

LETTERS TO THE EDITOR

SATURATION DEPTH FOR THE MULTIPLE SCATTERING OF 662 KeV PHOTONS IN ALUMINUM AND COPPER

L. PARAMESH, P. VENKATARAMAIAH, K. GOPALA AND H. SANJEEVIAH
Department of Physics, University of Mysore,
Mysore 570006, India

COMPTON scattering of photons is used to measure the electron momentum distribution. A correct measurement of Compton profile requires that the photons scattered in any sample should have undergone only one inelastic collision. But in an actual experiment, since the scatterer has finite dimensions both in depth and lateral extension, the scattered beam contains invariably photons scattered more than once. These are called multiple scatter photons which can make a significant difference to the shape of the measured Compton profile. In addition multiple scattering acts as noise when one is interested in Compton cross-section measurement. Further multiple scattering is a process in which the incident photons are softened. Therefore an accurate measurement of the spectral distribution of these photons accompanying singly-scattered ones is essential for the correct evaluation of Compton profile, Compton cross-section and the role of the material as an effective radiation shield.

There are several experimental procedures¹⁻⁵ by which the contribution of multiple scattering is estimated. Simple procedures² in which the measured Compton profiles from different sample thickness are extrapolated to zero thickness are also followed. Monte-Carlo calculations^{1,6} show that simple extrapolation procedures are both time-consuming and inaccurate. Weyrich⁷ has obtained an empirical relation that possesses linear behaviour at small thickness and levels off when the sample thickness becomes greater than the penetration depth. Several analytical expressions⁸ are also available to give the amount of double scattering where the first scattering process is isotropic. It is both useful and interesting to determine experimentally the amount of multiple scattering and look for its systematics with the thickness of material sample. The present experiments were carried out to estimate the contribution of multiple scattering in the backscattering of 662 keV gamma rays from Al and Cu.

The source and detector collimators were mounted on a precision goniometer. The gamma ray source, ¹³⁷Cs, of strength 1 mCi was obtained in Planchet form from Bhabha Atomic Research Centre, Bombay. In the experimental arrangement the shielding was such that the source-dependent background was not much

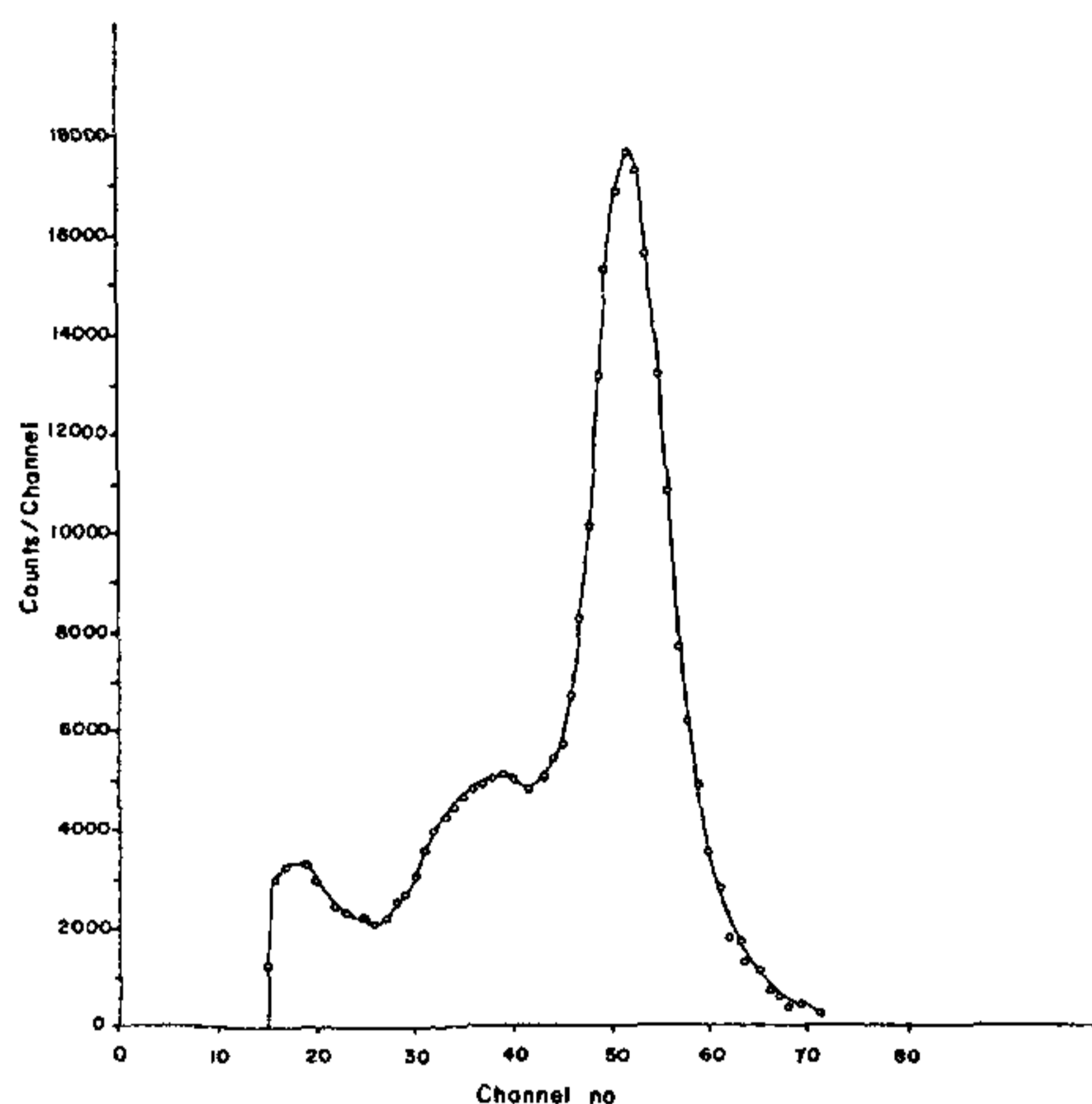


Figure 1. Background corrected spectrum of photons scattered at 120° by Al of 4.97 cm thick.

higher than the general laboratory background. The thickness of the scatterer was varied, in each case, up to 3 mean free path in steps of 0.5 mfp. Figure 1 shows a typical background corrected spectrum of photons scattered at 120° by Al scatterer of thickness 4.97 cms. The prominent peak at the highest energy, corresponding to the single scatter photons, agrees

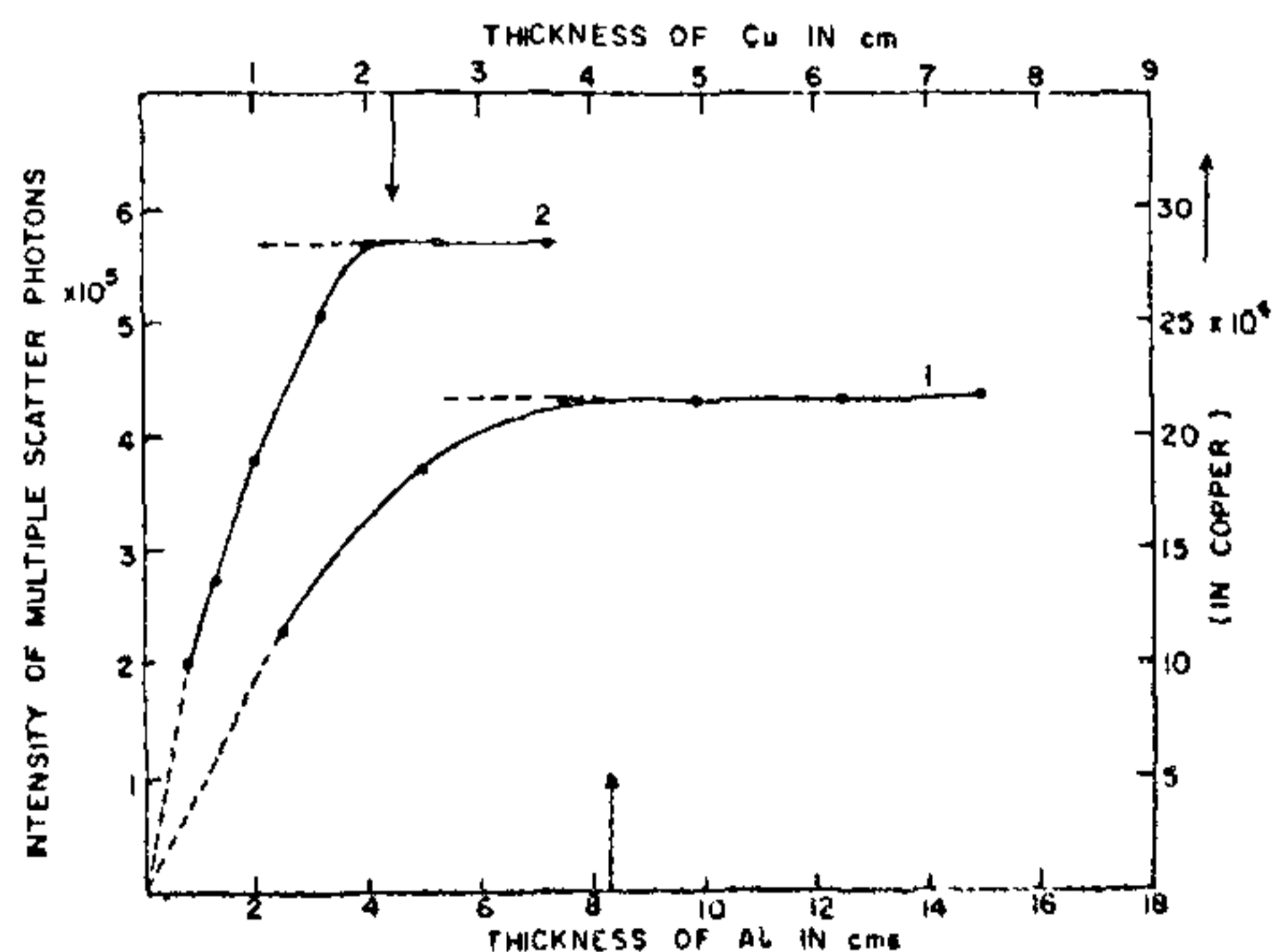


Figure 2. Intensity of multiple scatter photons as a function of thickness (1) Al, (2) Cu. Arrows indicate the saturation depths.

with the calculation. Since the K-X ray escape fraction is negligibly small the intensity of the single scatter photons was found by numerically integrating the Gaussian fitted to the above peak and dividing it by the appropriate peak-to-total ratio. The remaining portion in the low energy region is treated as that due to multiple scatter events. The intensity of multiple scatter photons as a function of scatterer thickness in Al and Cu is shown in figure 2. The results show that multiple scatter events in the backward direction increase with the sample thickness and saturate after a particular depth is reached, depending on the material. This is generally in agreement with the analytical results⁹. The saturation depths correspond to 8.3 cm in Al and 2.2 in Cu. Table I gives the saturation depth, μ_d , the optical thickness and λ , the sample thickness⁵.

TABLE I
Saturation depths at 662 KeV

Material	Saturation depth in cm	λ in cm	μ_d
Al	8.3	4.035	1.669
Cu	2.2	1.172	1.426

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- Williams, B. G. and Halonen, V., *Phys. Fenn.*, 1975, 10, 5.
- Reed, W. A. and Eisenberg, P., *Phys. Rev.*, 1972, 36, 4596.
- Hulubei, H., *C. R. Acad. Sci.*, 1932, 195, 1249.
- Phillips, W. C. and Chin, A. K., *Philos. Mag.*, 1973, 27, 87.
- Williams, B. (ed.) *Compton Scattering*, MacGraw Hill Book Co., New York, p. 79, 1977.
- Felsteiner, J., Pattison, P. and Cooper, M., *Philos. Mag.*, 1974, 30, 537.
- Weyrich, W. Ber Bunsenges, *J. Phys. Chem.*, 1975, 79, 11.
- Paatero, P. and Halonen, V., *Nucl. Inst. Methods.*, 1976, 135, 537.
- Tanner, A. C. and Epstein I. R., *Phys. Rev.*, 1976, A13, 335.

FLUORINE CONTAINING BIO-ACTIVE HETEROCYCLES: SYNTHESIS AND BIOLOGICAL ACTIVITY OF SOME FLUORINE CONTAINING TRIAZINO [5,6-b] INDOLES

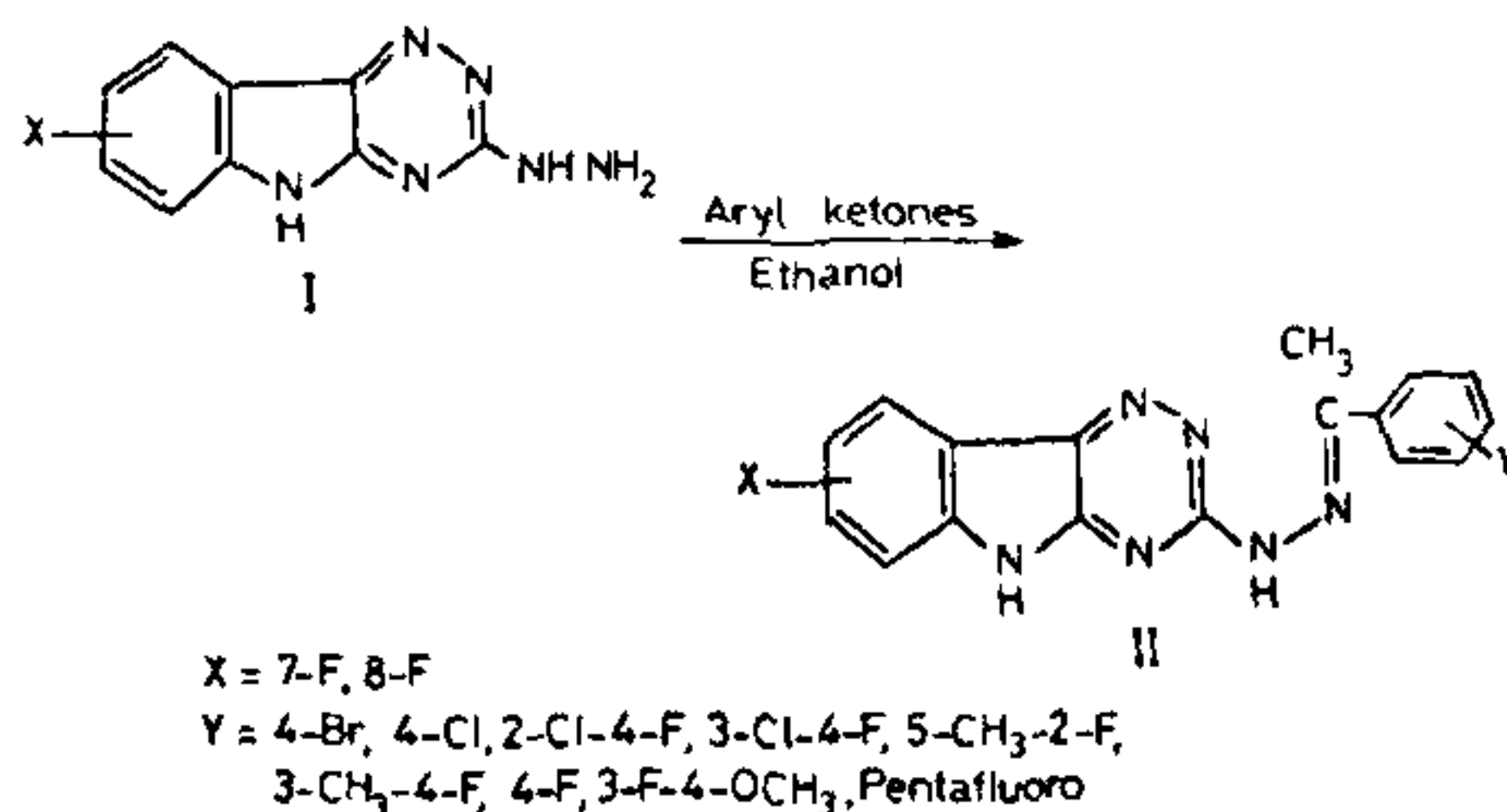
K. C. JOSHI, S. K. JAIN AND A. K. JAIN*

Department of Chemistry, University of Rajasthan
Jaipur 302 004, India

*Department of Botany

CONDENSED derivatives of indole-2, 3-dione have been found to possess antibacterial, antifungal, antiviral and carcinogenic activity¹. 5-Bromoisatin has shown analgesic activity stronger than that of aspirin². 3-Substituted triazino [5, 6-b] indoles have exhibited antiviral activity against rhinovirus respiratory infection in Chimpanzees³. The hydrazino derivatives of these indole derivatives have been found to possess antiviral, anticonvulsant activity⁴.

Keeping the above observations in view, a large number of fluorine containing triazino [5,6-b] indole derivatives are reported along with their spectral studies viz. IR, PMR, ¹⁹FNMR and antibacterial activities [Scheme-I.]



Scheme I

7-/8-Fluoro-3-hydrazino-1,2,4-triazino [5, 6-b] indoles [I₁].

An appropriate fluorine containing indole-2,3-dione (0.051 M), thiosemicarbazide (0.055 M) and potassium carbonate (0.075 M) in water (200 ml) were refluxed to yield 1,2,4-triazino [5,6-b] indole-3-thiones⁵, which were recrystallized from a suitable solvent. Subsequently, the 1,2,4-triazinoindole-3-thione (0.02 mole) and hydrazine hydrate (20 ml) were refluxed for 4-5 hr. The reaction mixture was filtered and the product washed with water to give corresponding 3-hydrazino-1,2,4-triazino [5,6-b] indoles, which were purified by recrystallization from DMF. The products are homogeneous to TLC.

7-Fluoro-3-hydrazino-1,2,4-triazino [5,6-b] indole, yield 85%, m.p. 282-3. (Found N 38.10 C₉H₇FN₆