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FEBRUARY MEETING

The first meeting of the month takes place on Feb. 13 at 8 pm using room 110, Lockhart Hall at the University of Winnipeg. John Wunderlick will be speaking on the evolution of galaxies. This subject is currently one of importance since research into the size and age of the universe requires some knowledge of the effects of aging of galaxies.

The second meeting will be on the 20th. More details of this are given below by Roy Belfield.

PRESIDENT'S MESSAGE

For the Centre's second meeting in February, Prof. Robert Miller has generously offered to take us on a tour of the sky using the University of Manitoba's planetarium. This event will give us a look at the fabric of the heavens from a comfortable armchair. Our last few meetings have offered a variety of subjects, which have been entertaining as well as informative and we hope to continue bringing you good programs, each with a different appeal. But... there are times when we are at a loss... so I invite all the members to send me their suggestions, comments, or thoughts as to what kind of program would make the most interesting meetings. Membership is growing every month, which is encouraging to the people who have given time and effort.

Our thanks to Low McQueen for his donation of $25.00, w hich will be put toward a printing machine. The Centre realized $105.71 from the Christmas Party, giving a total of $130.71. We have now found a Gestetner printing machine for about this amount, and are awaiting delivery. I was told by one person that we want a lot for a little money, and knowing her, I think we may have got it.

Last of all, thanks to Jay Anderson for putting on a star party for the cubs, on January 13. The harsh weather makes your efforts the more appreciated.

--Roy Belfield
president

FOR SALE: 8" Cave Optical Custom Newtonian RFT approximately f/4 with solid pedestal mount, casters, setting circles, RA clock drive, and 2 eyepieces. Instrument can be used for deep sky observing and photography and has a Barlow lense for planetary and lunar work. About 3 years old, but used only once. New cost $900, but will accept best offer around $700. Contact: Rick Leach
320 Langside Drive
774-2398

LIBRARY NEWS

When the temperature hits -30 degrees Celcius, even if it's clear, I don't often venture outside with my telescope. I'd rather keep warm inside and read books.

"Direct Use of the Sun's Energy"--Farrington Daniels

With so much emphasis on the energy crisis these days, this is a very topical book. Dr. Daniels leads us through the many possible uses for the cheapest and most plentiful energy source we know. Because our own high energy consumption pushes prices upward, developing countries are looking for cheaper sources as they move into the industrial era. With the continuing demand, solar power resources could be tapped, but whether research will provide an efficient low cost energy source in the immediate future remains to be seen.

Even though this book was written with the scientist in mind as a reader, technical details have been minimized, so that the unspecialized reader will find it quite entertaining.

"A View From a Height"--Isaac Asimov

Even though written in 1964, this book is enlightening and entertaining. Asimov is at his best, making sense out of the complications of science for the reader, and takes us on a merry jaunt through biology, chemistry, and physics into astronomy. He loves to ask questions, such as 'how high is up?'. His use of cards to describe one of the most nebulous concepts of thermodynamics in his chapter on entropy, is a stroke of the Asimov genius that has characterized his many publications. When Asimov explains, the reader understands.

The book "We Reach the Moon" by John Noble Wilford has been donated by Jack Iverson. It, and many others, are available from 14 Argonne Bay. If you phone beforehand, I can bring any book you may be interested in, to the meeting.

--Phyllis Belfield

A CALENDAR OF MANNED SPACEFLIGHT
from Vostok to Skylab

APOLLO 17--Dec. 6 - 19, 1972

Despite a 2 2/3 hour delay in the early December launch when automatic equipment failed to pressurize the third stage's liquid oxygen tank, Eugene Cernan and Harrison H. Schmitt (first geologist to set foot on the moon) landed on the moon only a minute late. The third member of the crew, Ronald E. Evans, remained in orbit. To restore the mission to its original schedule, Cernan had fired the third-stage rocket engine a few extra seconds during the planned six-minute burn that sent the craft out of its parking orbit toward the moon.

While Cernan steered the lunar module toward the landing spot south of the crater Littrow, Schmitt called out altitudes, speeds, and fuel levels. On landing, enough fuel remained for three minutes of flight and Schmitt quipped, "We should have hovered around a little bit, gone and looked at the scarp." "No, thank you," replied Cernan, "I like it right here." He placed his boot on the lunar surface some three hours after touchdown, at 7:05 pm EST, Monday, December 11, and was joined within minutes by Schmitt.

They were only 300 feet from the expected landing point. During the first hour out, they readied the lunar rover and its television camera, and had a chance to look around. The region was highly pitted with small shallow craters. Cernan noticed tracks of rocks that rolled down nearby hills. On the valley floor, Schmitt saw what appeared to be "boulders covered by some of the dark mantle." This dark material, possibly volcanic and young, was one reason for selecting this landing site. As on the five earlier manned landings, high priority was placed on setting up the Apollo lunar surface experiments package, or ALSEP. At a spot about 300 feet east of the lunar module, Cernan and Schmitt deployed the five experiments in a spokelike pattern centered on the central station. Because of difficulties in placing the ALSEP instruments, the planned traverse in the rover was somewhat curtailed. The men did go as far as the crater named Steno (the name really belongs to a crater on the back side of the moon). There they collected some rock samples and drove back. The astronauts' ride was plagued by flying dust, because Cernan had accidentally knocked off part of the rover's right rear fender. A makeshift one was clamped on the second EVA, curing the problem.

The next day at 6:17 pm, the cabin was depressurized again, to begin the longest interval that the astronauts have ever spent outside their lunar module, (7hr, 37 min). During a round trip of some 12 miles, Cernan and Schmitt followed closely the prescribed route that took them to the foot of the 7,000 foot South Massif mountain. While driving the men encountered many shallow, dish-shaped craterlets, some with glassy linings, instead of the blocky, deep, rimmed variety attributed to recent impacts. At the foot of the mountain, the explorers saw blue-gray and tan-gray conglomerates, while of the slopes were blue-grey outcroppings, possible very old. The biggest surprise of the mission came at station 4,Shorty crater, shen Schmitt happened to kick at some dark material covering the crater's rim. "There is orange soil!" he shouted, and Cernan came over to confirm it. The geologist suggested that the orange material might be from a fumarole or volcanic vent, while his companion likened its color

to "oxidized desert soil." They also observed red streaks extending down into the crater, as if a covering layer had slumped to reveal the underlying material. After the men's return, preliminary tests at the Manned Spacecraft Center in Houston revealed that at least 90% of the orange soil consisted of tiny glass spherules, brownish to burnt orange in hue. According to the geochemist Paul Gast, the orange soil was not formed as a result of volcanic action involving water. There is a keen interest in what detailed study of this peculiar material may reveal.

At 5:31 pm on December 13, the third day on the moon, Cernan and Schmitt opened the hatch of the lander to begin their last lunar excursion. Once more, in their four-wheeled, battery-powered vehicle they were able to follow closely the assigned rout. They visited the foot of the mile-high North Massif and collected samples of boulders that may have rolled down its slopes. It was the sculptured hills near this formation that Cernan, two days earlier, had likened to the "wrinkled skin of a 100 year old man." Returning by way of so-called Van Serg crater, the travellers reached the safety of the lunar lander after 7 1/4 hours.

For three lonely days, astronaut Ronald Evans circled the moon by himself, conducting the experiments designed to study the moon. Evans exposed some two miles of film with his 3" mapping camer. At his height of about 70 miles, the 24" panoramic camer, objects up to five feet could be distinguished. Additional film was used in the lunar sounding experiment. Radio pulses were reflected from the moon, received by antennas on the command module (including a dipole extendable to 80 feet long), converted to light signals, and photographed. Stronger reflections were expected from layers of the lunar crust which conduct electricity better, such as those containing iron ore or water. In this way, it was hoped to map subsurface layers almost a mile deep, using signals a 5, 15, and 150 megahertz. Both projects depended on successful retrieval of the film cassettes during Evan's space walk on the way back from the moon. About 21 hours after the trio had left lunar orbit, the hatch was opened, and in three trips to the experiment unit, Evans was able to bring all the film back inside the spacecraft.

It was reported that the laser altimeter aboard the command module had performed properly, reading line-of-sight distances to points photographed simultaneously with the mapping camera. Good results were obtained with the S-band transponder that returned radio signals to Earth. Doppler shifts of these signals allow detection of slight changes in the craft's orbit around the moon, which in turn can be used to map the lunar gravitational field.

An experience familiar to Apollo astronauts for some years is the seeing of tiny flashes of light, which may be the effects of cosmic rays traversing the eye. To test the potential threat of cosmic radiation to crews of future long-duration space flights, Apollo 17 carried five pocket mice, each about the size of a man's thumb. As the astronauts were picked up by the USS Ticonderoga in the Pacific after their 2:25 pm splashdown on December 19, the canister of mice was flown to Samoa ahead of them. One mouse had died of unknown causes the the pea-sized brains of the other four were studied for cosmic ray damage.

The safe return of the Apollo 17 astronauts concluded the last, longest, and most successful of six manned lunar landings. No less than 22 hours had been spent in travel and work on the lunar surface, where a record weight of samples was collected. The time spent in orbit around the moon was 148 hours, the longest ever.

In summary, more than 50 spacecraft, American and Soviet, have flown near or landed on the moon. Of 24 Americans who have observed the moon close up, 12 have walked on its surface. There they spent 160 man-hours, traversing 60 miles afoot and by rover. Thirty thousand photagraphs from Apollo alone have captured the moon in intimate detail. On the moon's surface, nearly 60 major scientific experiments were performed by Apollo; in orbit, some 30 more. Five of the six scientific stations left by Americans on the moon continue to transmit information. All told, more than 1000 scientists in 19 countries have been studying the Apollo samples, a priceless trove of 841 pounds of lunar rock and soil. This was Apollo!

Don Hladiuk

NEW SATELLITE OF OUR GALAXY

The known satellites of the Milky Way include the Magellanic Clouds and seven dwarf elliptical galaxies. Since the dust and gas of our own system covers about 10% of the sky, there is a reasonable probability that at least one more galaxy lies hidden behind it.

Radiation in the visible part of the spectrum does not penetrate the Milky Way to any great extent, but the much longer wavelengths in the radio region push through dust and gas with little effect. Using the results of measurements at 21 cm. wavelength, S.C. Simonson has determined that a fast moving region of hydrogen in the anti-centre of the galaxy is probably due to the presence of another small galaxy. Radio maps of the region indicate considerable tidal distortion of our new neighbour with long streamers of hydrogen gas stretching over 25 degrees. The new dwarf is probably the closest other galaxy to us since it covers such a large area on the sky. This object could become quite important in the future, since the effects of its gravitation will allow a more accurate determination of the mass of our galaxy.

-Jay Anderson

If the Stars should appear one night in a thousand years, how w would men believe and adore, and preserve for many generations the remembrance of the City of God which had been shown! But every night come out these envoys of beauty, and light the universe with their admonishing smile---Emerson

COMETS

The discovery of comets, traditionally the fiefdom of amateur astronomers, has succumbed to the expertise of the professional. Since the beginning of the 70's the majority of comets have been found on photographic plates, generally taken by large Schmidt telescopes, though amateurs still seem to find the brighter naked eye comets which appear near the sun.

In the years from 87 BC to 1973, about 946 comets have been discovered. In recent times, the number of discoveries per year has ranged from just one in 1971, to a record twelve last year. Combined with the recovery of five previously known comets, 1975 gave us a magnificent 17 "hairy stars."

Once a comet has been discovered, its position must be measured at three separate times and places in order for a preliminary orbit to be worked out. The best time for doing this measuring is while the cometary image is small and round. At least three, and preferably four to six reference stars must appear on the negative with the comet. If the object can be followed for three months, the perturbations in its orbit become noticeable, and after six months, corrections can be applied to the original orbit to provide a definitive orbit.

Comet orbits present special problems to the astronomer, and the care taken in calculating them accurately is essential for determining their origin. The orbit takes one of three forms--an ellipse, a parabola, or an hyperbola. A comet following an elliptical path is gravitationally bound to our solar system and will eventually return to the neighbourhood of the sun. The hyperbolic orbit is followed by a body which is approaching from outside the solar system, or is escaping from it. Separating these two systems is the parabola. New comets are assumed to follow a parabolic path when their ephemerides are first calculated, but in reality this type of orbit probably does no exist. It's like a fence between two pieces of land--if you measure accurately enough, the fence is always a little more on one piece of land than the other.

Up to August 1973 some 614 individual comets have been discovered. Of these, 99 had periods of less than two hundred years and are considered short period comets. Obviously all of these have elliptical orbits, since they return to the sun. The long period comets consist of 515 members, of which 145 have elliptical orbits, 68 follow hyperbolas, and the remaining 302 have indeterminate parabolic orbits. When a comet is close to the sun, the difference between a long elliptical orbit an an hyperbolic one is extremely small. The difference only begins to become apparent as the comet receeds from the central solar system. For this reason, orbits are best determined for those visitors which are followed for several months.

About half of the long period comets have retrograde orbits, but only five of the long period ones do (including Halley's Comet). This may be due to the longer period of interaction with the planets that a direct orbit would provide. This is readily apparent when you consider that it takes longer to pass a car going in the same direction than it does if it's coming toward you. As evidence for this point of view, almost all short period comets are confined to low orbital inclinations where the planets are.

Not surprising, short period comets are continually being influenced by Jupiter, so that all those comets with aphelia less than 7 a.u. are classified as belonging to the Jupiter family. Most of these objects probably result from multiple encounters with the giant planet, rather than just one.

Since long period comets tend to approach from high inclinations, interactions with planets are much rarer than for short period comets. Many of the hyperbolic orbits which have been calculated are probably very long elliptical orbits, if the comet is assumed to be in orbit around the whole solar system rather than just the sun. This approach works best when the comet is a long way from the sun and the known planets. Nevertheless, these bodies move so far out from the sun that many probably do escape the solar system.

According to Oort, comets originate in a cloud of 'icy' debris at vast, but still gravitationally bound, distances from the sun. His evidence for this theory lies in the fact that 'new' comets seem to follow elliptical orbits more often than hyperbolic ones. While this point of view has been questioned for some time, present results seem to verify it. Statistically the average new comet has an aphelion of 50,000 a.u. and a period of 400,000 years. Presumably the comets are caused to veer in toward the sun by perturbations from other stars. One problem with this approach (no pun intended) is that there appears to be a shortage of comets making a second or third approach, when, as a result of previous planetary interactions, their orbits could be expected to have a aphelion of 3,000 a.u. or so.

The nucleus of a comet is generally only detectable with very short exposures and very large telescopes. Elizabeth Roemer estimates a typical size of 1 kilometer for a short period comet, and up to 10 kilometers for a long period comet. Masses are uncertain, but are not large since comets do not perturb other planets.

At large distances from the sun, the comet spectrum is essentially continuous, with no absorption or emission lines. At about 3 a.u., the first lines appear. These are simple molecules composed of carbon, hydrogen, oxygen and nitrogen. As the comet crosses inside the Earth's orbit, sodium makes its appearance as the temperature rises. Sun-grazing comets may show many metallic lines, including iron, nickel, potassium, copper, calcium and cobalt. All of these are found near the nucleus and indicate a very mixed chemistry there.

The gaseous tail generally shows carbon monoxide with lesser amounts of nitrogen and carbon dioxide. Skylab and the OSO satellites have shown that a large hydrogen halo surrounds the comets.

The spectral lines and bands are formed by molecules which result from the breakup of more complex parent molecules. These parents cannot be identified by their own spectra, but their fragments can be reconstructed with some speculation as to their precise environment. They probably include acetylene, water, formaldehyde, methane, ammonia and methanol. This highly volatile mixture of gases may be useful to future space travellers. On a small scale, comets seem to carry some of the same molecules now being discovered by radio telescopes in the gas clouds of the galaxy.

The reddening of reflected sunlight from comets indicates that considerable dust is also present. The dust is found primarily in the tail and some comets show two tails--one of dust and the other of gases. The nucleus is believed to consist of a conglomerate of ices and meteoric material. As the comet nears the sun, the ices sublime and the tail or tails are formed.

Many periodic comets with well determined orbits are found to arrive earlier or later than predicted at their perihelion passage. The explanation lies in small non-gravitational accelerations resulting from the uneven release of gases from the nucleus. These gases act as a small but persistent 'rocket' which may slow or speed up the comet. Calculations show that from 0.1 to 1% of a comet's mass may be lost per revolution while most of the non-gravitational forces occur when the comet is close to the sun and mass loss is greatest. These comets which do not show the effect may have a small gas component or the gases may be emitted evenly in all directions.

Since most of the molecules in a comet vaporize at low temperatures, the tail should begin to form at about 7 or 8 a.u.'s. That it does not is an indication that the largest constituent of the comet must have a fairly high melting point. The most reasonable candidate detected so far appears to be water. The concept of a comet as a dirty snowball appears to be well founded.

Over the years many comets have become lost, generally due to inaccurate orbital determination. When computers were applied to the problem, only four remained lost, and may have turned into meteoroids. Several sungrazers have been seen to split in two and in 1889 Comet Brooks 2 split into several components after passing very close to Jupiter. Many comets that split appear to be making their first trip in toward the sun. Possibly they have a brittle shell which splits the comet when it begins to warm. One short period comet which split (Biela) may have collided with an asteroid.

If comets split several times, it is possible to get groups of comets. It appears certain that comets 188s II and 1965 VIII are fragments of a comet which split during a previous passage about 1200 AD. In fact, both of these comets were observed to split themselves. Look for them again about 2550.

Despite the professionals usurping the amateurs role in comet discovery, they remain one of the most pleasing spectacles of amateur astronomy. Their sudden appearance and unpredictable behaviour still leaves room for a lucky or dedicated observer to go down in the pages of history.

--Jay Anderson

THE CENTRE OF OUR GALAXY

Using two radio telescopes as an interferometer, U.S. astronomers have been studying the centre of the Milky Way with very high resolutions. The 242 km. separation of the telescopes has allowed them to put an upper limit on the size of the galactic core at 200 a.u. Since some previous studies did not detect the feature, it would also appear to vary in intensity.

Now is the time for all good men to come to the aid of the partyvvvvvvvvv
Now is the time for all good men to come to the aid of the patry

This nucleus appears to be considerably smaller than similar features in other galaxies, since the radio emission from the others is much stronger than our own. Further studies are planned at even higher resolutions with the hopes of attaining the actual size of the region instead of just an upper limit. It should be noted that 200 a.u. represents a linear dimension approaching that of our solar system (Pluto equals 40 a.u.)

--Jay Anderson

THE NATURE OF QUASARS ?

Photographs taken with the 4 meter telescope at Cerro Tololo in Chile show visible filaments and blue star-like images radiating outward from the galaxy associated with the radio source Centaurus A. The blue 'stars', presumably ejected from the galaxy, would appear as 12 magnitude objects from the centre of Centaurus A if they were ordinary O-type stars. This is slightly brighter than the quasar 3C 273 as seen from Earth.

One theory about quasars holds that they are extremely fast moving stars whose radio emission is due to their motion through the dust and magnetic fields of a nearby galaxy. Since the blue objects photographed near Centaurus A are in its radio-emitting region, this theory would now appear to have some physical support. Future observations may show the answer, since the motion of these new stars should be apparent after 10 to 20 years.

--Jay Anderson

Sir James Tirrell, of London's Holyscone Observatory, has devoted a good part of his long career alerting the scientific community to the grave threat posed by the "cloud crisis". An exhaustive study of meteorological data has led Tirrell to the conclusion that the number, size, and density of clouds has increased sharply in recent years, and that if this grow th goes unchecked, the sheer weight of these monsters will overcome the natural forces which keep them airborne. Tirrell also believes that cloud growth goes in cycles, and the great craters in Arizona and Lake Baikal in the Soviet Union may have been caused by cloud impacts. He has long opposed what he calls "the fluffy-white psychosis". "People think these things are some kind of candy fluff covered with angels. Nothing could be further from the truth. They're icebergs of the air, and when they fall, there's going to be a real mess."

--reprinted from National Lampoon, August, 1970

Januery Meetings

At the first meeting, Dr. Martin Clutton-Brock was the featured attraction. Originally from Sussex, England, Dr. Clutton-Brock moved to Canada and taught at the University of Victoria and York University before undertaking the education of first year students at the U of M. His specialties are with the formation of galaxies and cosmology, but his subject for the Center was on interstellar exploration.

According to Dr. Clutton-Brock, mankinds evolution into space is not only possible, but essential. With the demands for increased living space, and the attendant depletion of energy and material resources, the jump into space will be the only practical solution. Planets were the breeding ground for intelligent life, but future man will move away from this confinement out of sheer economic necessity.

Our solar system has much to offer. Energy is everywhere as sunlight and huge mirrors can bring it to a focus where the heat generated can provide energy or be used in manufacturing. Asteroids can provide the minerals and comets the lighter elements - in far greater quantity than available on Earth. Colonies of several thousand people are possible.

Very large telescopes, perhaps constructed around small asteroids, will enable us to find planets around other stars. But the detection of life on these planets will have to await the arrival of man. While chemical fuels are too bulky for star travel, ships can be sailed out of the solar system using the pressure of light.

The first explorers, possibly robots, will have to be circumspect in their behaviour in order to avoid disturbing any natives. This is the same behaviour attributed to UFO's and Dr. Clutton-Brock stressed the need for keeping an open mind on these. As yet there is no evidence to favour either the natural or extraterrestrial origin of UFO's.

Following Dr. Clutton-Brock, slides were shown of the recent lunar eclipse. They were taken by Malcolm Ellis in England, and were accompanied by a letter giving a full description of the event.

At the second meeting Hans Thater presented an enlivening talk and slide show of the Martian moons. According to the Mariner 9 photographs, the moons are solid heavily cratered oblong bodies. Using a crater-size calibration technique, their age is estimated at 3.4 billion years. They appear to be formed of igneous rock with a high calcium content. Experiments on impact patterns point toward an origin in orbit about Mars.

The Unicity display was described as a great success and another venture is planned for Grant Park in the near future.

Jay Anderson reports that Comet Bradfiels was rather disappointing. The object is not bright, has no tail, and is hard to find because of its small size.

-Ella Dack