4c: Schmp. 83–88°. – MS (70 eV): m/e = 285 (75 % M^+). – ^{1}H-NMR ($CDCl_3$): δ (ppm) = 7,15 (t, J = 8 Hz, aromat. H, 1 H), 6,8 (d, J = 8 Hz, aromat. H, 1 H), 6,68 (d, J = 8 Hz, aromat. H, 1 H), 3,80 (s, $-OCH_3$), 3,2 (d, J = 7 Hz, alicycl. H, 1 H), 2,5–3,1 (m, 4 H), 2,4 (s, $N-CH_3$), 0,75–2,31 (m, 13 H). – ^{13}C-NMR ($CDCl_3$): δ (ppm) = 159,25 (s, C-10), 140,18 (s, C-6a), 129,47 (s, C-10a), 126,71 (d, C-8), 122,15 (d, C-7), 108,46 (d, C-9), 76,09 (d, C-4a), 58,39 (t, C-3), 55,22 (q, $-OCH_3$), 44,18 (q, $N-CH_3$), 42,04 (s, C-10b), 37,51 (t, CH_2), 37,38 (t, CH_2), 31,59 (d, C-5), 30,81, 29,71, 23,44, 22,78 und 20,05 (jeweils t, 5 CH_2). – Methoiodid: Schmp. 276–278° (Zers.; Ethanol). – $C_{20}H_{30}INO$ (427,4) Ber.: C 56,2 H 7,07 N 3,3; Gef.: C 55,3 H 7,07 N 3,3.

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Potential Biologically Active Agents, XXVIII[1)]

Synthesis of Substituted Indophenazines

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5-Fluoroisatin was condensed with various *o*-phenylenediamines to yield substituted 9-fluoroindophenazines **1**. A similar reaction of 1-methyl-5-fluoroisatin with *o*-phenylenediamines furnished 6-methyl-9-fluoroindophenazines **2**. The Mannich reaction of **1** with secondary amines gave rise to substituted 6-aminomethyl-9-fluorindophenazines **3**. Compounds **1–3** have been tested for their insecticidal and antibacterial activity.

Potentiell biologisch aktive Substanzen, 28. Mitt.: Synthese von substituierten Indophenazinen

5-Fluorisatin wurde mit verschiedenen o-Phenylendiaminen zu substituierten 9-Fluorindophenazinen **1** kondensiert. Bei gleicher Behandlung erhält man mit 1-Methyl-5-fluorisatin die 6-Methyl-9-flu-

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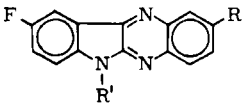
orindophenazine **2**. Eine Mannich Reaktion von **1** mit sekundären Aminen liefert die substituierten 6-Aminomethyl-9-fluorindophenazine **3**. **1–3** wurden auf insektizide und antibakterielle Aktivität getestet.

In continuation of our work on the synthesis of isatin derivatives[2] as potential biologically active agents, the synthesis of certain indophenazines bearing a fluorine atom is described in this report. The starting material 5-fluoroisatin, has been prepared via *Sandmeyer* reaction. Condensation of 5-fluoroisatin with *o*-phenylenediamines in equimolar proportions in AcOH gave rise to **1**. Treatment of 5-fluoroisatin with dimethylsulfate in ethanolic KOH yielded 1-methyl-5-fluoroisatin which, when condensed with *o*-phenylenediamines under identical conditions, furnished **2**. The reaction of **1** with secondary amines and formalin under *Mannich* conditions yielded **3**. All the synthesised compounds gave satisfactory elementary analyses and were further characterised by means if IR, NMR and mass spectral data.



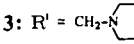
1: R' = H
2: R' = Me
3: R' =  X = CH_2, O

Table 1: *Substituted 9-fluoroindophenazines* **1** *and 6-Methyl-9-fluoroindophenazines* **2**

Compound	R	R'	Yield %	M.P. °C	Mol. formula	Insecticidal activity mean killing time in h at concentrations 0.5 %	0.1 %
1a	H	H	81	> 270	$C_{14}H_8N_3F$	18	23.5
1b	Cl	H	84	245–246	$C_{14}H_7ClN_3F$	20	23
1c	2,3-di-Me	H	79	> 270	$C_{16}H_{12}N_3F$	17.5	21
2a	H	Me	85	154–155	$C_{15}H_{10}N_3F$	16.5	20.5
2b	Cl	Me	82	153–154	$C_{15}H_9ClN_3F$	19	22
2c	2,3-di-Me	Me	86	170–171	$C_{17}H_{14}N_3F$	18.5	22
Parathion						4	6.5

1a, Lit.[5] m.p. 302. Ms (70 eV): **1b**, M^+ M/e 271/273; **2a**, M/e 236 (M- Me). IR (KBr): **2a**, 1590 cm^{-1} (C=N).

Table 2: *Substituted 6-Aminomethyl-9-fluoroindophenazines* **3**

Compound	R	R'	Yield %	M.P. °C	Mol. formula	Insecticidal activity mean killing time in h at concentrations 0.5 %	0.1 %
3a	H	PM	68	125–6	$C_{20}H_{19}N_4F$	17.5	21.5
3b	H	MM	65	138–9	$C_{19}H_{17}N_4FO$	18	23
3c	Cl	PM	71	140–1	$C_{20}H_{18}ClN_4F$	17	21
3d	Cl	MM	66	154–5	$C_{19}H_{16}ClN_4FO$	19	23.5
Parathion						4	6.5

PM Piperidinomethyl, MM Morpholinomethyl.
IR (KBr): **3c**, 1580 (C=N), 2900 cm^{-1} (CH_2); UV (Methanol): λ max 270, 348 (s), 357 nm. **3a**, H-1 NMR (CCl_4): δ (ppm) = 1.39 (CH_2 remote from N), 2.49–2.56 (CH_2 attached to N in the ring), 5.4 (N-CH_2-N), 6.9–7.96 (ArH).

Table 3: *Antibacterial Activity of Substituted Indophenazines*

Compound	B. subtilis	S. aureus
1a	+	–
1b	+	+
1c	–	–
2a	++	–
2b	+	+
2c	+++	++
3a	+	+
3b	+	–
3c	+	+
3d	–	–

– no inhibition, + zone size 6–8 mm, ++ zone size 8–10 mm, +++ zone size greater than 10 mm.

Experimental

Substituted 9-fluoroindophenazines **1** (Table 1)

A mixture of 3.3 g (0.02 mole) 5-fluoroisatin and 2.16 g (0.02 mole) *o*-phenylenediamine in 20 ml glacial acetic acid was refluxed for 5 h. The reaction mixture was then cooled to room temp. and the solid product that separated was washed with ethanol and recrystallised from acetic acid.

Insecticidal Activity (Table 1 and 2)

The topical method [4] of application by micrometer syringe was employed to test the toxicity of the compounds on adult male and female cockroaches. The compounds were dissolved in acetone and applied at dosages of 0.02 ml of 0.5 % and 0.1 % concentration. The compounds were injected in the 4th and 5th segment of the cockroaches on the ventral side and the treated insects were kept under observation for 48 hr. For each sample 10 replications were performed and the insecticidal activity was determined as an average value (parathion as standard). It was observed that after injection of the test

compound the posterior part of the insect became inactive, flickering of the antenna continued for 10 h and the moribund or knockdown state was reached between 16.5–23.5 h after the application of the substances under study.

Antibacterial Activity (Table 3)

The method of agar diffusion technique[3] was employed for determining the antibacterial spectrum of all the compounds. The test organisms were *Bacillus subtilis* and *Staphylococcus aureus*. Sterile filter paper discs (diameter 5 mm) saturated with the solution (lomg/ml) of the test compound in ethanol were placed on the nutrient agar plates (1.5 % w/v agar, 0.5 % w/v NaCl, 0.5 % w/v glucose and 2.5 % w/v peptone, pH 6.8–7) after elimination of the solvent. After an incubation period of 24 h at 37° the zones of inhibition around the discs were measured. Bacterial cultures were obtained from Public Analyst's Laboratory, U.P., Lucknow.

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Synthese von 9-Fluorenalkanaminen, 1. Mitt.

2-(9*H*-Fluoren-9-yl)-2-propanamin und seine kernsubstituierten Derivate

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Der Diphenylaminoalkohol **1** reagiert mit Phosphorsäure zum Fluoren **2**. Während **1b** nur zu **2b** cyclisiert, können sich 3,3-disubstituierte Derivate von **1** theoretisch zu **6**, **7** und **8** umsetzen, in der Praxis entstehen jedoch nur **6** und **7**, abhängig von der Art des Substituenten. **3** reagiert zum Fluoren **4** und unter Ringöffnung zu **5**.

Synthesis of 9-Fluorenealkanamines, I:
2-(9*H*-Fluoren-9-yl)-2-propanamine and Its Aryl Substituted Derivatives

The diphenylamino alcohol **1** reacts with phosphoric acid to yield the fluorene **2**. Whereas **1b** cyclises to yield **2b** only, 3,3-disubstituted derivatives of **1** should be capable of producing **6**, **7** and **8**. In fact, however, only **6** or **7** are formed depending on the nature of the substituents. Compound **3** reacts to yield the fluorene **4**. Ring opening leads to **5**.

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