TRANSIT

The Newsletter of

Cleveland & Darlington Astronomical Society

September, 2004.

Editorial. An unusual Transit this month – without the coloured pictures, for a change. I'm developing an idea to improve our knowledge of astronomical objects. Over the coming months, images of well-known or spectacular galaxies, Moon features, important satellites and famous telescopes will be featured. At the first showing, they will not be named and it is hoped that in this way we will all learn to recognise some new image – even the experts. If you have a favourite picture with which to test us all, please let me know.

June meeting. In June we had a second members' night**,** really, dedicated to observations of the Transit of Venus.

September meeting. Please note that the usual lecture night has been replaced by a full day of lectures at Cosmos V on Saturday, September 18th. Details of Cosmos V and the 2004/5 programme are enclosed with this Transit.

Scarborough Star Festival. On the weekend of August 14th to 16th Scarborough Astronomical Society are holding their Fourth Summer Star Festival. The venue is a dark sky site in Dalby Forest. Details and an application form are enclosed.

Transit of Venus Reports. This edition of Transit has been dedicated largely to reports of observations of the Transit of Venus from various people. Some of these observations are being used in an attempt to calculate our own value for the Astronomical Unit. More on the success or otherwise of this venture in the next edition.

Cosmos V. September the 18th will see the fifth event in this series, which is held every four years (the year of the Olympic Games). Secretary Neil Haggath puts in an enormous effort to stage this day of lectures on behalf of the Society and deserves our whole-hearted support. Details and an application for tickets are enclosed.

Programme of Meetings for 2003-4. The Secretary's Newsletter and his programme of Society lectures are enclosed with this Transit. Once again, Neil has arranged a monthly meeting for us all to enjoy.

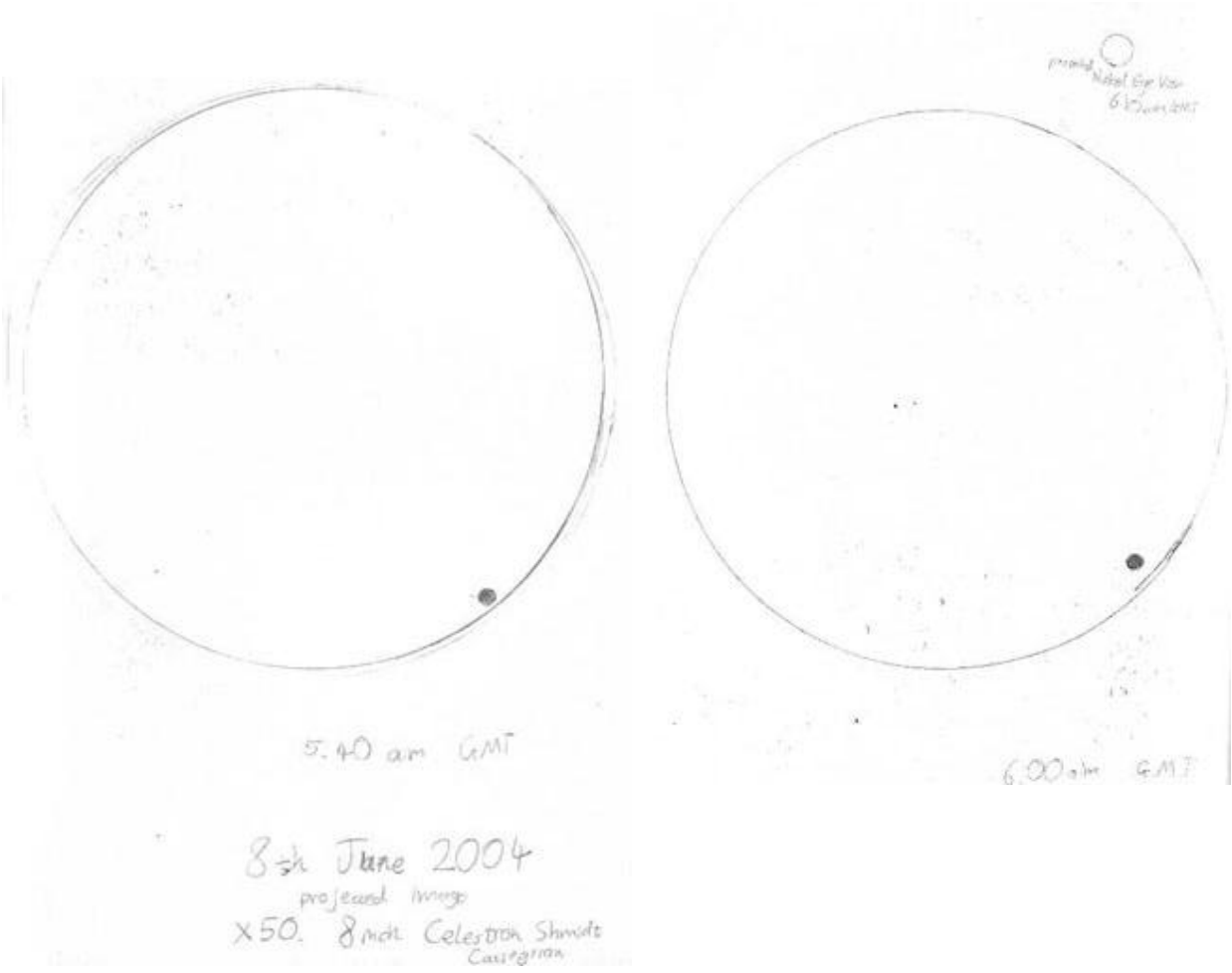
Observing the 2004 Transit of Venus

by Michael Roe

Early in the morning of 8th June 2004 several of us were lucky enough to observe the transit of planet Venus across the sun from next to our Society Planetarium.

Several of us arrived the night before including Bob Mullen who drove me there, John McCue, the Gargett twins, David Blenkinsop and John Fadian. I brought my 22 year old 8 inch Celestron Schmidt Cassegrain telescope to observe the transit.

Although the night was completely cloudy with rain and sheet lightning the dawn sky improved and the sun emerged between clouds just before the Transit. Someone did see the predicted first contact of Venus on the sun at 5:19 GMT. I saw it at 5:21 GMT as a slight notch on the sun. By now many telescopes were set up to observe the transit of Venus, perhaps ten, ranging from 2 1/2 inch refractors to 10 inch reflectors. The conditions were varying haze and partial clouds, giving views of the sun for a few seconds to several minutes. I used the projection method to observe the transit using x 50 and x 80 magnification with x 220 for a short time. I took about eight photographs and made three drawings plus a few small sketches of the first and second contacts. Other observers used Mylar filters on their telescopes for direct observing.



The appearance of Venus was of a sharp edged circle about 1 arcminute in diameter, or 1/30 of the suns diameter. Only two, possibly three, small sunspots near the centre of the sun were visible. Using Mylar viewing spectacles the protected naked eye view of the sun revealed Venus as tiny but visible. I observed the second contact at 5:39 GMT. At about 8:20 GMT Venus was at approximate mid-transit, about 5 Venus diameters into the sun's disk.
Just before third contact at 11:20 GMT cloud intervened and only a fuzzy sun could be seen so that was the end of our transit viewing, the first since 1882, or 122 years previously.

Famous observers such as Crabtree, James Cook and Robert Ball had seen previous transits of Venus mainly to measure the distance from of Earth from the Sun. We had quite a number of visitors including a Radio Cleveland van and a school party. I stayed awake for 27 hours but I am really glad to have witnessed a Transit of Venus, a rare and amazing sight, last seen before any person now alive was born.

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From John McCue

A preliminary report from the Wynyard Transit of Venus meeting.
There were many public visitors, two school parties (All Saints College, Newcastle, and Abbey Hill, Stockton), and about a dozen Cleveland and Darlington Astronomical Society members.
The weather was a disappointment. Cloud and haze made hard work of observing, recording, videoing and photographing the event, but a good internet link to Pretoria was a good source of images for a comparison from another country. Three reasonable images from Wynyard were combined with Adobe Photoshop, as were six from Pretoria. Ed Restall found the Pretoria site, monitored the pictures and saved them. Ed also sent a thank you to the Pretoria Astro Soc for saving our transit day, especially with school parties coming to the planetarium.
Both sets were merged to see that the track of Venus was displaced; England and SA were looking at the event from slightly angles. The difference, according to latitudes, should have been about half the width of Venus. Refined calculations will be possible when three Wynyard images spoiled by the developer (!) when transferring to CD have been re-processed.

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From Dave Weldrake in Australia

Hi Everyone,
Sounds like quite a few of you had good views of the transit. Well, here in Australia we were on the wrong side of the globe to get the whole event, but were well placed for the first half of the transit, although the weather wasn't too good either.

It started off clouded out. We didn't get to see the ingress phase at all and it actually rained for about half an hour, which is officially the first rain we have had in Canberra for 3 months. Sods Law again...
We decided there was little point in hanging around, the weather was very bad, so I went back to the office to do a bit of work. About 1/2 an hour before sunset the clouds parted and the sun shone. A bunch of us then very quickly set-up my 6" refractor and projected the image. Incredible. The image was around 8 inches across and Venus appeared much larger than I was expecting.
We saw it continuously for around 15 minutes before the sun set behind the mountains, an amazing view of the sun setting behind the trees, with Venus large as life and distant tree branches resolved on the projected image.
I took about a dozen pictures of the projected image, one wide field shot with a nice rainbow in the background! Hopefully this should be enough to derive a track, and add Stromlo's part to the CaDAS AU experiment. I'll send on the pics once I get them developed, I have half the roll still to take so more pics of burnt telescopes to come shortly! A guy from a nearby Laser Ranging Station arrived with his movie-camera, so I'll likely be getting a mpeg of the transit to forward on too..
Thats all for now, Ill be in touch with my pictures...

Dave...

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Transit of Venus Report

by Neil Haggath

First of all, I'm really sorry to hear that the Great Event was something of a washout in Cleveland! But I gather that, at the Observatory, you at least got a few glimpses between clouds, which is better than nothing at all.

As with the 1999 eclipse, Don Martin and I refused to gamble with the British weather, and headed for sunnier climes. We based ourselves in the resort town of Icmeler, near Marmaris, on the Mediterranean coast of Turkey. This is not the sort of place where either of us would normally be seen dead; the resort caters mainly for the British "holidays for the braindead" trade - for those who, for reasons which will always mystify me, want to go abroad, only to spend their time watching Coronation Street and EastEnders, eating fish and chips and drinking British beer! But going there was simply a means to an end. At least, among all the English and Irish pubs, restaurants offering English breakfasts, and Harry Ramsden's fish and chip shop – I kid you not! – we found a good Indian restaurant, and an excellent Chinese up the road in Marmaris, which helped to keep us happy. (The former had an amusing advertising board, which read, "Authentic Indian cuisine. Famous chef from Bradford.")

While we were there, we took the opportunity to visit some of the country's other attractions – just as well, because simply staying in Icmeler for a week would have driven us mad; it isn't our scene at all! Along with all the other tourists, we did the standard two day excursion to visit the two "must sees" of the region - the ancient Greek/Roman city of Ephesus and the famous rock formations of Pamukkale.

Unlike everyone else, we also made a day trip to Istanbul, which we organised for ourselves. This involved internal flights at the most horrendous early-morning and late-night times imaginable, and a severe shortage of sleep, in order to give ourselves the full day to see the city.

Meanwhile, we had to grapple with the world's most idiotic and worthless currency; the exchange rate for the Turkish lira is currently about *2.6 million* to the pound! So everyone walks around with bulging wallets full of huge wads of money – the biggest note is 20 million lire, worth about £8 – and when you get your bill in a restaurant, there are enough zeroes to attack Pearl Harbour!

But back to the point; our reason for being there was, of course, to be in a place of guaranteed (???) clear sky on 8th June! We arrived in Icmeler on Friday 4th, and all looked good; there wasn't a cloud in the sky. The next day, however, brought a bit of a scare… about 90% cloud cover, and even the odd smattering of rain! On Sunday, the clouds were breaking up, and by Monday, it was completely clear again.

We were also two time zones east, so First Contact took place at a quite civilised 08h19m local time, and at an altitude of 29°. We observed from a corner of the hotel poolside, from where the entire transit was visible, without having to worry about buildings, trees, etc., being in the way. We had got up early, set up our equipment before breakfast, and commandeered "our corner".

We attracted a lot of interest from the other people in our hotel; we had deliberately chosen the smallest hotel we could find, as the last thing we wanted was hordes of kids rushing around when we had our equipment set up! Most of the other guests, and most of the staff, came to see what we were doing, and had a look; some knew about the transit from the media, while others didn't, and were curious to know what was going on.

We both photographed it with long lenses – 900 mm for me, 800 mm for Don - and followed it visually with two Solarscopes - small solar projection instruments. The latter are the ultimate in low tech, but they are lightweight and fold flat, so they are ideal for carrying in airline luggage. (If you're not familiar with this fine instrument, see my write-up in last December's Transit). They use a 40 mm objective to project a 110-mm solar image; at that scale, the disc of Venus was very sharp and a good size - a distinct disc, which became obvious within the first couple of minutes of ingress.

At Ingress: We could first discern a "bite" about 90 seconds after the predicted time of First Contact. (We had predicted timings for Istanbul, which would be within a few seconds of those for our location). For about 30 seconds after Second Contact, a discernible Black Drop was seen, making it difficult to judge the time of Second Contact.

At Egress: For about 30 seconds before Third Contact, the Black Drop became very pronounced, with Venus appearing as a distinct "teardrop" shape. Again, this made it difficult to judge the time of the contact. The last "bite" ceased to be discernible about 20 seconds before Fourth Contact.

For the last couple of hours, the Sun's high altitude made it difficult to tilt the Solarscopes to the required angle; I could only manage it with mine by propping it up and tilting the base. But Don's, a newer model with an improved base, fared better, so we still managed to get a good clear image right up to Fourth Contact. It also became very awkward to aim and balance the cameras. An appreciable breeze also blew up, which didn't help - though up to about midday, it had been dead calm.

I managed to produce some reasonable photos, which I hope will be good enough for John to plot a track for use in the CaDAS “determination of the AU” experiment.

Throughout most of the transit, Don could easily see Venus with the naked eye through a mylar viewer; for me, it was just discernible at the limit of visibility. We couldn't see it this way when it was close to ingress and egress.

For those who are sufficiently interested, here’s the technical bit – our precise location, and the transit timings, as estimated by me.

Our location (determined by GPS): 36°48’.09 N ± 0.02, 28°13’.83 E ± 0.02

Estimated contact times (UT):
First Contact: 05h21m00s ± 20s (first discernible “bite”)
Second Contact: 05h39m05s ± 20s (Uncertainty due to Black Drop)
Third Contact: 11h04m10s ± 20s (Uncertainty due to Black Drop)
Fourth Contact: 11h22m40s ± 20s (last discernible “bite”)

Footnote
How about this one ...
I got my transit photos developed at a local shop which does the printing on the premises. I took prints, the idea being that I could then get the best ones reprinted, with a lot of adjustment of the colour balance, in order to turn the "mylar blue" Sun back to a somewhere-near-natural yellow.
Today, I took them back to the shop to ask for this. I showed the original prints to the guy who runs the place, and told him what I wanted done. While weighing up how best to do it, he asked me...
"Is that black speck important?"
I somehow managed to restrain myself from visibly cringing, as I explained, "Er, yes - that 'speck' is the whole point! *That's* what I was trying to photograph, and what I travelled to Turkey to see!"

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From Dave Graham

Conditions were far from perfect at Ripon, the ingress phase being clouded out, but the clouds did eventually break (at about 9hrs UT) to leave hazy sunshine, allowing Andy Johnson and I to observe the transit with my 102mm f13 Vixen refractor and a Thousand Oaks solar filter, the 'scope being set up next to my garden shed, so I didn't have far to travel! That said, we did experience a brief shower half way through the event (a very 'English' transit!) during which the instrument was very quickly covered by an old sheet! We felt very privileged and humble to see this momentous event, all the more so, as we never had to travel to see it! It literally came to our backyard! Like Neil, we did record a 'black drop' phenomenon at egress. With Andy at the eyepiece, and yours truly checking a wrist watch which was calibrated using a radio controlled clock, our best attempt at some times would be as follows -
3rd contact - 11h 03m 57s UT

4th contact - 11h 23m 07s UT
We were using a power of X 70 on the refractor at this time

David Graham ex.FRAS (can't afford the sub., two small children you see...) WC & Chain

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Report from Rod Cuff

Pity about the unfriendly clouds most of the day! I managed to get some nice views with my Meade ETX-125 using the 26mm eyepiece (with which the Sun fills the entire field of view) and with a 2x Barlow added; anything stronger was too fuzzy under the conditions. No pics, but very satisfying to see the thing looking so beautifully round! Clouds obscured all the contact times, but clear periods included most of the time between third & fourth contacts, so that made a satisfying end. I hope viewing was better from where you each were.

The main point of this note, though, is to point you at a lovely montage of Venus shots taken by a guy called Pete Lawrence from Selsey in Sussex -- these include shots taken over recent months as well as excellent pictures of all 4 contacts from yesterday.

150k version... http://www.pbl33.fast24.co.uk/Venus2004_800.jpg
300k version... http://www.pbl33.fast24.co.uk/Venus2004_1200.jpg

Alas, I missed the CaDAS transit showcase meeting.

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From Scarborough AS

Here in Scarborough, we got rain, fog and a thunder storm but we had some fine views of the transit later. The east coast must have been the very worse place in the country for weather conditions on Tuesday.
However, the fog allowed those who came up to Oliver's Mount the very rare experience of actually seeing the planet with the naked eye alone (without any need of filters and without any optical aid) because of the fog through which the disc of the sun could be looked at without any harm to the eye! I have been looking forward to this event since I started my interest in astronomy at the age of 12, almost a lifetime ago, and for me this was a priceless and unique experience!

With very best wishes,
Occultation Section,
SPA

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Light Pollution Issues
Lighting Public Buildings

John Crowther reports an item at a meeting of his PCC recently.

"Proposed Lighting scheme. There is a possibility of SRB funding to finance a lighting scheme for Christ Church as part of the Council's scheme to enhance prominent buildings. Matched funding would be required in the form of a contribution towards the cost from this financial year's budget. We would have to maintain the lighting equipment. Proposal is to light the building from dusk to midnight each evening. After lengthy discussion it was agreed unanimously to accept this proposal (with the exception of John Crowther who objected on astronomical and environmental grounds) and to offer a contribution of up to £2500 towards the cost."

John says he was defeated 16 to 1 but fortunately the scheme has now been abandoned. It went over the £2,500 limit.

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The Essay

Some of us like to keep our learning facilities well honed, by taking courses of various kinds. Distance learning courses – Open University, John Moore's University, University of Central Lancashire – are popular and usually the student is required to produce an essay on their chosen subject. A lot of effort and midnight oil goes into these essays, as I know very well. Sadly, they are seen only by the Course Tutors. They deserve a wider audience and four members have agreed to have their efforts published for members' enjoyment. Here is the first in the series.

The Cosmic Background Radiation in Modern Cosmology

By Bob Mullen

- **Introduction :**

The purpose of this essay is to introduce the term CBR (Cosmic Background Radiation), its conception by astronomers and early cosmologists, the discovery of the CBR and interpretation of its actual measurement, the conclusions drawn from its presence and its impact on modern cosmology.

- **The Cosmic Background Radiation :**

The term Cosmic Background Radiation refers to remnant radiation from the early universe, originating when photons were finally released from the dense primordial fireball, approximately 300,000 years after the Hot Big Bang, to eventually penetrate throughout the expanding universe.

Prior to this release, motion of photons was restricted to relatively short distances within the fireball by continuous high-energy collisions with matter. During this era both radiation and matter existed in thermal equilibrium, at least long enough and stable enough to have established a blackbody spectrum.

Cooling due to expansion of this fireball caused matter to form into atoms, allowing photons to escape and scatter further into the universe, primarily because photons and electrons scatter well, whereas neutral atoms do not. The black body temperature at the time of scattering was 3000K.

The photons continued to travel through the expanding universe for billions of years until the present day. They can now be observed as a cool background radiation, pervading the whole universe, at a much redshifted temperature of 2.74 K.

- **Prediction of the CBR**

The CBR was envisioned by a number of early astronomers but unfortunately the reasoning behind its existence was rather confused. Eddington in 1926 [(1)] discussed the temperature of empty space and calculated that a stellar body would eventually cool to a minimum of 3.18K (later refined to 2.8K). Unfortunately he allocated the radiation to the combined temperature of all the discrete fossil heat sources that occupy the universe and not a primordial explosion.

The breakthrough of cosmological understanding started with Hubble's discovery of an expanding universe based on his work on galaxies in 1929. It was then possible to fit a starting scenario to the early formation of galaxies and even look back earlier to the birth of the universe.

George Gamow used his knowledge of nuclear physics to grasp the concept of an early fireball and Hubble's expanding universe. Alpher and Herman [(2)], students of Gamow, developed the theory of the fireball having a blackbody spectrum, with this spectrum being redshifted into longer wavelengths as the fireball expanded over time into the cooling universe. Their principle was correct but unfortunately their estimates at 5K were not. Later Gamow, after a few years consideration, actually increased his own estimate to 50K [(3)].

Cosmology at the time was running into conflict between steady-state universe proponents versus evolving-universe proponents. Whilst theorists were considering their equations, the technology to accurately measure the radiation was not yet available.

- **Discovery of the CBR**

In 1964 two researchers, Penzias and Wilson, working at Bell Laboratories in New Jersey, attempted to identify a background noise on their satellite communications antenna. Static was always apparent wherever they pointed the antenna in the sky and appeared unrelated to any particular point source. They were observing this noise at 7.3cm at a temperature of 3.5K [(4)]. They sought the assistance of Dicke at Princeton, whose team members Wilkinson and Roll [(5)] were simultaneously working on a cosmic microwave background radiation experiment. Penzias and Wilson, it appeared, had serendipitously discovered their radiation and scooped the Nobel Prize from under their noses.

Although now found, the CBR was difficult to measure due to the effect of the atmosphere on short wavelength microwave signals. The next practical step was to take the measuring equipment above the earth's atmosphere.

With a combination of balloons, high flying aircraft, rockets and orbiting spacecraft the CMB was measured at a number of millimetric radio frequencies which, when finally plotted, followed the anticipated blackbody spectrum with remarkable accuracy after its 15 billion year journey from the fireball.

- **Importance of the CBR in Modern Cosmology**

Today we observe the release of those early photons as an almost uniform background microwave radiation of low temperature energy that is both isotropic (looks the same in all directions) and homogenous (uniform in every way and every where). This particular phenomenon is one of the fundamental tenets of today's cosmological principle.

The cosmological principle is an important factor in supporting the Hot Big Bang theory based on :-

a) expansion of the universe
b) existence of the fireball radiation
c) abundance of helium in the universe

The CBR strongly supports (b) and has helped unseat the steady-state universe proponents.

As the CBR was being measured in various experiments the evolving-universe proponents were hoping the results would show some kind of temperature variation however small – anisotropies - across the sky to support their theory of early galaxy growth from clumping matter. A continuous smooth radiation would imply matter being equally distributed (and therefore too widely) across the universe and incapable of starting galaxy formation.

Their theory required a "lumpiness" of matter to exist within the original fireball. As the universe cooled baryonic components of matter (electrons and protons) would eventually accumulate into atoms and then through gravity begin to clump together to form the seeds of the early galaxies.

Instrumentation has improved sufficiently to observe CBR variations as relatively hot and cold spots. Such variations above and below the average sky temperature have now been identified at 2.74 +/- 0.02 K within an accuracy of 30 millionths of a degree. The colder spots being the more dense lumps of radiation within the CBR [(6)] . This implies a relationship between lumpy matter and lumpy radiation whilst within the early fireball.

Another theory in modern cosmology is the horizon problem – asking why all CBR hot spots have almost the same temperature, whatever their size or location across the present universe. It is not possible that *all* parts of the early universe could have been causally in contact with each other when matter and radiation eventually decoupled.

Guth in 1981 [(7)] developed the cosmic inflation theory to account for the horizon problem. He theorised that just after 10^{-43} seconds from the Hot Big Bang, when the universe was approximately a trillionth the size of a proton, a superluminal and violent explosion occurred, with rapid expansion continuing until around 10^{-34} seconds, with the

universe at that time being approximately ten metres diameter. This rapid expansion phase, or inflation, was followed by a more leisurely rate of expansion up to the present day. The relative densities and pressure ratios at the end of the inflation era remained within the expanding CBR and have left an almost equal-temperature but heavily redshifted imprint on the present CBR hot spots.

When theorists examined CBR measurements they were able to calculate from the known ratio of photons versus matter in the universe that there was insufficient visible matter available to produce the early galaxies. It would take more than 15 billion years for gravity to pull in enough visible matter to produce the present galaxy clusters. However, if dark matter also existed in the early universe, its presence would have speeded up the process. Cold dark matter was thought too slow to produce the present galaxy structure but hot (and fast) dark matter may succeed by keeping matter spread out further to form larger scale structures [(8)]. As identification of both hot and cold dark matter is still uncertain theorists still continue to theorise.

To satisfy cosmological models of an expanding and accelerating universe a dark energy or vacuum energy is required (dark energy overcomes the force of gravitational attraction). This energy apparently played little part in the early universe but today appears to be denser than matter and may eventually dominate matter. Future high precision CBR measurements may help resolve the nature and form of this energy [(9)].

- **Conclusion**

Thus, the confirmed existence of the CBR and its temperature variations not only supports the theory of an evolving universe but also supports evidence of inflation, dark matter and even dark energy.

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(2) Alpher R.A. and Herman R. (1949), Physical Review 75:1089-1095 USA.
(3) Gamow, George (1961), "The Creation of the Universe", (new York Viking Press).
(4) Penzias A.A. and Wilson R.W. (1965) Astrophysical Journal 142. 419-421
(5) Dicke R.H, Peebles P.J.E., Roll P.C. and Wilkinson D.T. (1965) Astrophysical Journal 142. 414-419.
(6) Chown, Marcus, (1996), "Afterglow of Creation", University Science Books, California page 185
(7) Guth A (1981) "Inflationary Universe, a possible solution to the Horizon and Flatness problem". Physical Review D, 23:347-356
(8) Chown, Marcus, (1996), "Afterglow of Creation", University Science Books, California, page 192
(9) Freedman R.A. and Kaufman W.J. (1996), "Universe", 6th Edition, W.H.Freeman and Co, page 660.

Transit Tailpiece

From John Crowther :-
On hoardings last June – "FREE SKY until June 30th". But we know it's always free, although spoiled by light pollution.

Quote/Unquote
When I am not understood, it shall be concluded that something useful and profound is couched underneath.
Jonathon Swift

Our knowledge of time and space owes more to the labours of mathematicians and physicists than to those of professional philosophers.
C.D.Broad.

Let us then take a leap over a precipice so that we may contemplate nature undisturbed.
Arthur Eddington

* *

Book Review
"Starseekers" by Colin Wilson
From John Crowther

Colin Wilson is a prolific writer on various subjects, including the para-normal. But don't be put off, for if you are into the history of astronomy, this beautifully illustrated book is a must. Many of the photos, paintings and drawings were new to me, as were some of the stories about the important characters. The explanation of the theory of relativity was very well done.

The first and last chapters are rather controversial, as they include the author's ideas on the evolution of the human brain and the importance of intuition in human development.

I was puzzled by the illustration labelled "A nocturnal or timepiece, which resembles an astrolabe. It appears to be a sighting instrument and does not have a shadow-casting gnomon, as I (being more into sundials) expected. For when we have latitude, time and star position, any two of these unknowns can give us the third. So is there such an instrument as a moondial?

"Starseekers" is divided into three sections, with each section having three chapters. The sections are headed "Ancient Cosmology, "The Era of Discovery" and "The Exploding Universe".
Publishers Bellow and Higton, 1980, 261 pages. Available in Redcar library.