11-29-38

Dear Schuyler:

You are no doubt familiar with the concept of the milky-way as a great aggregation of stars some 30,000 parsecs in diameter and perhaps one tenth this distance in thickness. These stars are continually throwing off gas which expands and tends to fill up the space between the stars. To a rough approximation the galaxy is then filled with a cloud of very tenuous gas. The dimensions of this cloud are about the same as the galaxy, perhaps somewhat thinner. Call this cloud case I.

Recently some evidence has been put forward that the above cloud is not a simple homogeneous mass but actually made up of many small clouds a few hundred parsecs in diameter and spaced on the same order of distance. The density of these smaller clouds must be somewhat greater than case I because the total mass of the material possible is fixed within rather close limits. In any case the mass of even one of these clouds is much greater than an average star and the temperature as in case I is only a few degrees absolute. Call this case II.

Last year a peculiar object turned up as companion to Epsilon Aurigae. It had a mass of only a few times that of the sun but a diameter several thousand times as great. In other words it was an immense bubble of gas at a relatively low (1200° abs.) temperature for a star but far above cases I & II. The density also undoubtedly was somewhat greater. Call this case III.

For some time a type of supergiant stars have been known which have a diameter a few hundred times that of the sun. While the mass is considerably greater they seem to have a v ry hot and dense center with the main volume of the star being of low density. This is case IV. Antares is an example.

In all these cases we have to do with a very tenuous gas mostly at low temperature. If this gas is bombarded with photons (from star light in cases I & II, from Epsilon Aurigae in case III and from central core in case IV) the gas will be ionized, that is free electrons will be ejected from the atoms with high velocity (a few volts energy). We now have a cloud of high speed negative particles and remaining positive nuclei. These may encounter in a variety of fashions. The one of interest is known as a free-free transition; that is an electron approaches a positive particle from one direction and is acted upon to leave in another. In 1923 Kramer showed that there will be energy radiated during this transition at the expense of the velocity of the electron. This loss of energy is the crux of the whole argument. Since Kramers time this work has been revised by Gaunt and applied by Eddington and others to various problems. The fundamental features of this radiant energy are that it is a continuous spectrum and the intensity is an inverse function of frequency.

Quantitative calculations will show that the very simple case I can be made to account for the original data of Jansky. Case II will probably explain the large regions mentioned in previous letter and cases III & IV are possibilities for the point sources. My mention of the moon is very uncertain and does not fit the theory at all. When I get going again I intend to test out various objects such as sun, Nebulae in Andromeda and Orion, Epsilon Aurigae, etc. to better find out what is what. Unfortunately case II can't be checked very well as no data is available on any specific cloud, the condition merely believed to exist.

Yours truly,