THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

SASKATOON CENTRE

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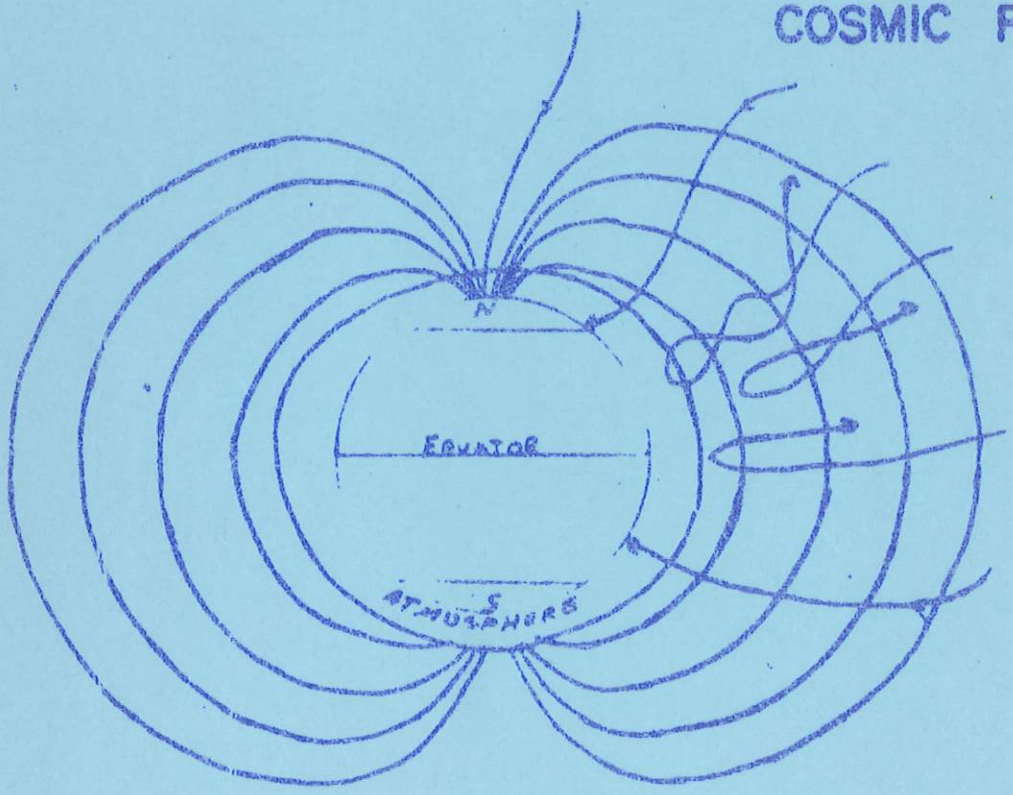
News Letter

COSMIC RAYS



Charged particles deflected by
the Earth's magnetic field

COSMIC RAYS

Greg Towstego

At about the turn of the century scientists were studying the manner by which some kind of energetic radiation was ionizing atoms in the atmosphere. Ionization occurs when negatively charged electrons are knocked out of their orbit around the positive nucleus of protons to leave a dominant positive charge. The positively charged atom fragments left were called "positive ions". It was found that no matter how good a sample of air was shielded, positive ions still formed. A radiation which had not yet been observed must have penetrated the lead barrier. At first it was taken for granted that the radiation was coming from the soil as all radioactive materials came from this source. In Canada, John C. McLennan and his associates considered that a thick shield of water might protect detectors from the radiation, so one day McLennan and other scientists took electroscopes far out onto Lake Ontario and sunk their equipment many feet into the icy water, but the electroscopes still discharged indicating the presence of the radiation.

To settle the controversy Austrian physicist Victor Franz Hess (1883-1964) did a series of balloon ascensions beginning in 1911. It was thought that as the balloon rose the rate of ionization would decrease, but instead the opposite happened: the rate of ionization increased, and the higher the balloon rose, the greater the increase. It was now clear that the source of the radiation was not below the Earth's surface but above it. Hess found that at 6,000 feet the rate of electroscope leakage equalled the leakage on the ground, and at 18,000 feet the rate of leakage was twice as fast as on the ground. Hess called the radiation "high-altitude radiation".

Werner Kolhoerster, an interested scientist at the University of Halle in Germany took electroscopes up to nearly six miles by balloon. At that height the instruments discharged thirteen times as fast as at sea level. In a few years it was confirmed that the radiation was coming from outer space.

After World War I Robert Andrews Millikan (1868-1953) of the California Institute of Technology became interested in the radiation and he and Kolhoerster ran many experiments such as taking electroscopes down into mines and crevasses of glaciers. In 1925 Millikan named the remarkable radiation "cosmic rays".

The nature of these cosmic rays was the next question to arise. One of two choices seemed to be most likely: they were either extremely energetic photons with a shorter wavelength than ever observed or else they were massive particles moving at an extremely high velocity. All of the massive particles known in the 1920's had an electric charge so it was assumed that is cosmic rays had mass they also had charge. It was also thought that if they had a charge they

would strike the polar regions in greater a number than the equatorial regions due to the fact that the Earth behaves like a magnet. Some unusually high energy particles would come in through the equatorial regions but on the whole one would find an increase travelling north or south. The charged particle choice could also be tested by applying electromagnets to the newly invented cloud chamber. The electromagnet would either repel or attract the particle giving the charge of the particle. If a photograph was taken when the particle entered the chamber the energy of the particle could be calculated by knowing the curvature of the particle track and the strength of the electromagnet. On the other hand, photons would remain unaffected by a magnetic field because they have no charge. They would not be affected by the poles either, they would strike all parts of the Earth's surface equally.

Arthur Rolly Compton (1892-1962) beginning in 1930 did extensive studies of cosmic rays on all parts of the Earth and found a definite increase in intensity with latitude as was expected for charged particles. By 1935 it was clear that they were positively charged particles.

This is true for at least the radiation before it hits the Earth's atmosphere (primary radiation). Upon contact with the atmosphere, it interacts with other atoms and produces a variety of lesser but still very high energy radiation called secondary radiation. It is with the primary radiation that astronomers are mainly concerned. To get to the primary radiation one must rise to the stratosphere where most of the interfering air molecules are beneath. In the 1930's altitudes as high as thirteen miles were achieved and at that height 97% of the atmosphere is below.

It turned out that the primary radiation consisted of about 90% protons (hydrogen-1 nuclei) moving at nearly the speed of light (3.0×10^8 meters/second or 186,000 miles/second). Another 9% was made up of helium-4 nuclei, and the remaining 1% was the nuclei of heavier atoms up to and including iron-56. In short cosmic rays were made up of interstellar space matter put into violent motion and possessing unimaginable units of energy.

In the last few years physicists have been able to build huge particle accelerators that accelerate particles up to 200 billion electron volts (200 Bev), (1 electron volt is the energy gained by one electron crossing through one volt of potential difference). This great energy may be compared to that of a photon of light which has an energy of about 2 electron volts (2 ev). Man then can produce protons with energies billions of times greater than that of a photon, and these energies do approach some of the levels of cosmic rays. Some cosmic rays collide with the Earth at energies of 1,000,000 Bev and higher.

. . . . continued next month:

The Origin and further research of Cosmic Rays.

STRANGE PHENOMENA IN THE IONOSPHERE

David Pristupa

--a plea for information for the Observation Group's Sun Project

It is not very often that one is able to receive a distant FM or TV station. These signals are too high in frequency to reflect off the ionosphere but medium and long waves do reflect. Reflections are caused when charged particles in the high atmosphere are oscillated in unison with the broadcast waves. When these particles vibrate they oscillate radio waves and that is why you receive distant stations! A night reception from far stations occurs because the setting of the sun lets the reflecting layer rise and a larger skip is received.

Stations beyond the horizon are rarely received if they broadcast above 40 MHz. However temperature inversions can cause stations as high as 108 MHz to be received. These inversions are dense enough to guide the wave over hundreds of miles and "dump" it overseas. Sporadic reflections also can account for this type of reception. On June 6, 1973 I identified 23 FM Stations and four TV stations from mainly around the Great Lakes. I found this fascinating, and if you are interested in radio you can grasp the importance of such an event. If anyone receives FM or TVstations from far away, please try to identify them and tell me what you have received. I would like this information to see if the sun had anything to do with this strange reception. It may be difficult to identify the stations because they quickly fade and it is quite different from nighttime AM reception on the standard radio, so I would suggest taping this event. Although hard to identify, each bit of information helps, such as frequency, city, call letters, content, etc.

I would suggest scanning the FM band and TV band as often as you can during any hour especially in the late morning, afternoon and early evening. But this can happen at any time, so keep a watch on these parts of the radio spectrum. This project is a part of the Observation Group's Solar work. There is more information on radio waves in the astronomy section of the main branch Public Library, in the book The Sun and Its Influence.

"GENERAL MEETING"

DATE: Tuesday, January 15, 1974

TIME: 8:00 p.m.

PLACE: Room B110, Health Sciences Building (across from Observatory)

PROGRAM: Regular Business
"COSMIC RAYS" presented by
Dr. Phenneger

UP-DATE ON COMET KOHOUTEK (1973f)

G.N. Patterson

This much publicized Comet has not lived up to the wonderful expectations originally forecast for it. However, it is unique in one aspect - no other comet that we know of has ever behaved the way this one has and it should be interesting to see what explanation is finally arrived at to state why the Comet failed to rise to anywhere near the forecast brilliance, expecially taking into account it's huge-sized nucleus and it's proximity to the Sun at perihelion.

I sighted the Comet at about 6:15 p.m., Sunday, January 6 using a Celestron 8 telescope. At that time it was on a line projected from Jupiter to Venus and approximately as far from Venus as Jupiter but the other way. I would estimate the brightness as about magnitude 2 to 2.5, taking into account the brightness of the evening twilight. A photo taken with Tri-X Pan for 15 minutes exposure resulted in a grossly over-exposed film with no sign of the Comet on it. Binoculars are needed to see the Comet because of the bright twilight.

The following table can be used to assist in finding the Comet:

DATE	VISIBLE TIME	FADEOUT TIME	SET TIME	SEPARATION FROM SUN	MAGNITUDE	RT AS.	DEC.
Jan 8	6:00 pm	7:00 pm	7:12 pm	31°	2.2	$20^h\ 55^m$	-13.5°
Jan 13	6:30	7:30	7:55	40.5	3.0	21 53	- 8.9
Jan 18	7:10	8:05	8:35	48.5	3.7	22 49	- 4.0
Jan 23	7:35	8:35	9:10	50.5	4.3	23 4 40	+ 0.6
Jan 28	7:50	8:30	9:35	61.0	4.9	0 23	+ 4.6
Feb 2	7:55	8:15	9:55	65.0	5.4	0 59	+ 7.7
Feb 77	8:00	8:15	10:15	68.0	5.9	1 29	+10.1

I will be giving a repeat talk on this Comet at the Saskatoon Public Library on Sunday, January 20 at 3:00 p.m., using as much up-dated material as is available to that time.

THE PLANETS IN 1974

Morning "Stars"

MERCURY - A few days before and after March 23, July 22 and November 10.

VENUS - January 23 to November 6.

MARS - October 14 to December 31.

JUPITER - February 13 to September 5.

SATURN - June 30 to December 31.

Evening "Stars"

MERCURY - A few days before and after February 9, June 4 and October 1.

VENUS - January 1 to January 23 and November 6 to December 31.

MARS - January 1 to October 14.

JUPITER - January 1 to February 13 and September 5 to December 31.

SATURN - January 1 to June 30.

Brightest or Best Seen

MERCURY - As an Evening Star February 9, setting about one hour after the Sun, near the sunset point of the horizon, and as a Morning Star November 10, rising about an hour ahead of the Sun, near the sunrise point of the horizon.

VENUS - February 27.

MARS - Not in 1974.

JUPITER - August 26 to September 15.

SATURN - January 1 to January 3.

Dim or Invisible

MERCURY - At all other times than those given above.

VENUS - January 18 to January 28 and November 1 to November 11.

MARS - October 4 to October 24.

JUPITER - February 3 to February 23.

SATURN - June 20 to July 10.

MINUTES OF THE GENERAL MEETING
Saskatoon Centre, R.A.S.C.
Held in the Health Sciences Building
November 20, 1973, 8:00 p.m.

Present: Wendel Frenzel, Ron Waldron, Melodie Andrews, Gordon Patterson, Halyna Kornuta, Dr. Phenneger, Alan Blackwell, Hugh Hunter, Dr. Holden.

1. The meeting was opened by President Wendel Frenzel at 8:00 p.m.
2. Members are reminded to pay their membership dues as soon as possible.
3. Presentations to be made at the Saskatoon Public Library by this Centre's members are to be the following:
   Dec. 9--"The Comet Kohoutek"--Gordon Patterson
   Dec. 16--"The Christmas Star"--Ron Waldron
4. Alan Blackwell introduced our guest speaker Dr. Ian Halliday who presented a lecture on Comets.
5. The meeting was adjourned.

MINUTES OF THE EXECUTIVE MEETING
Saskatoon Centre, R.A.S.C.
Held in the Observatory, 7:30 p.m., December 3, 1973

Present: Wendel Frenzel, Ron Waldron, Hugh Hunter, Halyna Kornuta, Melodie Andrews, Dr. Phenneger, Gordon Patterson.

1. The meeting was opened by the President Wendel Frenzel at 7:30 p.m.
2. Ron Waldron discussed some of the publicity he prepared for the lectures at the Library.
3. A restricted telephone is being installed at the Observatory. The number is to be 343-2083.
4. A form letter about Comet Kohoutek is being prepared by Gordon Patterson and will contain answers to inquires made by the Public.
5. The Editor discussed changes to take place within future Newsletters.
6. The meeting was adjourned. (G. Patterson, R. Waldron)

MINUTES OF THE GENERAL MEETING
Saskatoon Centre, R.A.S.C.
HELD IN THE PHYSICS BUILDING
December 18, 1972, 8:00 p.m.

Present:
Wendel Frenzel, President
Melodie Andrews, Secretary
Alan Blackwell, Treasurer
Hugh Hunter, Librarian
Gordon Patterson, Activities
Halyna Kornuta, Editor
Milton Phenneger, Programming

Absent:
Ron Waldron, Vice President

Members Present: Approximately 35

Item No.	Detail	Action
1.	Meeting called to order at 8:00 p.m.	
2.	Reading and approval of the October and November minutes G. Patterson, M. Phenneger. CARRIED	
3.	Old Business: a. Please pay membership dues as soon as possible. b. Gordon Patterson explained the possibility for the formation of a junior and senior Fundamental's of Astronomy Class. The present system is no longer adequate as the seniors who have passed the course are leaving the newer members behind.	G. Patterson
4.	New Business: a. Changes in the Newsletter: i. "Did you know..." column ii. "Questions", to be answered by Dr. Phenneger. iii. Report by members on Constellations, possibly beginning with the Zodiac. These reports should include an introduction, mythological background and diagrams. iv. Biography of astronomers. v. A new format for the minutes. Note: A reminder that articles should be given to the Editor before the second Tuesday of the month for inclusion in the Newsletter.	H. Kornuta
5.	Motion of adjournment. CARRIED	Hugh Hunter Jim Young

Minutes prepared by
Melodie Andrews
Secretary

Approved by
Wendel Frenzel
President