

different from the value for the blue-green system ($^1\Sigma - ^1\Pi$), which has approximately the same intensity. The life-time of this system was measured by Hupfeld¹ and found to be 1.0×10^{-8} sec., which is of the same order as the theoretical result. Further results based on the hydrogen-ion and the hydrogen-molecule approximations will be reported in greater detail at a later date.

G. STEPHENSON

Department of Astrophysics,
Imperial College of Science and Technology,
London, S.W.7.

March 9.

Hupfeld, H. H., *Z. Phys.*, 54, 484 (1929).

Relative Diameters of Galaxies

In their communication on galactic noise and the rotation of the galaxy¹, Bolton and Westfold remark, on the basis of some early measures from the Mt. Wilson Observatory², that "the size of the external galaxies increases steadily with increasing spiral structure", and this result is used to support the surmise that our own large galaxy presumably has spiral structure. There are other strong evidences of the spiral structure of our galactic system, and therefore the revision of the results underlying the statement quoted above is of no consequence to the subject-matter of the communication by Bolton and Westfold.

The general inspection, and later the visual measurement of the ordinary photographs of external galaxies, indicated to both the Harvard and Mt. Wilson observers many years ago that the spheroidal and elliptical systems were distinctly smaller than the spirals. The later Harvard work with appropriately exposed small-scale plates showed, however, that there is no essential difference in the over-all size of spheroidal and spiral galaxies³. Afterwards, the microdensitometer was used to measure the photographic images, the equality of dimensions was confirmed, and both the spheroidal and the spiral systems were found to be much larger than previously supposed⁴. For example, the Mt. Wilson estimates gave the mean linear diameter of the spheroidal systems *E0*, *E1*, . . . *E7* as 0.36, 0.43, . . . 1.13 kiloparsecs, whereas comparable Harvard measures on small-scale plates gave the mean values of *E0-E7* as 3.7 kps.

When the Harvard plates of the Virgo Cloud of galaxies were measured with the microdensitometer, the following results were obtained, with the diameters in kiloparsecs.

| Class | Median | Mean | Number |
|-------------------|--------|---------------|--------|
| <i>E0-E7</i> | 4.6 | 4.9 ± 0.4 | 13 |
| <i>S0, Sa, Sb</i> | 4.2 | 4.4 ± 0.2 | 30 |
| <i>Sc</i> | 4.3 | 4.7 ± 0.3 | 69 |

Another determination with allowance for the possible selection on the basis of apparent magnitude gave 4.05 and 4.57 kiloparsecs for the mean diameters for spheroidal and spirals, respectively.

The spiral structure ordinarily photographed in external galaxies is rarely detected at more than half a radius from the nucleus. The arms are, in a sense, superficial, involving in most instances less than a quarter of the mass and light of the galaxy, and

in my view they indicate an early stage in the development of a galactic system^{4,5}.

HARLOW SHAPLEY

Harvard College Observatory,
Cambridge 38, Massachusetts,
May 3.

- ¹ Bolton, J. G., and Westfold, K. C., *Nature*, 165, 487 (1950).
² Hubble, E. P., *Mt. Wilson Contr.*, 324, 42 (1926). See also "The Realm of the Nebula", 178 (Yale Univ. Press, 1936).
³ Shapley, H., *Mon. Not. Roy. Astro. Soc.*, 94, 807 (1934).
⁴ Shapley, H., *Proc. U.S. Nat. Acad. Sci.*, 28, 186 (1942), and *Harv. Rep.*, No. 238 (1942).
⁵ Shapley, H., "Galaxies", 170, 171, 214-219 (Blakiston, 1943).

New General Methods for the Synthesis of Fluoroiodides and Fluoroacids

THE unusual properties associated with the fluorocarbons are now well defined, and current interest lies in the synthesis of compounds which contain fluorocarbon groups such as perfluoroalkyl groups. For such syntheses, compounds of the type *RX* are required, where *R* is a fluoroalkyl group (CF_3 , CF_2Cl , C_2F_5 , etc.) and *X* is a reactive group. The fluoroacids (*X* = COOH) are examples of such compounds, but lead in general to compounds of the general formula RCH_2Y , in which a $-\text{CH}_2-$ group has been introduced. The fluoroiodides, *RI*, have received attention recently, and it is now known that they readily yield perfluoroalkyl radicals which can be used for synthetic work. In particular, it has been reported that trifluoroiodomethane will bring about an addition polymerization with ethylene¹ and with acetylene² to give compounds of the type $\text{CF}_3[\text{CH}_2\text{CH}_2]_n\text{I}$ and $\text{CF}_3[\text{CH}=\text{CH}]_n\text{I}$.

The method used for the synthesis of trifluoroiodomethane until recently was the fluorination of carbon tetraiodide with iodine pentafluoride³. A method has now been evolved for the synthesis of this fluoroiodide in good yield from the commercially available trifluoroacetic acid. When salts of this acid—lead, silver and even sodium or potassium—are thoroughly mixed with iodine and heated, simultaneous decarboxylation and iodination occur, and the gaseous products are carbon dioxide and trifluoroiodomethane. The fluoroiodide, easily purified by fractionation, can thus be prepared without recourse to elementary fluorine. This reaction is general for the synthesis of fluoroiodides. Dicarboxylic fluoroacids yield diiodides, and fluoroiodides such as CF_3CHI , CFCl_2I , CHF_2I , CF_2I_2 and $\text{I}(\text{CF}_2)_{2-4}\text{I}$ are now easily prepared. Fluoroiodides derived from other fluorohaloacids are being investigated. By treatment with iodine pentafluoride as described previously⁴, the compounds $\text{I}(\text{CF}_2)_{2-4}\text{I}$ can be converted into $\text{CF}_3(\text{CF}_2)_{1-3}\text{I}$.

Now, it has been shown that a fluoroiodide such as trifluoroiodomethane will undergo an addition-polymerization with tetrafluoroethylene to give a polymer $\text{CF}_3[\text{CF}_2\text{CF}_2]_n\text{I}$, from which the compounds with $n = 1-10$ may be isolated¹. From the fluoroiodides, *RI*, mentioned above, it will be possible to synthesize the compounds $\text{R}[\text{CF}_2\text{CF}_2]_n\text{I}$, where $n = 1-10$. The fluoroiodides can be converted into the corresponding carboxylic acids by the general procedure of reaction with acetylene and isolation of the first member of the series (which constitutes c. 80 per cent of the product), followed by permanganate oxidation; the double bond on a carbon atom adjacent to a fluoro group is susceptible to oxidation, and $\text{CF}_3\text{CH}=\text{CHI}$, for example, readily yields trifluoroacetic acid.