ZIMBABWE - THE PLACE FOR ASTRONOMY AND THE NEXT TOTAL SOLAR ECLIPSE

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"Now eclipses are provoking things... visiting the same locality only once in centuries. Consequently, it will not do to sit down quietly at home and wait for one to come, but a person must be up and doing and on the chase." *Rebecca R. Joslin (1929)*

Well, the Internet has changed that somewhat - it is now possible to 'see' an eclipse on the web, or live on television, but that cannot compare with the experience of being there - and knowing totality for yourself. Some describe it as a mystical experience, profoundly moving, a rare and beautiful gift from God, while one eclipse-chaser has given up trying to explain to family and friends what it's like : he simply says "Come - feel it for yourself".

Your next opportunity for a total solar eclipse (TSE), darkness in the mid-afternoon, the Sun blacked out to reveal the ethereal majesty of the corona, is 21 June 2001, in southern Africa, principally Zambia and Zimbabwe. And, by a quirk of fate, we have the good fortune to have the following TSE also crossing southern Africa, including Zimbabwe, on 4 December 2002. Whether you did witness the last TSE (11 August 1999) or were disappointed by cloud (as I was) why not make Zimbabwe your destination for an experience of a lifetime. You'll never be the same again.....

Background: It is an extraordinary/amazing coincidence that although the Sun is obviously much larger than the Moon (by about 400 times), the Moon is almost 400 times closer to us than the Sun. This means that their angular size in the sky is almost the same - about 1/2 a degree. (If you glance at it, the Sun looks much bigger than a full Moon due to its glare, but if you view the Sun through special-purpose eclipse viewers (see below) you will be surprised how small the sun looks.) You can easily illustrate the relationship between distance and apparent size by holding out both your arms, making a fist with one hand and holding up a thumb on the other hand. When both at arm's length obviously the thumb cannot 'block out' the fist, but if you close one eye and bring your thumb closer to your face you can see how the fist can be eclipsed.

Eclipses of the Moon or Sun occur only when the straight line between their centres passes through some point on the Earth. Solar eclipses do not happen every time the Moon is New, because the Moon's orbit is inclined, so that it's conical shadow often misses the Earth. Although there must be at least two solar eclipses every year, they may both be partial, or occur in inaccessible places. Due to the orbits of the Earth about the Sun and the path of the Moon around the Earth being slightly elliptical and not true circles, the angular size of the Sun and Moon in the sky vary slightly. As a consequence, solar eclipses can be annular (when the solar disc is not completely hidden by the Moon, and a thin ring of sunlight still remains) or total (when the Moon appears larger than the Sun). Annular eclipses are slightly more common than total eclipses, but are nowhere near so spectacular. When the discs of the Moon and Sun do not completely overlap, a crescent of the Sun is visible - this is a partial eclipse, and the percent obscuration will determine how dark the sky will become for any observer. A partial phase always precedes and follows annular and total eclipses.

When the tip of the Moon's shadow (the umbra) does touch the Earth, it will sweep across it in a narrow curved track, due to the movement of the Moon and the spin of the Earth. Within this path of totality (which can be up to 270 km wide but thousands of kilometres long) observers will experience totality. The duration of totality will be a maximum (lasting for several minutes) if you are exactly on the centre line of this path, decreasing to zero minutes the further you are towards the northern or southern limits of the eclipse path. Still further away you can only see a partial eclipse, provided you are not beyond the penumbral limits, where the Moon and Sun are too far apart for an eclipse to be seen.

Total Solar Eclipse of 21 June 2001

The particular facts are given in the NASA Technical Publication -1999-209484 'Total Eclipse of 2001 June 21' by Fred Espenak and Jay Anderson. It is available on the web at ***http://sunearth.gsfc.nasa.gov/eclipse/TSE2001/TSE2001.html*** and includes maps and tables, as well as information on weather prospects, safe eclipse viewing (vital for the partial phases) and still and video eclipse photography. Also included is a map of the 4 December 2002 eclipse track.

The eclipse will enter northern Zimbabwe at 3:13 pm local time, sweep south eastwards along the Zambezi valley to cross into Mozambique 4 $^1/_2$ minutes later (see eclipse path map). Maximum duration of totality is 3m 29s, track width 166 km and Sun altitude 29° in the north-western sky (azimuth 309°). These values all decrease steadily to 3m 16s, 161 km, 25° and 307° at the Zimbabwe-Mozambique border. Precise coordinates of the centreline and southern limit of totality are given in the NASA bulletin. The length of the eclipse centreline within Zimbabwe is 327 km with a small 42 km section cutting across a corner of Mozambique. The area of Zimbabwe within the totality track is over 41 300 km^2.

Maxima of the partial phase in Harare will be 97% decreasing to 82% in the south of the country. Everyone in Zimbabwe will know something very strange is happening in the middle of the afternoon of mid-winter's day 21 June 2001.

Access by road or river (the Zambezi) into the totality zone is limited - there are only 10 tarred all-weather roads and several unsurfaced ('dirt' or 'dust') roads which are used by the local people and busses and can be rough or corrugated, i.e. generally navigable by a small truck or car provided you are not in a hurry. One dirt road runs west - east through the region. There are no major centres of population, but only rural settlements and some schools and mission stations. The area of totality includes commercial farming land, communal (i.e. rural) farm land and wildlife reserves, both National Parks and controlled hunting areas for which entry permits must be obtained in advance, and where 4x4 vehicles are an advantage.

Preparations for the eclipse in Zimbabwe

The local astronomical society, known officially as the Harare Centre of the Astronomical Society of Southern Africa, has been gearing up for 'our' eclipse for years, under the chairmanship of Simon Walsh (***sciman@stjohns.co.zw***). The Eclipse Subcommittee is led by Peter Morris (***morris@harare.iafrica.com***), who took over from the late Cees Mesu. See the society website ***http://www.geocities.com/zimastro*** or email: ***zimbabweeclipse@hotmail.com*** for further information.

We are anxious to take the opportunity of the eclipse to raise public awareness of the splendours of the night sky and what is 'out there' by raising funds to build an equip an observatory and mount a programme of public education : the sky is the limit - literally!! In return for a small surcharge levied on clients, tour and safari operators will have access to the official Zimbabwe eclipse logo, eclipse guides and training (within the limits of our membership) and technical information and advice. An eclipse information pack is being prepared for all 6000 schools throughout the country, which will contain a quantity of eclipse viewers. These were donated after the 11 August 1999 following an appeal in UK by Francis Podmore over radio, TV and newspapers. The response from companies and hundreds of individuals has been incredible - currently we have collected over 100 000, mostly new/unused!!! THANK YOU!!!

Tours and eclipse expeditions.

As this is the first total solar eclipse here in living memory (the last was on 29 August 1886, although annular eclipses crossed Zimbabwe on 28 June 1889, 22 November 1900, 17 March 1923 and 10 August 1934), we have honestly no idea of the number of eclipse-chasers who want to come south for this eclipse, perhaps up to 2500. Then there are many in South Africa who will want to travel north, mainly by road. And a substantial proportion of Zimbabweans will also not want to miss a truly awe-inspiring celestial spectacle. Ergo, the Zambezi valley is going to be very crowded.

Various tour groups and safari companies around the world are arranging excursions to Zambia and Zimbabwe, and some to Madagascar, Mozambique and the south Atlantic! (I have yet to hear of a trip to

Angola). Although many are still in the planning stage, others are already fully booked. At least one tent village is being erected, and a major arts&music festival is planned. (See ***http://www.solipse.com*** for a 9-day celebration in Zambia). One real difficulty is that the number of commercial airlines serving Harare is limited, so that seats on flights inbound and outbound are going to be hard to find next June. But many more airlines fly to Johannesburg in South Africa, and there are 23 flights a week from there to Harare. Book now if you haven't yet done so.

The following list of tours which plan to watch the eclipse from sites in Zimbabwe has been compiled from local information, web searching, following links on Fred Espenak's website (***http://www.mreclipse.com***) or using ***http://www.bit-net.com/~pauer/eclipse99/elinks/elinks.htm*** Many of the tours add on excursions to other tourist attractions in the region, e.g. the Victoria Falls, Great Zimbabwe and various game parks. If you know of **any** others, please let me, and Eric Pauer (***pauer@bit-net.com***), know so that our information is as complete and accurate as possible. But of course, plans and circumstances change - the only thing that won't is the timing of the TSE itself!! IT WILL HAPPEN ☺ (even if it's hidden by clouds ☹ - see below). Watch the Eric Pauer, Fred Espenak and zimastro websites which are frequently updated. Below are website, email and contact persons (shown ??? where unknown)

A1 SPECIALITY TOURS ('one' not 'eye') http://a1specialitytour.com/safari.html gs@specialitytours.com ???

AFRICA UNIQUE http://internet.co.zw/~zifem/auhome.html zifem@internet.co.zw Maija-Liisa Metsola

ALBATROS TRAVEL (not albatroSS) http://www.albatros.com albatros@pci.co.zw Kristina Korsgard

AMATEUR TELESCOPE MAKERS OF BOSTON http://www.atmob.org volz@process.com Bernie Volz

BIG BAD WOLF http://www.bigbadwolfdesign.co.uk/africaneclipse2001 ???? Sithokozile Sibanda

BLACK SUN ECLIPSE http://members.aol.com/kcstarguy/blacksun/africa2001.htm KCStarguy@aol.com Eric Flescher

CAREW SAFARIS http://www.carewsafaris.com carew@internet.co.zw Geoffrey Carew or Phillippa

CIVILISED ADVENTURES http://www.civilizedadv.com/trips-zimbabwe.html info@civilizedadv.com ???

CONTINENTAL CAPERS http://www.flycapers.com/eclipsemain.htm travel@flycapers.com ???

ECLIPSE EDGE EXPEDITIONS http://metaresearch.org/edge/homepage.htm tvf@mindspring.com Paula Foggo

ERIC BROWN ZIMBABWE TOUR http://www.eclipsesafaris.com/home.htm Kidinvs@aol.com Eric Brown

EXPLORERS TOURS http://www.explorers.co.uk/astro/astro_home.htm brian@explorers.co.uk Brian McGee

INNOVATIONS IN TRAVEL http://www.innovationsintravel.com innovationsintravel@msn.com Renate Martin

JOURNEYS WORLDWIDE http://www.journeysworldwide.co.au/Eclipse2001.htm pam@journeysworldwide.co.au

KOOL SPACE SCIENCE http://www.koolspacescience.com/eclipse_tours.htm ??? ???

LION ROARS - see SKY SAFARIS

RIVER HORSE CANOE SAFARIS http://www.riverhorse.co.zw elton@icon.co.zw Anthony Elton

SAFARI AUSTRAL http://www.safariaustral.com austral@africaonline.co.zw ???

SAFARI CONSULTANTS ??? victoria@safcon.co.zw Victoria Nash or gwen@safcon.co.zw Gwen Wawn

SKY SAFARIS http://www.lionroars.com/EclipsePackages.htm eclipse@skysaf.co.zw Brian Bailey

SKYSCAPES http://www.skyscapes.com/TravelOps/Africa2001.htm use email links on webpage for contacts

SPECIALITY TOURS - see A1 SPECIALITY TOURS

SUNSET TOURS http://www.vicfalls.com/spon/sunset PeterFe@zimsun.co.zw Peter Ferendinos

TIME FOR AFRICA http://www.timeforafrica.com/zimbabwe/zimbabwe_eclipse safari@icon.co.zw or info@timeforafrica.com ???

TOTALSOLARECLIPSE http://www.totalsolareclipse.com/Zimbabwe_2001/Zimbabwe_2001.html
email: 2001@TotalSolarEclipse.com or itsallgood@sedona.net Mark Peebler

UTC http://www.utcco.zw utczim@utc.co.zw or pkandemi@utc.co.zw Portia Kandemiri or Gillian Kombora

WAECICU TOURS http:www.waecicu.nl eclipse2001@waecicutours.nl ???

WILDERNESS TRAVEL http://wildernesstravel.com/zimecli.htm webinfo@wildernesstravel.com ???

WILDWAYS SAFARIS http://www.wildways-safaris.com wendy@wildways.icon.co.zw Wendy Bourne

WINCO ECLIPSE TOURS http://www.wincoeclipsetours.cm info@wincoeclipsetours.com ???

Keep an eye on ***http://www.geocities.com/zimastro/travel.htm*** for updates on approved Zimbabwean tour operators.

Astronomy in Zimbabwe - an overview

Due to our latitude about 97% of the celestial sphere is available to us. Although Polaris cannot be seen, the constellations Crux (the Southern Cross), Centaurus, and many minor ones adorn the night sky. Not only do there seem to be more stars visible from southern latitudes but we have the Magellanic Clouds, the Coal Sack, the Jewel Box (NGC 4755), the bright globular clusters ω Centauri and 47 Tucanae,
Eta Carinae and many more star clusters, nebulae and galaxies which cannot be seen from mid-northern latitudes. The ecliptic passes less than 40° from the zenith for much of the year. Due to low levels of industrial and light pollution viewing conditions are frequently excellent. Although dust, haze and cloud can be a problem, out in the bush on a dark night visitors are often amazed by how bright the countless stars appear. Being within the tropics twilight is short and nights are long - all year round. Commercially-available planispheres designed for 35° S are useful in Zimbabwe (but <u>not</u> northern hemisphere versions!!)

Amateur astronomy was started in Zimbabwe nearly a century ago by a few individuals, notably Fr Goetz who was appointed Astronomer in Bulawayo in 1903. There are astronomical societies in Bulawayo and Harare with well-attended monthly meetings. While there is no national or professional astronomical observatory, planetarium or radio telescope, a number of schools have instruments and movable domes. Dedicated amateurs have built themselves observatories and telescopes, mostly refractors (up to 20") with self-ground and polished mirrors. Results from serious observing campaigns were submitted to the International Halley Watch, and variable stars are regularly studied. (Last year Zimbabwe ranked fifth highest in the world for the number of observers reporting to AAVSO.) In 1987 Richard Fleet discovered the variable TT Crateris (Harvard designation 1129-11) and did the highest number of visual observations of Comet Halley in the world! Members are active in astrophotography and occultation work. Colin Henshaw in Kadoma spotted the supernova 1987A very early on and he could have been the third 'discoverer' in the world if cloud over Harare had not prevented his observation being confirmed! Prince Edward School has produced two professional astronomers and is the only school in Africa teaching Astronomy as an O-level subject. The society produces a regular news bulletin 'The New Cloudy Nights'.
A number of years ago a member of ASSA drew a set of 12 star charts appropriate for 8 pm at the middle of each month of the year. They are published quarterly in the magazine 'Zimbabwe Science News'.

Information on conditions in Zimbabwe

Zimbabwe is a semi-industrialised country with agriculture and mining being dominant. The population is about 12 million people (mainly Shona and Ndebele) with less than 100 000 'whites' and fewer Asians. English is spoken and understood in towns but in the remoter rural areas an interpreter may be required. The people are friendly everywhere, but crime (robbery, mugging and car hijacking) are on the increase in the larger towns, driven largely by unemployment and desperation. Be alert, try not to carry valuables. You are safer in a group, especially walking at night. Recent media attention to the political violence preceding the elections and the ongoing struggle over the lawless invasion of about a third of the larger commercial farms has done very serious damage to the already fragile economy and the tourism industry (a major employer and source of foreign currency). While at the time of writing (July 2000) it is impossible to predict the future, everyone who lives here is profoundly hoping (and praying) for a return to stability, good government and

respect for law and order. There are a number of websites with general information about Zimbabwe (e.g. ***http://www.lonelyplanet.com/dest/afr/Zim.htm***). See ***http://www.zimtoday.com*** for daily news coverage and several links.

Will it be cloudy?

The climate of Zimbabwe has been described as 'the best in the world' (!) Usually the winter months (May to September) are typically blue skies all day, cold in the early morning and evening - frost is not uncommon but it never snows. However this June and early July had 50 - 100% cloud almost every day ☹☹☹ and in 1999 two out of four weeks were cloudy. Attempts made this year to monitor cloudiness in the Zambezi valley were not very successful - there were plenty of clouds there too. But one resident remarked, "The weather here is so variable, it never does the same thing twice. So the only point of watching the sky this year is to know what is not going to happen next year!" All eclipse watchers know that despite millisecond prediction accuracies, the weather cannot be controlled, and all of us must make preparations optimistically while recognizing there is a ??% chance of real disappointment. The NASA bulletin contains a detailed meteorological analysis and discussion.

In the event of patchy cloud, mobility by vehicle will be a distinct advantage, but the few access roads and tracks could easily become jammed.

Health and safety

The three major health hazards are HIV/AIDS/STD (abstain from sexual contact and drug use), bilharzia (avoid static water or slow moving rivers) and malaria (take adequate prophylactics, but the risks are lower in the colder winter months). Although standards of health care have declined, MARS provides an excellent 24 hour emergency service.

To prevent serious eye damage you must view the partial phase of any eclipse through special-purpose viewers, pieces of high-quality optical filter material, either black or silver, mounted in a cardboard frame. Welding glass of sufficient density is also safe, but NO OTHER SUBSTITUES (e.g. exposed photographic film, sunglasses, Polaroid, kitchen foil, CDs, smoked glass, etc.). The only other safe way is to project an image of the Sun onto a card or wall and watch it with your back to the Sun.

NEVER try looking directly at the Sun through a telescope (or finder scope), binoculars or camera view-finder unless the correct solar filter is securely in place. You can watch the screen of a video camera as this is a digital electronic image and not the harmful ultraviolet and intense visible radiation.

Some other sources of information:

Eclipse information is vast and constantly changing, as are websites. If you know of other useful resources (or errors) PLEASE let me know. And if I have overlooked your website, please forgive me - I am new to eclipses(!!) ******** SEE LATE EXTRA ADDED BELOW ******

Maps: Relief (i.e. topographic) maps at scales of 1:1 million, 1:500 000, 1:250 000 and 1:50 000 are available from Map Sales, Dept of the Surveyor General, P.O. Box CY 540, Causeway, Zimbabwe although some are not up-to-date. There are tourist maps of the major game parks.

Some additional astronomy and eclipse books:

Brewer, Bryan. Eclipse. Seattle: Earthview - 2nd ed 1991
Crump, Thomas. Solar Eclipse. London: Constable 1999
Levy, David H. Skywatching. London: HarperCollins 1995
Littmann, Mark, Willcox, Ken and Espenak, Fred. Totality - Eclipses of the Sun. New York: Oxford University Press - 2nd ed 1999
Mack, Peter. Night Skies of Southern Africa. Cape Town: Struik - 4th ed 1996

Some excellent eclipse websites: Cees Bassa - ***http://phys.uu.nl/~bassa***
Fred Espenak - ***http://www.MrEclipse.com***
Eric Flescher - ***http://members.aol.com/kcstarguy/blacksun/eclipse.htm***
Olivier Staiger - ***http://eclipse.span.ch/total.htm***

Peter Tiedt - ***http://www.eclipse.za.net***

Any special eclipse website for Zambia?? Background information about Zambia in general is available on ***http://www.zamnet.zm***, then select the *About Zambia* button.

There is an eclipse webring of 68 sites: ***http://nav.webring.org/cgi-bin/navcgi?ring=eclipsering;list***

First Solar Eclipse Conference 14 - 15 October 2000, Antwerp, Belgium - ***http://www.eclipsechasers.net/home/home.html*** email: ***Patrick_Poitevin@hotmail.com***

Contact details for the astronomical societies in Harare and Bulawayo are given in the ASSA Harare website (***http://www.geocities.com/zimastro***)

Some additional email addresses:
For information on Zambia: Peter Kalebwe (***pkalebwe@natsci.unza.zm*** or ***envphys@zamnet.zm***)
Prof. Jay M Pasachoff is Chairman of the IAU Eclipse Working Group: ***jmp@williams.edu***

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PS. LATE EXTRA!!!!! Sheridan Williams has just launched a superb 'no-frills' website which is as comprehensive as possible as a classified listing of websites connected with eclipses - take a look at *http://www.clock-tower.demon.co.uk/wwwsites* and he asks you to send additions/comments to *web-info@clock-tower.com* or *sheridan@clock-tower.com*