star. The effect is due to the absorption of continuum radiation from the radio star by interstellar hydrogen which lies between the observer and the radio source.

If the radio star lies in the center of the antenna reception beam, the absorption is effective only over the small cone subtended by the radio star, whereas the emission contribution originates over the entire cone subtended by the antenna reception beam. With the 50 foot NRL antenna and radio stars such as Cassiopeia A and Taurus A, the cone subtended by the radio star is quite small compared to the reception cone of the antenna. This provides a unique increase in the effective angular resolution in the absorption observations.

By obtaining hydrogen line profiles for selected positions very close to the radio star, one can readily determine the "expected" 21 cm profile for the direction of the radio star. The expected profile is the profile that would have been obtained in the absence of the radio star, and is taken as the mean of the profiles obtained from the adjacent comparison positions. The comparison profiles show only minor differences and their mean is an acceptable measure of the "expected" profile. If we call this expected profile $\overline{\Delta T(\nu)}$, then it can be shown that the profile obtained when the radio star is in the antenna beam is given by:

$$\Delta T'(\nu) = \overline{\Delta T(\nu)} - T_A(1 - e^{-\tau_1(\nu)}) - [T_k(1 - e^{-\tau_2(\nu)})e^{-\tau_1(\nu)}(1 - e^{-\tau_s})] \frac{\Omega_S}{\Omega_B}$$

where T_A is the apparent antenna temperature of the radio star, $\tau_1(\nu)$ and $\tau_2(\nu)$ are $H\text{I}$ optical depths within the small cone subtended by the radio star, $\tau_1(\nu)$ the optical depth to the radio star and $\tau_2(\nu)$ the optical depth from the radio star to the most distant limit of $H\text{I}$. T_k is the temperature which defines the population distribution over the hydrogen hyperfine levels, τ_s is the continuum optical depth of the radio star, and Ω_S/Ω_B is the ratio of the solid angles subtended by the radio star and the antenna beam. For an antenna only 50 feet in diameter, Ω_S/Ω_B is of the order of 10^{-2} or less and the last term in the equation above may be safely neglected. This enables one to determine the approximate $H\text{I}$ optical depth from the observer to the radio star along the small cone subtended by the radio star:

$$\tau_1(\nu) \cong -\ln \left(1 - \frac{\overline{\Delta T(\nu)} - \Delta T'(\nu)}{T_A} \right).$$

The observations obtained for Cassiopeia A (Hagen, Lilley and McClain, 1954) show three sharp maxima in the $H\text{I}$ optical depth suggesting $H\text{I}$ cloud structure. One peak is near the local standard of rest in radial velocity, and two peaks occupy the radial velocity range of the second spiral arm near galactic longitude 80° . Van de Hulst, Muller and Oort (1954) place this second arm at a distance of approximately 3 kiloparsecs, which becomes the minimum distance to the Cassiopeia radio star. If a different model of galactic rotation were assumed, the computed distance to the second arm would be adjusted, but the minimum distance of the radio source remains that of the second arm, whatever its true distance.

It is interesting that for radio stars and interstellar hydrogen clouds, the effect is very similar to optical interstellar absorption lines in stellar spectra.

Hagen, Lilley and McClain 1954, Naval Research Laboratory Report No. 4448, Washington, D. C.

Van de Hulst, Muller and Oort 1954, *B. A. N.* 12, 117.

*Naval Research Laboratory,
Washington, D. C.*

Lippincott, Sarah Lee. Changes in chromospheric fine structure from films taken by Lyot at the Pic du Midi.

While a guest at the Meudon Observatory, France, the author was given access to the sequences of photographs of solar activity on the disc taken by Lyot at the Pic du Midi in 1942.

The purpose of the investigation was to explore the possibilities of obtaining a better insight into the small-scale changes of the chromospheric structure around a sunspot group which is characterized by fine dark line-structure, "fibriles," oriented in such a fashion as to suggest the presence of a magnetic field.

The observations showing a center of activity on the disc, which were used in this investigation, consist of 1/40 second exposures taken at 30-second intervals for several hours on August 25, 1942. These films were obtained by Lyot in $H\alpha$ radiation, using the Lyot filter mounted on the 38 cm refractor, which yields a solar diameter of 15 cm. Prints enlarged 4.75 times from 65 negatives, chosen for their quality, were used for measurements. The upper limit of accuracy for the position of small chromospheric patterns