ASTRONOMY AND THE PUBLIC

"The Stars Belong to Everyone"

Address to the Canadian Club of Toronto, February 14, 1977

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I am glad to know that members of this Club have some interest in things astronomical. And this is using the term astronomical in the true sense of the word. It seems to me that in recent years it has been getting an unhappy connotation. So often it is used to describe deficits, for example. And the CN is urging us to use their gadgets to avoid running up astronomical bills. And if we have new housing in downtown Toronto high-rises, we are told to expect astronomical rents.

Astronomy may well be the oldest of the sciences, though the story is told of three men chatting in their club. The first, a geologist, said that geology was the oldest science because it traces the evolution of the earth over billions of years. The second, an astronomer, brightened and said that astronomy was certainly older because it traces the very origin of the earth from chaos. The third laughed and remarked that, in that case, politics must be the oldest pursuit of man, because if there was any chaos around, the politicians created it.

Often I read or hear in the news media of the important political talks you hear at this Club, with statesmen from Ottawa or Queen's Park or elsewhere making significant pronouncements that the press is eager to pick up. As you saw from your program notice, my talk today is a miscellany of current astronomy. It has no earth-shaking opinions. However, I would like to make a comment on the perspective of things. Suppose a thousand

years from now an historian is writing the history of the world in the 20th century. What will stand out as the most important development of the 20th century? I hope it will not be the fact that the atomic bomb destroyed much of mankind, and I do not think it will. Rather I think the historian will seize the fact that after three million years of a man-like creature on this earth, it was in the 20th century that he became no longer earth-bound, - that for the first time he was able to escape the earth's gravitational field and travel to bodies beyond our own. This divides the stay of man on this earth into two parts - before and after he had this ability to leave the earth. The problems which press on us so hard today, separatism, inflation, unemployment may seem minor to our historian of 2977 A.D., but the fact that man developed the power to leave the earth will not seem minor.

And it is the development of astronomy itself which is basically responsible for this feat. The actual space exploits are due to thousands upon thousands of workers in all fields of technology and science. But it was the basic astronomical knowledge of the distances and conditions of the nearer celestial bodies, - knowledge not available as recently as four centuries ago - that made it all possible.

The space era has kindled a great deal of interest in astronomy. I'm sure most of you have seen the pictures from the Viking landers in recent months, either on TV or in newspapers and magazines. After centuries of trying to figure out from telescopes on this earth what the surface of Mars is like we now know. Astonishing evidence for flooding of water in

the past - that is the best explanation for some of the features observed: incredible closeups of a multitude of reddish rocks. We could even see the foot pads and scoops of the spacecraft in action. As the Kansas City Star remarked, "When Viking 1 landed on Mars it took a picture of its own foot. That's the way many of our vacation snapshots turn out." The Vikings are unique in being the first equipment designed to test for life on the surface of another planet. So far the tests are inconclusive - they have neither proved the existence of life on Mars nor ruled it out. More time is needed, and the Viking may last as long as the summer of 1978. The latest word is that when the recorders were turned down and idled for the conjunction of Mars with the sun, a WHAM appeared on November 6, - perhaps a Mars quake.

Personally I think that by the end of this century we will know for sure whether or not there is life on other bodies in our solar system. But it could take centuries or thousands of years for us to determine if there is life beyond our solar system. To determine that we would need to locate another technological civilization capable of communication.

A rather subtle spinoff from the space age, I think, is that many more people are beginning to feel they can understand some astronomy. For decades people have said to me, "I think astronomy is wonderful, but I haven't any training in it and I can't hope to understand it." That is really nonsense, any intelligent people can have some understanding of those pictures of the moon and Mars - which are certainly astronomy. And certainly today no one on earth understands it ALL.

Along with this upsurge in astronomy at least partly engendered

by the space age have come two handicaps for it. The first, of which you have read in the press I am sure, is light pollution. The growth of illumination around the big cities of the world, especially North America, has serious effects. First, it makes it difficult or impossible for astronomers to carry on their research programs with telescopes established many years ago. The David Dunlap Observatory at Richmond Hill, Ontario, given to the University of Toronto in 1935 by the late Mrs. David A. Dunlap as a memorial to her husband, has these problems. The surrounding municipalities have tried to cooperate with light shielding but there is naturally a limit beyond which they cannot go. However, there is no plan to move the 74-inch telescope to another location. A great deal of research can still be done with it where it is - research particularly which uses the instrument known as a spectrograph. Some research programs which are particularly light-sensitive, such as my own on the stars which vary in light in the great systems known as globular star clusters, have been very successfully moved to the University of Toronto 24-inch telescope in Chile, where my colleague Dr. Christine Clement has taken several thousand photographs already. This telescope is located at about 7000 feet on Cerro Las Campanas by the kind cooperation of the Carnegie Institution of Washington which has its southern observatory on that mountain, including the recently dedicated 100-inch Irenee du Pont telescope.

And in two more years the Canada-France-Hawaii telescope will be in operation. The telescope has a mirror 144 inches in diameter, located on Mauna Kea in Hawaii, at an altitude of about 14,000 feet. This will be

the finest optical telescope in which Canada has had some ownership. There is excellent Canadian participation in the construction of this instrument. The sophisticated mirror-support system is being fabricated by the firm of Dilworth, Secord, Meagher and Associates Ltd. in Toronto, while the great mirror itself is being ground in the optical shop of the Dominion Astrophysical Observatory in Victoria.

The growth of night sky brightness around the cities affects not merely the professional astronomers, but also all people who enjoy looking up at the stars. For example, much of the public disappointment at Comet Kohoutek in 1973 stems from the fact that many people were trying to look for it in the environs of large cities. At good observing locations, Comet Kohoutek was a fine spectacle and scientifically it proved a real bonanza. The same public disappointment could come with the return of Halley's Comet in 1985 and 1986. Currently predictions are that its brightness may be comparable with that of Comet Kohoutek and that the comet may not be the spectacular object whose tail swept the skies in earlier centuries. Perhaps the best time for northern hemisphere viewing will be in April, 1986. Perhaps the energy shortage will cut down on the growth of illumination over the next decades, - otherwise we may get a sort of perpetual twilight at night over the cities on this continent.

Besides the sun and moon, there is one lovely celestial object that the bright lights cannot fade. That is the brightest planet Venus, visible now and for the next few weeks as evening star, high in the west at sunset. It is the third brightest object in the sky, so you can hardly miss it.

In fact, even the brilliance of the sun does not fade it because Venus is visible to the naked eye in the daytime.

It intrigues and astonishes people to see a star in the daytime. Napoleon Bonaparte learned this when, after his successful Italian campaign he came out on the balcony of the Luxembourg Palace in Paris to receive the plaudits of the multitudes. To his chagrin, he found the multitudes were not looking at him on the balcony. Instead, they were craning their necks to see a star at high noon, - the planet Venus.

Besides light pollution astronomy is suffering from another pollution, and that is pollution from pseudo-science. Unlike light pollution this does not affect astronomical research. It does however distort public interest in basic astronomy. I am not speaking now of science fiction, to which I have no objection. Rather I am referring to the books and articles on various subjects which readers believe to be scientific, but whose facts are interwoven with unproven theories and guesses. Scientists are trying to inform the public of the fallacies inherent in some of these. For example, 192 well-known scientists, including 19 Nobel prize winners, in 1975 signed a manifesto against astrology, which was given wide publicity. Carl Sagan presented a refutation of Velikovsky's ideas to the American Association of the Advancement of Science in 1974. But scientists keep open minds. A well-informed committee has now been set up for the Scientific Investigation of Claims of the Paranormal, and this committee will publish a magazine, The Zetetic. It will deal impartially with strange reports, such as some of those for flying saucers.

Canada has had a strong public interest in astronomy for decades. The Royal Astronomical Society of Canada was established in 1890, and consists of nearly 3000 amateur and professional astronomers, with headquarters in Toronto.

I would like to mention some of the contributions of Canadian research astronomy. The efforts of Canadian astronomers are internationally recognized, as you realize if you look at the list of presidents of commissions of the International Astronomical Union which will be meeting in Montreal in August, 1979.

Researches are on the motions of stars in our galaxy or the determination of temperatures of stars and the chemical elements of which they are composed, and the study of the other galaxies, systems each with thousands of millions of stars at great distances of space. Of course some of the results are so specialized and technical that not even the cleverest science writer could thrill the public with them.

I will mention in detail only two of the many aspects of astronomical research in Canada. First is the search for impact craters caused by a meteorite hit eons ago, eroded with time, and called fossil meteorite craters. This began with the discovery of a crater in Ungava in northern Quebec by prospector Fred Chubb of Toronto and Dr. V.B. Meen of the Royal Ontario Museum in 1950. Their expedition to that remote territory was kept secret because to start with they conjectured that this vast round lake might be a so-called diamond pipe, that is, the source of diamonds found over the eastern part of this continent. Their expedition and subsequent ones

showed definitely that it was an impact crater, undoubtedly caused by an enormous rock from space, hitting with high velocity and scattering large blocks of bedrock around like toothpicks. After that discovery a systematic search of millions of air photographs was organized by the then Dominion Astronomer Dr. C.S. Beals, and the search by ground and air has been continued ever since. Canada's terrain is favorable to the long-term preservation of these craters, and its scientists are leading the world in locating them.

Drill cores, among other tests, prove the existence of a smashing collision. Now about 23 craters are confirmed as caused by impact even though the meteoritic material itself has long since been obliterated. The most famous of these is the Sudbury basin, with its great mineral deposits, where a meteorite hit 1800 million years ago. One which is of easy access, and virtually undisturbed, is the Holleford crater. The little hamlet of Holleford, 15 miles north of Kingston is nestled in the crater, with eroded, gently sloping crater walls around.

A second Canadian accomplishment is of a totally different type. It is in the realm of radio astronomy, in which Canada has been active right from the start. Enormous telescopes in Algonquin Park and at Penticton, B.C. gather long-wave radiation from the sun and stars, and from curious objects like quasars, working in wavelengths of centimeters or meters. When radio astronomy started its upsurge a quarter-century ago, one of its big difficulties was that even a large radio telescope could not pinpoint well the area of the sky from which the radiation was coming, - they could only

show it was coming from a given region about half again as large as the apparent diameter of the full moon. Then a new technique was developed. By joining up two large telescopes a few hundred feet apart, you could identify the source within perhaps a 3000th of the moon's diameter. In 1967 came a big breakthrough in which Canadians were first. By means of atomic clocks and tape recorders, using very sophisticated techniques, they linked the 150-foot telescope in Algonquin Park with the 84-foot telescope at the Dominion Radio Astrophysical Observatory in Penticton, B.C. This meant that the source in the sky could be pinpointed within about 1/70,000 of the moon's apparent diameter. Dr. J.L. Yen of the University of Toronto was a prominent member of the team that did this experiment, and which received the gold medal of the American Academy of Arts and Science for their work.

Now last November came another breakthrough, released to the press in late December. This involved a team of Canadian and U.S. scientists again with Dr. Yen. And the project was a daring one. They hooked up the 140-foot telescope of the National Radio Astronomy Observatory at Green Bank, W. Va. with the 150-foot in Algonquin Park via Canada's Communication Technology Satellite, launched late in 1975. This would pinpoint the source in the sky to within a two-millionth of the moon's apparent diameter and will provide valuable material on the structure of those elusive objects, quasars. This scientific achievement has not yet received the publicity it should have. This link with the two telescopes by satellite gives the equivalent for precise detail of a single telescope more than 500 miles in diameter.

Since this is Valentine's Day, I was reminded of an astronomical

incident which has a decidedly sentimental flavor (technically not Valentine flavor since it occurred before St. Valentine). It pertains to Berenice, the wife of Ptolemy Euergetes of Egypt in the 3rd century B.C. When Ptolemy was called off to war, to show her devotion Berenice cut off her hair, and laid her tresses on the altar. Can you imagine the consternation in the court when it was discovered they were missing? Someone had stolen them. But the court soothsayer proved equal to the occasion. He pointed to a faint, misty patch in the night sky and said, "There - there is the hair of Berenice, immortal forever." And the constellation is named Coma Berenices, the hair of Berenice, the only constellation in the sky whose official name is that of an historic figure. The misty patch is a nearby cluster of faint stars. But in the same constellation 30 million light years farther off, 20th century photographic plates reveal a cluster of 10,000 faint galaxies, galaxies comparable with our own, our Milky Way system, each one with thousands of millions of stars. Now those are truly astronomical figures.