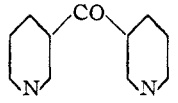
what modified process, whereby the vapors of nicotinic acid were passed through a heated column of thorium dioxide, gave a comparable yield of the ketone. This was identified by analysis of the dipicrate. The same result was obtained when aluminum oxide was used in place of thorium dioxide.



Experimental

β,β′-Dipyridyl Ketone.—A Pyrex tube, 25 inches long, closed at one end, was charged with 20 g. of nicotinic acid, followed by 100 g. of thorium dioxide. The outlet was connected with a descending condenser and the receiving flask was immersed in an ice-bath. Nicotinic acid was slowly distilled through the thorium oxide layer which was kept at 300° during the process. The distillate was collected, and pyridine and water were boiled off at atmospheric pressure, leaving a dark residue which was extracted with ether. After the ether was evaporated, this extract yielded 0.4 g. of a viscous oil. The dipicrate, formed in alcoholic solution and recrystallized from alcohol, was in dark green plates; m. p. 135°.

Anal. Calcd. for $C_{11}H_8N_2O \cdot 2C_6H_3N_3O_7$: C, 42.99; H, 2.17. Found: C, 43.00; H, 2.02.

RESEARCH LABORATORY
RALPH L. EVANS ASSOCIATES
250 EAST 43RD STREET
NEW YORK 17, N. Y.

RECEIVED JANUARY 31, 1946

The Relative Efficiency of Some Polymerization Inhibitors[1]

BY ROBERT L. FRANK AND CLARK E. ADAMS

Considerable losses often occur in the preparation of vinyl monomers due to their ease of polymerization, especially during distillation. The present comparison of inhibitors was undertaken to prevent such losses.

Equal weights (0.20 g.) of a number of compounds were added to 2.0-ml. samples of three monomers, styrene, 3,4-dichlorostyrene, and 5-ethyl-2-vinylpyridine, each freshly distilled. These monomers were chosen for their tendency toward ready polymerization. Each sample was sealed in a 10 × 110-mm. test-tube and allowed to stand in a refluxing water-bath. No effort was made to exclude oxygen from the tubes, but all were of the same size and had approximately the same air space above the monomer–inhibitor mixtures. The fluidity of the samples was periodically compared with the initial fluidity by means of the flow-times when the tubes were inverted. The heating time required to show a difference in flow-time is given in Table I as the "inhibition period." At the "total time of polymerization" the samples were too viscous to give a measurable flow time.

There appears to be no great variation in the order of inhibitory strength from one monomer to another. A good inhibitor for one monomer is likely to be good for another.

TABLE I

EFFECT OF INHIBITORS ON POLYMERIZATION

Inhibitor	Inhibition period, hr. S[a]	DCS[a]	VEP[a]	Total time of polymerization, hr. S[a]	DCS[a]	VEP[a]
Picric acid	299	39	<120	>490	130	>120
Trinitrobenzene	299	39		>490	82	
2,5-Dihydroxy-1,4 benzoquinone	154	32		442	82	
1,4-Naphthoquinone	81	22	120	251	66	>120
1,4-Benzoquinone	81	22	<120	130	66	>120
Chloranil	81	9		>490	34	
9,10-Phenanthraquinone	57	17		130	66	
t-Butylcatechol	34	9	12	154	17	72
4-Amino-1-naphthol	9	9	<120	130	17	>120
Hydroquinone	9	9	24	22	17	>120
Phenyl-β-naphthylamine	9	<9	12	17	9	72
Triphenyl phosphite	<9	<9		9	9	
Control	<9	<9	12	9	9	24

[a] S stands for styrene; DCS for 3,4-dichlorostyrene; VEP for 5-ethyl-2-vinylpyridine.

One fact that stands out in the present study is that phenyl-β-naphthylamine and *t*-butylcatechol, two widely used inhibitors, are among the poorest in inhibitory action at least for the monomers tried.

Picric acid and trinitrobenzene are now being used in this Laboratory with great success during distillation of a wide variety of monomers. Some question has arisen concerning the possible hazard from explosion of polynitro compounds, but the use of traces should involve no danger.[2] Picric acid should probably not be used, however, in metal containers.

(1) This investigation was carried out under the sponsorship of the Office of Rubber Reserve, Reconstruction Finance Corporation, in connection with the Government Synthetic Rubber Program.

(2) *Cf.* Belyaev and Yuzefovich, *Compt. rend. acad. sci.* (URSS), **27**, 133 (1940); *C. A.*, **34**, 7607 (1940).

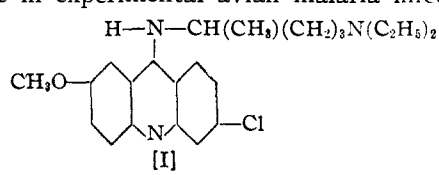
NOYES CHEMICAL LABORATORY
UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS

RECEIVED MARCH 11, 1946

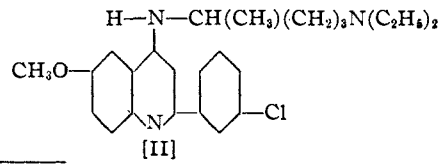
Anils as "Open Models" of a Modified Atebrin

BY HENRY GILMAN AND SAMUEL P. MASSIE, JR.

In a recent study[1] concerned with some quinolines patterned as so-called open models of atebrin, [I], it was shown that a compound like 6-methoxy - 2-(3′ - chlorophenyl) - 4 - [(α - methyldiethylaminobutyl)-amino]-quinoline, [II], was active in experimental avian malaria infections.



[I]



[II]

(1) Gilman and Spatz, THIS JOURNAL, **66**, 621 (1944).

TABLE I

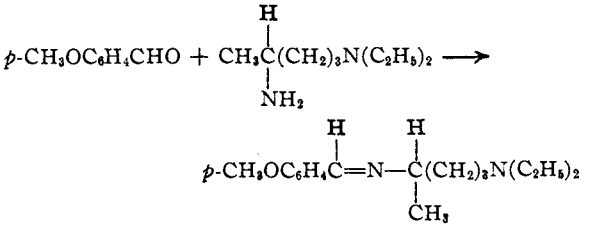
ANILS FROM 1,1-DIETHYLAMINO-4-AMINOPENTANE

Benzal group	B. p., °C.	Mm.	Yield, %	$n^{20}D$	Sp. g.$^{20}_{20}$	Formula	Analyses, % N Calcd.	Found
(1) Benzal	148–150	2.5	67	1.5134	0.9087	$C_{16}H_{26}N_2$	11.38	11.36
(2) *o*-Chlorobenzal	150–151	3.0	72	1.5225	.9989	$C_{16}H_{25}N_2Cl$	10.00	10.17
(3) *o*-Methoxybenzal	154–155	3.0	80	1.5210	.9558	$C_{17}H_{26}ON_2$	10.14	10.38
(4) *p*-Methoxybenzal	153–154	3.0	76	1.5250	.9584	$C_{17}H_{26}ON_2$	10.14	10.32
(5) *p*-Dimethylaminobenzal	193–194	3.0	64	1.558	.9450	$C_{18}H_{31}N_3$	14.53	14.54

This compound has a chlorophenyl group in place of the fuzed chlorobenzo group in atebrin. Later[2] it was shown that another related model, 2-(3′-chlorophenyl)-4-[(α-methyl-ϑ-diethylaminobutyl)-amino]-6-methylquinoline, was also active.

The principle involved was then extended so that the simple central pyridine nucleus of atebrin was used as a fundamental grouping.[3] Among the compounds examined was 2-(*p*-γ-diethylaminopropylaminophenyl)-pyridine which was shown to be active in experimental avian malaria.

A logical extension from the fuzed trinuclear system of atebrin, to the fuzed dinuclear system of quinoline, to the simple pyridine nucleus was to some appropriately substituted anils having the azomethine grouping which is present in the aforementioned nitrogen heterocycles. Several anils were prepared in accordance with the typical reaction



None of these compounds was found active.

Experimental

Anils Derived from 1,1-Diethylamino-4-aminopentane.—Equimolecular quantities of the amine and the aldehyde were dissolved and mixed in benzene. The reaction was usually instantaneous, the mixture becoming warm and turbid, but in the case of the *p*-methoxy- and the *p*-dimethylamino- derivatives it was desirable to apply heat to start the reaction. The mixture was allowed to stand for ten to fourteen hours, the water was separated, and the benzene layer dried over anhydrous sodium sulfate. The solvent was removed by distillation and the product distilled under reduced pressure. The benzaldehyde derivative was a colorless liquid, and the other compounds were yellow liquids.

5-(*p*-Anisalamino)-8-methylquinoline.—(By Fred J. Marshall). A mixture of 4.7 g. (0.03 mole) of 5-amino-8-methylquinoline and 4 g. (0.03 mole) of *p*-anisaldehyde in 35 cc. of benzene was refluxed for three and one-half hours. After removal of the benzene under reduced pressure, the product was crystallized from methanol. The yield was 5.7 g. (68%) of compound melting at 102–104°.

Anal. Calcd. for $C_{18}H_{16}ON_2$: N, 10.14. Found: N, 10.37.

In addition to the compounds described, the following were also examined and found to be inactive in experimental avian malaria: benzal-*m*-bromoaniline, benzal-*p*-bromoaniline, *m*-bromobenzal-aniline, benzal-*o*-hydroxyaniline, benzal-*p*-dimethylaminoaniline, *p*-dimethylaminobenzalaniline and *p*-dimethylaminobenzal-*o*-methoxyaniline.[4]

Acknowledgment.—The authors are grateful to Drs. R. J. Porter and L. T. Coggeshall, of the University of Michigan, for the antimalarial tests, the results of which will be published elsewhere.

(2) Gilman, Christian and Spatz, *ibid.*, **68**, in press (1946).

(3) Gilman and Edward, *ibid.*, **68**, in press (1946).

(4) The last three compounds were supplied by Merrill Speeter. See, Gilman, Tolman, Yeoman, Woods, Shirley and Avakian, THIS JOURNAL, **68**, 426 (1946), on N-(*m*-trifluoromethylbenzal)-*m*-trifluoromethylaniline and 4-(*m*-trifluoromethylbenzalamino)-dibenzofuran which were also found to be inactive.

CHEMICAL LABORATORY
IOWA STATE COLLEGE
AMES, IOWA

RECEIVED FEBRUARY 23, 1946

The Methylation of Carvacrylamine

BY JOHN F. R. KUCK AND J. V. KARABINOS

The preparation and physical constants of carvacrylamine as well as its N-methylated derivatives are reported in this communication.

Carvacrylamine was obtained by the nitration of *p*-cymene according to the method of Kobe and Doumani,[1] and catalytic reduction of the 2-nitro-*p*-cymene.[2] Purification was accomplished by recrystallization of the formyl derivative from hot water and regeneration of the free base.

An attempt to make the N-methyl derivative by reductive alkylation[3] gave a mixture of amines. Careful vacuum fractionation gave a 15% yield of the pure tertiary amine which boils slightly lower than the other two.

Other methods for monomethylation were tried. Methylation of N-formyl-N-carvacryl sodamide in dry toluene with dimethyl sulfate gave a low yield of fairly pure secondary amine, and autoclaving 2-bromo-*p*-cymene with aqueous methylamine in the presence of cuprous chloride at 600 lb./sq. in. max. and 150 to 175° gave the N-methyl derivative in 25% yield. All methods attempted in this Laboratory for alkylating the amine directly gave a mixture of amines from which the pure secondary amine could be separated by a nitrosation procedure.[4]

(1) K. A. Kobe and T. F. Doumani, "Organic Syntheses," Vol. 21, John Wiley and Sons, Inc., New York, N. Y., 1941, p. 96.

(2) C. F. H. Allen and J. Van Allan, "Organic Syntheses," Vol. 22, 1942, p. 9.

(3) W. S. Emerson and H. W. Mohrman, THIS JOURNAL, **62**, 69 (1940).

(4) J. S. Buck and C. S. Ferry, "Organic Syntheses," Coll. Vol. 2, John Wiley and Sons, Inc., New York, N. Y., 1943, p. 290.