A POSSIBLE "SUPER-SUPERNOVA" REMNANT IN NGC 6946

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A feature in the galaxy NGC 6946 resembles closely the "super-supernova" remnant identified in the Large Magellanic Cloud by Westerlund and Mathewson (1966).

Westerlund and Mathewson (1966) have presented rather convincing evidence that Constellation III of the Large Magellanic Cloud (Nail and Shapley 1953) is the result of a large-scale ("super-supernova") explosion possibly of the type hypothesized by Shklovskiĭ (1960). Hayward (1964) has noted several similar formations in photographs of galaxies printed in the *Hubble Atlas*. This note describes a probable formation of this type in NGC 6946.

Plate I shows two photographs of a section of the galaxy NGC 6946. One of the photographs (V) was taken on Kodak 103a-D emulsion with a Schott GG 11 filter; the other represents an Hα composite, made by subtracting a negative of the V plate from a plate taken on 103a-E emulsion with a Schott RG 1 filter. On the composite, Hα emission objects show up as black regions. In the center is the feature that appears to be similar to the SSN loop of the LMC. The notable features of this object are: that stars are arranged in a bright circular loop, 17″ in diameter; that this loop shows evidence of being made up of two or perhaps three somewhat nonconcentric parts; that these loops are rich in extremely bright blue stars, readily resolved on blue plates with the 120-inch telescope; that the loops, bright in the continuum, are *not* rich in H II regions, as are other bright star clouds in the galaxy; that a small, bright H II region, No. 33 in a catalog of Hα regions in NGC 6946 (Hodge 1966), can be seen at the center of the loop; and that a larger, faint H II region (No. 34 in the catalog) lies just outside the stellar loop. All of these features find their counterparts in the Constellation III features, identified by Westerlund and Mathewson as an SSN loop in the LMC. Figure 1 graphically compares them.

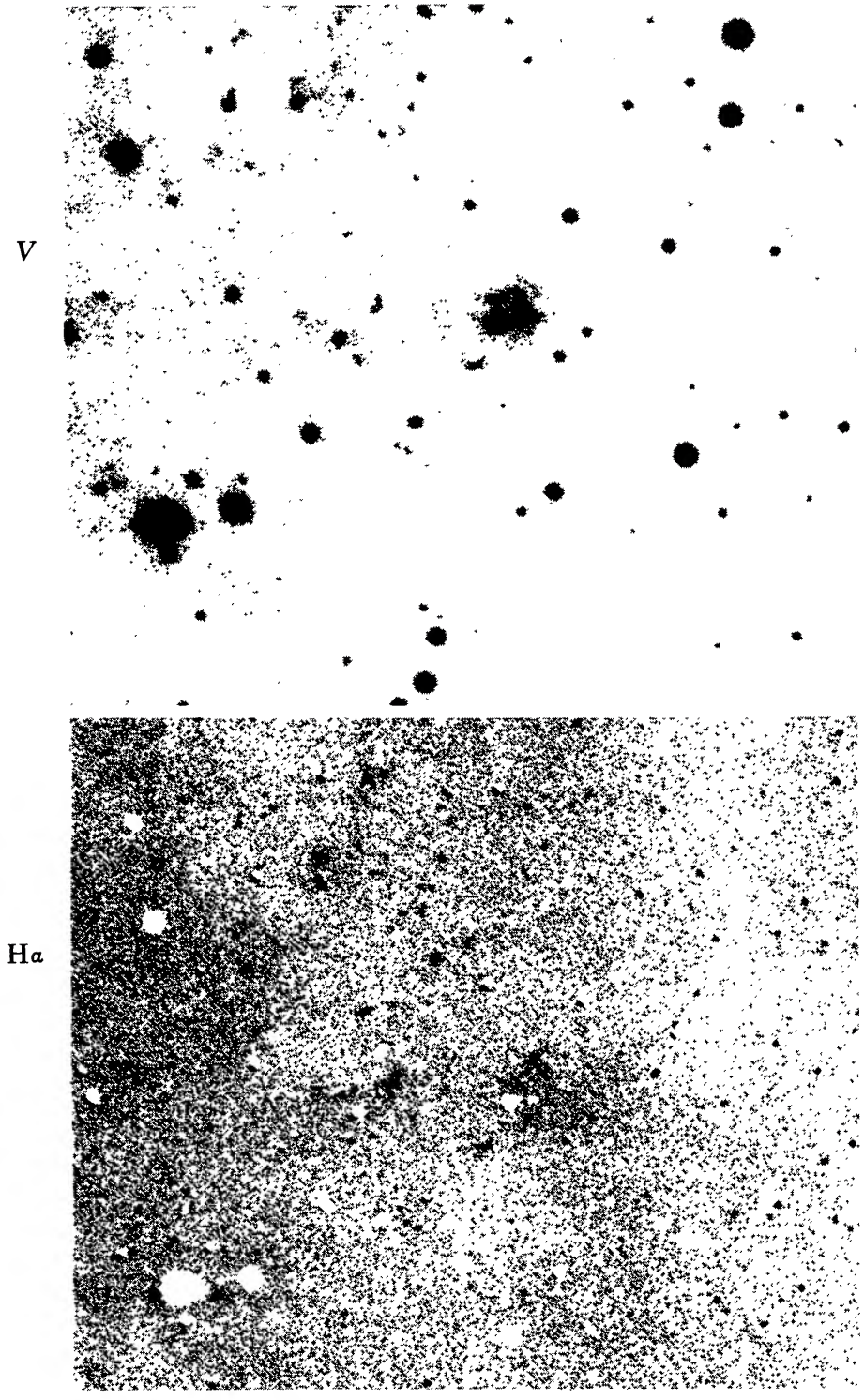

PLATE I

A comparison of photographs in the yellow (V) and in Hα of the bright loop in NGC 6946. The small black dot at its center in the Hα photograph is a bright H II region. Lick Observatory 120-inch telescope photographs. North is at the top and east to the left. Scale: 4″.7/mm.

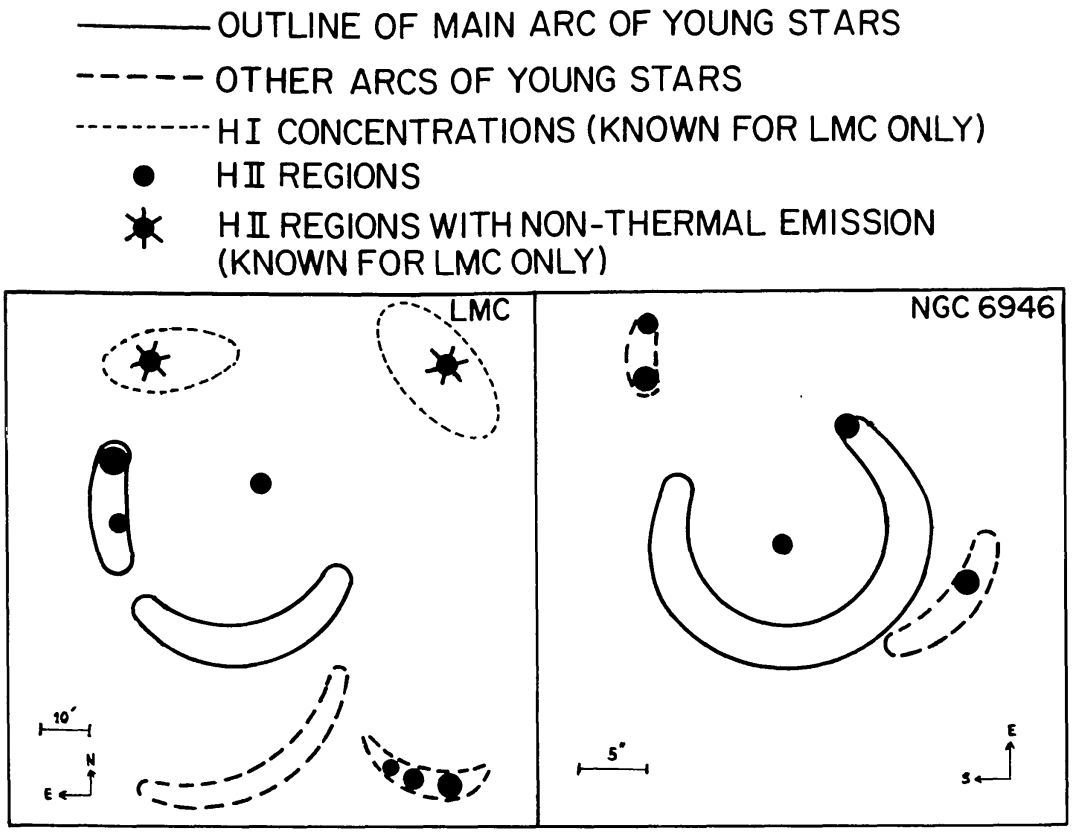

FIG. 1 — Schematic comparison of the LMC's Constellation III and the probable SSN remnant in NGC 6946.

The distance to NGC 6946 has been a subject of some uncertainty because of its low galactic latitude. Hubble (1936) suggested that it is possibly a member of the Local Group. However, on the basis of his luminosity calibration, van den Bergh (1960) believes it to be more distant. The most recent measurement is that of Hodge (1966), based on diameters of H II regions, with the derived distance being 4.1 Mpc. At this distance, the diameter of the probable SSN loop is 340 parsecs, making it somewhat smaller than the LMC feature, but well within the range of sizes for rings found by Hayward (1964).

Three normal supernovae have been observed in NGC 6946 since 1917 (Zwicky 1958), an unusually large rate for a galaxy. Continuum radio radiation from NGC 6946 is rather strong (Howard and Maran 1965), and it is rich in H I (Epstein 1964). It will be of interest to observe both continuum and 21 cm radio radiation

from NGC 6946 with high source resolution, as has been done for the similar LMC feature.

In the meantime, from the similarities already obvious between the objects in NGC 6946 and the LMC, it can be concluded tentatively that remnants of these super large-scale explosions are characterized *at least* by the following properties:

1. sizes of the order of hundreds of parsecs,
2. the presence of bright arcs of blue stars, *without extensive coincident* H II *regions,*
3. the presence of two or more of such rings, not exactly concentric to one another,
4. the presence of a relatively small, bright H II region at the center.

Probably, also, though this is not yet known for NGC 6946, a characteristic property is the presence of one or more nonthermal radio sources on the less populated parts of the ring.

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