Acknowledgments. The authors wish to thank Dr. R. C. Shah for his very helpful advice during the course of this work.

National Chemical Laboratory of India
Poona, India

Some Aromatic and Heterocyclic Derivatives of Carbazole[1]

Henry Gilman and Julian B. Honeycutt, Jr.

Received August 20, 1956

The simplest N-arylcarbazole, 9-phenylcarbazole, was first mentioned in a German patent[2] as having been obtained in unspecified yield by heating potassium carbazole, bromobenzene, and copper powder in an autoclave at 180–200°. Dunlop and Tucker[3] obtained a 65% yield of the compound by heating carbazole, iodobenzene, potassium carbonate, and copper bronze at 190–200°. The same substances refluxed in nitrobenzene resulted in an 88% yield of 9-phenylcarbazole.[4] Lister[5] states that in Hager's method bromobenzene could be substituted for iodobenzene, and that the nitrobenzene could be replaced by high-boiling petroleum ether. Although the yield drops to between 50 and 60%, the use of petroleum ether is said to facilitate separation of the product from unreacted carbazole as the latter is soluble only with difficulty in the petroleum ether. Other syntheses of 9-phenylcarbazole involve the thermal decarboxylation of 9-*o*-carboxyphenylcarbazole,[6] and the dehydration of 9-phenyltetrahydrocarbazole with chloranil.[7]

Although substituents, as nitro[3,8] and carboxyl,[6,9] have been introduced on the phenyl group, no other aromatic systems have been attached to the 9-position of carbazole. We now wish to report the preparation of 9-*p*-biphenylyl-, 9-2′-pyridyl-, and 9-2′-quinolylcarbazole, as well as 4,4′-*bis*-(9-carbazolyl)-biphenyl and *p*-*bis*-(9-carbazolyl)-benzene. So far attempts to prepare 9-(*p*-dimethylaminophenyl)-carbazole in various solvents, or without a solvent, have been unsuccessful.

Since 2- and 4-halopyridines and quinolines are more reactive than benzenoid halides, attempts were made to synthesize 9-2′-pyridyl- and 9-2′-quinolylcarbazole under less strenuous conditions. 9-Alkylcarbazoles can easily be prepared by refluxing alkyl iodides and carbazole in acetone solution in the presence of potassium hydroxide.[10] We found that neither 2-bromo- nor 2-chloropyridine yielded the desired product by this method. Higher reaction temperatures, obtained by using pyridine as a solvent, likewise failed to give N-substituted carbazoles either with or without added potassium hydroxide. A report by Banks[11] indicates that the amination of certain haloheterocycles may be acid-catalyzed.

The compounds described at this time were prepared incidental to a study concerned with organic liquid solution scintillators. Evaluation of the compounds for this purpose is being made by Dr. Wright H. Langham, F. N. Hayes, and D. G. Ott of the Los Alamos Laboratories who will report the results later.

EXPERIMENTAL[12]

9-p-Biphenylylcarbazole. In a 1-l., 3-necked flask equipped with a thermometer, mechanical stirrer, and a moisture trap with attached air condenser, a mixture of 16.7 g. (0.1 mole) of carbazole, 23.3 g. (0.1 mole) of *p*-bromobiphenyl, 13.8 g. (0.1 mole) of anhydrous potassium carbonate, 0.2 g. of copper bronze, and 250 ml. of petroleum ether (b.p. 190–210°) was stirred and refluxed for 12 hr. The solvent was removed by steam distillation and the residue extracted with two 100-ml. portions of hot benzene and two 50-ml. portions. The benzene was evaporated to yield a yellowish brown solid which was dissolved in 300 ml. of a 2:1 mixture of benzene-petroleum ether (b.p. 60–70°) then chromatographed on alumina using 1:1 benzene-petroleum ether (b.p. 60–70°) as eluant. The largest fraction (m.p. 81-165°) was extracted with ethanol to remove any *p*-bromobiphenyl and the residue recrystallized from a mixture of petroleum ether (b.p. 60–70°) and benzene to yield 3.1 g. (10%) of colorless 9-*p*-biphenylylcarbazole, melting at 224–226°. The infrared spectrum indicated both *o*- and *p*-disubstitution, and no N—H band.

Anal. Calcd. for $C_{24}H_{17}N$: N, 4.39. Found: N, 4.24, 4.23.

p-Bis-(9-carbazoyl)-benzene. Refluxing a mixture of 10 g. (0.0598 mole) of carbazole, 8.3 g. (0.025 mole) of *p*-diiodobenzene, 13.8 g. (0.1 mole) of anhydrous potassium carbonate, 1.0 g. of copper bronze, and 200 ml. of petroleum ether (b.p. 190–210°) for 24 hr., steam distilling the product, and extracting the residue with hot benzene gave a dark solution which was treated with Norit-A and cooled to give 4.0 g. (39%) of white product, m.p. 320–322°. Subsequent recrystallization did not raise the melting point. Evaporation of the mother liquor gave a dark solid which was washed with hot ethanol, and then recrystallized from benzene-petroleum ether (b.p. 60–70°) to yield an additional 1.5 g. (15%) of product, m.p. 319–321°.

Anal. Calcd. for $C_{30}H_{20}N_2$: C, 88.20; H, 4.94. Found: C, 88.51, 88.44; H, 4.74, 4.83.

4,4′-Bis-(9-carbazolyl)-biphenyl. In an apparatus similar to that described above, but without a moisture trap, a mixture of 18.4 g. (0.11 mole) of carbazole, 15.6 g. (0.05 mole) of 4,4′-dibromobiphenyl, 15.2 g. (0.11 mole) of potas-

---

(1) This work was supported by the United States Atomic Energy Commission under Contract No. AT(11-1)-59.

(2) Cassella and Co., Ger. Patent 224,951, Apr. 4, 1909, *Chem. Zentr.*, 81, II, 699 (1910).

(3) H. G. Dunlop and S. H. Tucker, *J. Chem. Soc.*, 1945 (1939).

(4) F. D. Hager, *Org. Syntheses*, **Coll. Vol. I**, 547 (1941).

(5) F. Lister, M.S. thesis, Iowa State College, 1942, p. 8.

(6) A. Eckert, F. Seidel, and G. Endler, *J. prakt. Chem.*, **104**, 85 (1922).

(7) Campbell and Barclay, *J. Chem. Soc.*, 530 (1945).

(8) M. C. Nelmes and S. H. Tucker, *J. Chem. Soc.*, 1523 (1933).

(9) H. Gilman, C. G. Stuckwisch, and A. R. Kendall, *J. Am. Chem. Soc.*, **63**, 1758 (1941).

(10) S. H. Tucker and T. S. Stevens, *J. Chem. Soc.*, **123**, 2140 (1923).

(11) C. K. Banks, *J. Am. Chem. Soc.*, **66**, 1127 (1944).

(12) All melting points are uncorrected.

sium carbonate, 1.0 g. of copper bronze, 2.7 g. (0.011 mole) of iodine, and 250 ml. of nitrobenzene was refluxed for 24 hr. The product was steam distilled and the residue extracted with hot benzene. The cooled extract deposited 5 g. of white solid which yielded, after repeated alternate recrystallizations from benzene or toluene and extractions with hot ethanol, 3.2 g. (13%) of transparent crystals, m.p. 282.5–284°. The infrared spectrum indicated both *ortho-* and *para-*disubstituted benzene rings.

Anal. Calcd. for $C_{36}H_{24}N_2$: C, 89.00; H, 5.10. Found: C, 89.13, 89.04; H, 5.18, 5.45.

9-2'-Pyridylcarbazole. A mixture of 8.35 g. (0.05 mole) of carbazole, 7.25 ml. (11.8 g., 0.075 mole) of 2-bromopyridine, 10.4 g. (0.075 mole) of potassium carbonate, 1.0 g. of copper bronze, 1.9 g. (0.0075 mole) of iodine, and 200 ml. of petroleum ether (b.p. 190–210°) was stirred and refluxed for 24 hr. The product was steam distilled and the residue extracted with hot benzene. The cooled extract was evaporated in an air stream to give a heterogeneous solid which was recrystallized twice from ethanol and three times from petroleum ether (b.p. 60–70°) to yield 1.5 g. (13%) of colorless crystals, m.p. 93–95°. The infrared spectrum has a C=N band and lacks a N—H band.

Anal. Calcd. for $C_{17}H_{12}N_2$: N, 11.47. Found: N, 11.36, 11.51.

9-2'-Quinolylcarbazole. Refluxing a mixture of 16.7 g. (0.1 mole) of carbazole, 24.5 g. (0.15 mole) of 2-chloroquinoline, 20.7 g. (0.15 mole) of potassium carbonate, 2.0 g. of copper bronze, and 3.8 g. (0.015 mole) of iodine for 48 hr. yielded a dark product which was extracted with hot benzene. Evaporation of the extract, dissolution of the residue in hot ethanol (Norit-A), filtration, and cooling gave a dark tar and a yellow solution. The solution was decanted into an equal volume of cold water. The resulting oil slowly crystallized. Successive recrystallizations from ethanol, petroleum ether (b.p. 77–115°) and petroleum ether (b.p. 60–70°) yielded 1.5 g. (10%) of colorless crystals, m.p. 93–94°. This compound, in contrast to the pyridyl analog, showed a very troublesome tendency to form an oil at every stage of purification. The infrared spectrum indicated the presence of a C=N bond and an absence of a N—H bond.

Anal. Calcd. for $C_{21}H_{14}N_2$: C, 85.56; H, 4.79. Found: C, 85.52, 85.38; H, 4.97, 5.07.

Acknowledgment. We are indebted to Mr. Robert McCord of the Ames Laboratory of the Atomic Energy Commission for the infrared spectra mentioned above.

CHEMICAL LABORATORY
IOWA STATE COLLEGE
AMES, IOWA

New Synthesis of Trichocereine

F. BENINGTON,[1] R. D. MORIN,[1] AND L. C. CLARK, JR.[2]

Received August 27, 1956

During the course of investigation of the alkaloids present in *Trichocereous terscheckii* (Parmentier), Reti[3] isolated a new phenethylamine base, trichocereine, which is peculiar to this species of cactus. The structure of trichocereine was shown by degradation to be N,N-dimethyl-3,4,5-trimethoxy-β-phenethylamine. Reti gives a cursory description of his synthesis of the base, in unstated yield, from the reaction of 3,4,5-trimethoxy-β-phenethyl chloride with dimethylamine; the phenethyl chloride was obtained by subjecting an aqueous solution of mescaline hydrochloride to the action of nitrous acid. Banholzer, Campbell, and Schmid[4] describe the synthesis of trichocereine (28% yield as the picrate) from 3,4,5-trimethoxybenzoyl chloride *via* the diazo ketone.

A more direct route has been found for the synthesis of trichocereine hydrochloride from 3,4,5-trimethoxyphenylacetic acid[5] in an over-all yield of 47%. The acid was converted to 3,4,5-trimethoxyphenylacetyl chloride by treatment with thionyl chloride in the presence of catalytic amounts of pyridine. Reaction of the resulting acid chloride with dimethylamine afforded N,N-dimethyl-3,4,5-trimethoxyphenylacetamide, which was subsequently reduced to trichocereine with lithium aluminum hydride.

EXPERIMENTAL

N,N-Dimethyl-3,4,5-trimethoxyphenylacetamide. A slurry of 3,4,5-trimethoxyphenylacetic acid (11.3 g.) in 50 ml. of dry ether was treated with 7.3 ml. of thionyl chloride and then 2 drops of dry pyridine were added to the mixture. After standing at room temperature overnight, the ethereal solution of the acid chloride was filtered free of suspended pyridine hydrochloride and the ether removed at diminished pressure. The residual acid chloride was purified by distillation; b.p. 150–152°/1.5 mm.; yield, 9.1 g. (74%).

A solution of 3,4,5-trimethoxyphenylacetyl chloride (9.1 g.) in 20 ml. of dry ether was first cooled and then slowly added to an ice-cold ethereal solution of 7 ml. of dimethylamine in 30 ml. of dry ether. After the vigorous reaction had subsided, the reaction mixture was filtered free of the precipitated dimethylamine hydrochloride and the clear filtrate evaporated to an oily residue at reduced pressure. Distillation of the residue *in vacuo* afforded 6.7 g. (72%) of N,N-dimethyl-3,4,5-trimethoxyphenylacetamide, b.p. 173–175°/0.4 mm. as a light yellow oil. The amide was crystallized by cooling an ether-petroleum ether solution in a dry-ice bath; colorless prisms, m.p. 49–50.5°. Literature,[4] m.p. 50–51°.

Trichocereine Hydrochloride. Reduction of 8.2 g. of N,N-dimethyl-3,4,5-trimethoxyphenylacetamide was carried out with 1.3 g. of lithium aluminum hydride in 100 ml. of dry ether. The resulting ethereal suspension of the intermediate complex was hydrolyzed by the careful addition of water, and the ether solution was decanted from the solid lithium *meta* aluminate. The ether solution of the reaction product was dried over anhydrous magnesium sulphate, filtered, and treated with a slight excess of an ice-cold solution of hydrogen chloride in dry ether. The crude trichocereine hydrochloride which precipitated was collected and washed with additional dry ether; yield 7.8 g. (88%); m.p. 199–201°. Recrystallization from ethanol containing a small amount of dry ether gave the pure base hydrochloride (6.4 g.) as colorless prisms; m.p. 207–208°. Literature,[3] m.p. 205°.

---

[1] Battelle Memorial Institute.

[2] Fels Research Institute.

[3] Reti and Castrillon, *J. Am. Chem. Soc.*, **73**, 1767 (1951).

[4] Banholzer, Campbell, and Schmid, *Helv. Chim. Acta*, **35**, 1577 (1952).

[5] This compound is available from the Aldrich Chemical Company, Milwaukee, Wis.