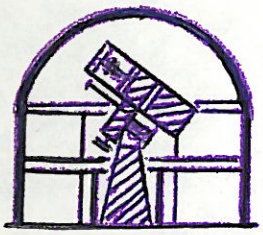

# the spectrum

NOVEMBER 1966 THE BUFFALO ASTRONOMICAL ASSOCIATION EDITOR B. COOK

## BAA MEETS NOV. 11TH

The November meeting of the Buffalo Astronomical Association will be held on Friday the 11th at 8:00 PM in the Science Museum. The speaker will be president Ron Clippinger, whose subject is "The Golden Age of Amateur Astronomy" - a look at amateur astronomy in the days when the world's largest telescopes were owned and used by amateurs. The talk will be illustrated.

After the meeting we will hope for fair skies so we can observe through the museum's 8" telescope. there will also be the usual social and refreshment period.

## MEMBERSHIP CARDS

Membership cards will not be sent out until January, when, in the interest of economy they will be mailed with the Spectrum to save mailing costs.

## OBSERVERS HANDBOOKS

The Observers Handbooks for 1967 have been ordered and will be sold at the December meeting on a first come first served basis for those who didn't reserve a copy.

## STUDY GROUPS

At the October meeting of the Advanced Study Section, an up to the minute, authoritative review of Quasars was given by Ron Clippinger. His talk also projected some interesting theories and ideas on the subject.

This month the Advanced Study Section will hear an informal lecture by Ron on "Star Populations in Galaxies" and "The Evolution of Galaxies", to be followed by a question and discussion period. The meeting will be held on Friday November 25th at 8:30 PM.

Otto Struve's "Elementary Astronomy" will be the basic text to be used in the study of the subjects under discussion this year. We might say in passing that the texte is "elementary only to an astronomer of the stature of Otto Struve.

The Instrument Section will also have its meeting on Friday November 25th. In order that members may attend both section meetings, the Instrument section will meet at 7:00 PM.

So far we have tested two lines of speculation and concluded that: 1. An intelligent race could reach us if it wanted to; 2. Once an intelligent race develops technology, it is not very likely to dispose of it and return to nature. But our original question remains unanswered. If intelligent races abound among the stars, why have they not visited us? Is man alone in his intelligence and technology?

The answer to that question was first proposed about a dozen years ago by a group of English astronomers and mathematicians, among them Thomas Gold, Fred Hoyle and Hermann Bondi. The stars of course are nuclear reactors, fusing hydrogen into helium, and in the process, converting four million tons of mass into energy every second. But, said Gold, Hoyle and Bondi, this is only the beginning of a star's career. At a certain piont in its lifetime (some five billion years from now, for the sun) a star reaches a critical stage. Its hydrogen fuel is becoming depleted. At the coreof the star is a large amount of helium "ash" from the hydrogen fires - under tremendous pressure and consequently, at very high temperatures, perhaps 100 million degrees Kelvin.

Under these conditions, helium will fuse to produce heavier elements: oxygen, carbon, neon. Eventually the star goes on to produce constantly heavier elements at constantly heavier temperatures. Finally the star runs out of energy sources, collapses and explodes. Most of its material - from hydrogen on up- is hurled out into space. This is a super nova.

The theory that results is that the older stars fused the heavier e elements within their cores and then spewed them out in supernova explosions. The remnants flung into space mix with the primeval hydrogen and provide new raw material for "second generation" stars. Now what has this to do with the possibilities of intelligent life in the galaxy? Simply this:

The oldest stars in the milky way were built on hydrogen alone. They could not have planetary systems like ours because the heavier elements were not available yet. There might be a few spheres of frozen hydrogen circling these stars at great distances, but they would be sterile worlds.

If astronomy has taught man anything it is the painful fact that we are not special creatures in any sense of the word. Our star is an average one, and the conditions that led to the formation of our planet and ourselves are probably not very extraordinary. Even granting that we might be among the elder citizens of the milky way, we must assume that among the galaxy's 100 billion stars there must be some that harbor much more intelligent species. Then the question returns: Where is everybody?

The settlement of the question comes in a formula as cosmologically important as Einstein's $E= Mc^2$, for itsshows that reason and the best of scientific thought leads to the inescapable conclusion that man is far, far from alone in what was once called "his" universe.

The Green Bank Formula: $N=R_* f_p n_e f_l f_i f_c L$

N is the estimated no. of communicative societies in the galaxy at any time.

$R_*$ is the rate of formation of stars like our sun.

$f_p$ is the fraction, or percentage of stars forming planets.

$n_e$ is the average no. of planets per system with environments suitable for the development of life.

$f_l$ is the fraction of suitable planets on which life develops.

$f_i$ is the fraction of life-bearing planets on which intelligence appears.

$f_c$ is the fraction of intelligent cultures which are communicative in an interstellar sense. Both complex social associations and elaborate technological capabilities are needed for a culture that wants - and is able to communicate with other star systems.

L is the lifetime a communicative culture would spend in a communicative state.

Here we are trying in effect to estimate doomsday. It was noted that "Fears that the value of L on earth may be quite short are not groundless". Some civilizations might destroy themselves in less that 1000 years; others

surmounting the crisis, may continue development almost indefinitely, perhaps for 1oo million years. So, these two values were considered for L.

Taking the lowest values in order we have:

N= 1x.4x1x1x1x.1x1ooo Or N=40

Taking the highest values in order we have:

N= 1x.5x5x1x1x.2x100,000,000 or N=50,000,000

What this means by the Green Bank formula, is that any one time in our Galaxy, there should be somewhere between 40 and 50 million civilizations either trying to get in touch with us or waiting for us to signal to them or both.

Imagine if you will, a race of intelligent creatures, human beings living in their own world. They have developed in isolation, and have split into many local cultures. Some have advanced into high civilizations. Others have remained in the stone age. But all of them are members of a fully human species and at least as intelligent as we are. Now what would happen if this vaslty superior race suddenly dropped out of the blue, straightened out our political squabbles, handed us a child's textbook of fusion reactors, and generally took over the running of our planet? Could our deep-grained pride stand such a shock, or would we go into what the sociologists call a racial decline?

Consider the question of studying the primate apes. A good deal can be learned by observing them in captivity. But the key to the entire scheme is that the animals under scrutiny must never know that they are being watched. Only by remaining invisible can the scientists learn how the apes behave naturally.

Now let us consider the reactions of an advanced race that discovers intelligent life on the planet earth. Any race capable of developing interstellar travel and communication should also be intelligent and ethical enough to observe a race like our own without interfering with us. They have far more to learn by keeping us under surveillance . They might have a "closed door" policy about contacting us, but an "open window" attitude about observing us.

They may be watching us right, using us to learn about this phenomenon we call intelligence.

R. Zygmunt
48 Colonial Ave.
Kenmore 17, N. Y.

TONAWANDA, N.Y. NOV 8 AM 1966 14150

PRAY


Mr. Bruce Cook
Mrs. Edward Cook
33 Burbank Drive
Snyder, N.Y.
14226