move the telescope East or West to the value ascertained in 1).

7) The object will then be found somewhat West of the centre of field, depending on the duration of the process. If it is not, then sweep slightly first in declination, and, if still not found, then in RA.

The second method makes use of Siderial time, but is really very easy.

1) Unclamp the RA circle and rotate until the reading against the index of the FIXED vernier equals the siderial time at the instant.

2) Move the telescope until the index of the MOVING vernier reads the RA of the object sought.

3) Set the telescope to the declination of the object sought.

And that's all there is to it, assuming that the telescope has been accurately set up. By employing these methods I have been able to study Venus and Mars in bright daylight, and at night to find such interesting objects as M4, M5, M6, M7, M11, M19, M22, M23, M57 (the famous ring nebula in Lyra), M62, M80, M104 (the so-called sombrero nebula, which is an "island universe" well over a million light years distant), and many other wonderful objects in our Southern skies.

I would now like to say a word about the space-penetrating power of a telescope. Every astronomer who has the pleasure of showing his telescope to a novice has been asked the delightfully vague question "How far can you see with your telescope?"

The answer, of course, depends on the type of object the telescope is supposed to be directed upon, and has nothing to do with it's magnifying power as such. It really depends on the brightness of the object one is looking at. Thus, at a distance of ninety two and a half million miles the sun is so bright that one can see it without the help of a telescope. But if the sun could somehow be removed to a distance of sixty light years, it would become a faint star of about sixth magnitude and would be just of about one half it's diameter should be placed over the object glass. If no new adjustment is required for distinct vision the spherical abberation is corrected, since the mean focal length and the focal length of the central rays are equal. If, when the cap is on, the eyepiece has to be pulled out for distinct vision, the spherical abberation has not been corrected. If the eyepiece has to be pushed in, the abberation has been over-corrected.

A star of the first magnitude should next be brought into the field of view. If irradiation from one side is perceived, part of the object-glass has not the same refractive power as the rest; and the part which is defective can be determined by applying in different positions a cap which hides half the object glass. If the irradiation is double, it will probably be found that the object glass has been too tightly screwed, and the defect will dissappear when the glass is freed from pressure.

The best tests for determining the defining power of a telescope are close double or multiple stars, the components of which are are not very unequal. The illuminating power should be tested by directing the telescope towards double or multiple stars having one or more minute components.

As regards the number of eyepieces needed, it can be said that a telescope of from 2 to 4 inches aperture should have at least three, namely, a low power for nebulae, comets and open clusters; a medium power for the planets, sun and moon and variable stars; and a high power for detailed planetary work; close doubles, and so on. To get the best out of a 6 or 8 inch one should have not less than five or six eyepieces.

Most beginners make the mistake of asking for powers that are too great, and it is well always to start off observing with the lower powers and gradually increase the power, remembering that with the best seeeing one can rarely use as much as 80 to 100 times to each inch of aperture, while the lowest useful power, for average eyes, is 3 to 4 times to each inch of aperture. Thus with an 8-inch reflector the highest power that can be used under extremely good conditions would be somewhere between 640 to 800 times, and the lowest would be between 24 and 32. In favourable weather the following is a good general test for the performance of a telescope : a star of the third or fourth magnitude at a considerable elevation above the horizon should, when examined with a high power, exhibit a small well defined disc, surrounded by two or three fine seldom unbroken rings of light. These are called respectively the spurious disc and the interference rings.

Most telescope users like to know the magnifying power they are using, and there are several methods of ascertaining this. The first method which I shall describe is the one given in Norton's famous star atlas, namely, by means of a Berthon Dynanometer. This little instrument is used for measuring small thicknesses of wire or paper or glass slides, and such like. But it has been said that it is not a very accurate thing to use because it measures not a diameter but a chord, and that there is further error due to irradiation. However, as these errors act in opposite directions they tend to balance each other. As a matter of fact the error has been found to be 7 parts in 10,000 or less than 0.1 %. What one does is to focus a star in the telescope. Next day without altering the focus, point the telescope at a neutral tinted surface, such as a grey wall. With the eye placed at about reading distance from the eyepiece, there will be seen a small, clearly-defined disc of light, the so called

Ramsden disc, which is nothing else than the image of the object glass. Next you measure the diameter of this disc by laying the dynanometer against the eyepiece, and a magnifying glass will help you to read the divisions quite easily. The magnifying power of the eyepiece is then found by dividing the clear aperture of the object glass by the measured diameter of the Ramsden disc.

In the second method you place the eyepiece level with the table (preferably screwed into a short tube or roll of cardboard) with it's axis horizontal, and with a sheet of white paper or other illuminated surface on the side normally toward the object glass. Keeping the eye level with the table, and about two or three feet from the eyepiece, move the head from right to left until the light coming through the eyepiece is just cut off by the diaphragm bounding the field. Stick pins in the table to mark these positions; and measure the angle subtended at the position of the Ramsden disc by the line joining the pins. This is the apparent angular field of view of the eyepiece. The actual field in the sky is found by timing a star on or near the celestial equator across the field. The ratio of the apparent angular field is then the magnifying power of the eyepiece.

To find the angular diameter of the field for an eyepiece, focus the telescope on any bright star near the celestial equator such as gamma Virginis or delta Orionis, and with a stop watch measure the time it takes to drift centrally across the field of view from one side to the other. This time, expressed in minutes and seconds, when multiplied by 15, will give the diameter of the field in minutes and seconds of arc. It is very useful to know the the diameter of the field of view of all eyepiece-telescope combinations.

A telescope should not be mounted within doors, if it can be conveniently erected on solid ground, as every movement in the house will cause the instrument to vibrate unpleasantly. Further, if the telescope is placed in a warm room, currents of cold air from outside will render observed objects hazy and indistinct. In fact, Sir William Herschel considered that a telescope should not even be erected near a house or elevation of any kind round which currents of air are likely to be produced. If a telescope must be used in a room, the temperature of the room should be made as nearly equal as possible to that of the outer air.

The observer should not leave to the precious hours of the night the study of the bearing and position of the objects he proposes to examine. This should be done by day - an arrangement which has a twofold advantage - the time available for observation is lengthened, and the eyes are spared sudden changes from darkness to light, and vice versa. Of the effect of rest to the eye we have an instance in Sir John Herschel's rediscovery of the satellites of Uranus, which he effected by keeping his eyes in darkness for a quarter of an hour. Kitchener, indeed, goes so far as to reccomend an interval of sleep in the darkness of the observatory before commencing operations! I have never tried the experiment, but I should expect it to have a bad rather than a good effect on the eyesight, as one commonly sees the eyes of a person who has been sleeping in his day clothes, look heavy and bloodshot. Nevertheless a shaded red light in the observatory is very useful for reading maps, etc..

It is important that the student should recognise the fact that the highest powers do not necessarily give the best views of celestial objects. High powers in all cases increase the difficulty of observation, since they diminish the field of view and the illumination of the object, increase the motion with which (owing to the earth's motion) the image moves across the field, and magnify all defects due to instability of the stand, imperfection of the object-glass, or undulation of the atmosphere. With the best seeing a good object glass will sometimes bear a magnification of a hundred to every inch of aperture, but generally speaking much lower powers give better results.

It will sometimes be found that, even in the worst weather for observation, there are instances of distinct vision (with moderate powers) during which the careful observer may catch sight of important details. And similarly, in the best observing weather, there are moments of unusually distinct vision well worth patient waiting for, since in such weather alone the full powers of the telescope can be employed.

And now finally I would advise all who are interested in astronomy to beg, borrow or steal a telescope for their own use. The amount of pleasure that can be derived from a telescope of even two inch aperture, providing that it is mounted on a really rigid stand, is very great indeed, and useful work can always be done by amateurs to further this wonderful hobby of ours.

Taken from "Urania" Nov 1966.

Die aarde wiggel as hy draai en die vog in sy dieptes skommel ook. Terselfdertyd is daar aardbewings, asook ander faktore wat veroorsaak dat die aarde eintlik al hoe stadiger draai. Min mense behalwe die sterrekundiges besef dit. Tog het dit nodig geword om sedert 1972 elke klompie jare 'n sekonde by die jaar te voeg, 'n 'skrikkelsekonde' dus.

Die jaar is nou 'n sekonde langer

Verlede jaar was op die oog af 'n gewone jaar met 365 dae van 86 400 sekondes elk. Die totale getal sekondes in 1987 behoort dus 31 536 000 te gewees het. Maar dit was nie. Die getal sekondes was 31 536 001. Die rede is dat daar net voor die einde van die jaar ingevolge 'n internasionale ooreenkoms 'n ekstra sekonde ('n "skrikkel-sekonde") bygevoeg is. Hoekom? Omdat die aarde onreëlmatig draai.

Dié onreëlmatige draaiing van die aarde is maar onlangs eers ontdek. Die aarde is so massief dat dit groot kragte eis om sy rotasiesnelheid te verander. Omdat die rotasie skynbaar so reëlmatig is, is dit gewoonlik moontlik om te voorspel dat 'n ster elke 86 400 sekondes bokant 'n mens se kop sal verbygaan, en nie 'n sekonde te vroeg of te laat nie.

Tog is die rotasie van die aarde nie perfek nie. Daar vind massaverskuiwings in die aarde self plaas. Die binneste vloeistofkern skommel 'n bietjie as die aarde draai. Daar is aardbewings wat hier en daar die massas herversprei. In die winter word groot hoeveelhede water van die oseaan onttrek en op land as sneeu neergesit om weer in die lente water te word wat see toe vloei. Daar is waterstrome in die see en winde in die atmosfeer. Dit veroorsaak 'n waggeling in die aarde se draaiing sodat dit nou en dan 'n deel van 'n sekonde vinniger of stadiger is.

Dit is nie die ergste nie omdat dit op die lange duur uitgeskakel word en selfs as 'n deel van 'n sekonde so nou en dan gewen of verloor word, kan dit nie juis vererger nie. Daar is egter een verandering wat kumulatief is. Hier speel die getye 'n rol.

Die uitwerking van die maan se swaartekrag is groter aan die kant van die aarde naaste aan die maan, want die ver-kant is sowat 8 000 myl verder. Gevolglik "rek" die aarde so effens in die rigting van die maan. Dit het 'n groter uitwerking op die oseaan wat dan 'n bult maak. Die ou bekende verskynsel van die getye dus. Wat die gewone mens dikwels uit die oog verloor, is dat die getye saam met die draai van die aarde op die vlakker seebodems, soos die Ierse See wrywing veroorsaak met die gevolglike verandering van energie in hitte. Hierdeur verloor die aarde stadigaan sy rotasie-energie en draai hy stadiger.

Niemand behalwe sterrekundiges kom dit agter nie. As hulle die posisie van sterre bestudeer soos dit vroeër vasgelê is, is daar 'n verskil. Dit lyk of die sterre agterbly. Hierdie veranderinge is kumulatief en na 'n klompie duisend jaar is die sterre heeltemal op 'n ander plek hoewel dié lengte van die dag nie waarneembaar verleng het nie.

Die bestudering van ou sterrekundige gegewens gee net 'n aanduiding van hoe die draaiing van die aarde in die algemeen stadiger geword het. Maar hoe meet ons die rotasie van dag tot dag? Daarvoor is 'n horlosie nodig wat meer bestendig as die aarde beweeg. So 'n horlosie is in 1955 ontwikkel. Teen daardie tyd het ons reeds atoomhorlosies gehad wat die vibrasies van atome kon tel. Jy kon sê maar 9 192 631 770 vibrasies per sekondes tel en dit sou altyd dieselfde bly. As 'n mens dan die lengte van elke dag meet, kan jy sien dat die dag van dag tot dag met 'n paar vibrasies wissel, soms vinniger en soms stadiger. Op die lange duur word die pas egter stadiger.

Wanneer die aarde se rotasie met 0,9 sekond agtergeraak het, word 'n "skrikkelsekonde" bygevoeg. Toe hierdie stelsel in 1972 ingevoer is, moes tien sekondes bygevoeg word. In die vyftien jaar sedertdien is dertien skrikkel-sekondes bygevoeg. Hulle word òf einde Junie òf einde Desember bygevoeg. Op 31 Desember 1987 het die jaar 1987 om middernag 'n sekonde bygekry. Die vorige skrikkel-sekonde is op 30 Junie 1985 bygevoeg. Hierdie sekonde is nie net vir sterrekundiges van belang nie, maar ook vir navigators en vir die radio en TV.

deur Isaac Asimov