adipic acid. Since the present work has also shown that the initial enzymatic steps in the breakdown of tryptophan are common to bacteria and mammals, it would not be surprising if β-ketoadipic acid proves to be an intermediate in the mammalian oxidation of tryptophan and other aromatic compounds. Full experimental details will be published shortly.

References

1. Stanier, R. Y. *J. Bact.*, **54**, 339 (1947).
2. Suda, M., Hayaishi, O., and Oda, Y. *Symposium on Enzyme Chemistry* (Tokyo), **1**, 79 (1949); *Med. J. Osaka University*, **2**, 21 (1950).
3. Karlsson, J. L., and Barker, H. A. *J. Biol. Chem.*, **175**, 913 (1948).
4. Stanier, R. Y. *Bact. Revs.*, **14**, 179 (1950).
5. Stanier, R. Y., and Tsuchida, M. *J. Bact.*, **58**, 45 (1949).
6. Hayaishi, O., and Hashimoto, K. *Med. J. Osaka University*, **2**, 33 (1950).
7. Stanier, R. Y., *et al. J. Bact.*, **59**, 137 (1950).
8. Elvidge, J. A., *et al. J. Chem. Soc.*, 2235 (1950).
9. Evans, W. C., and Smith, B. S. W. *Biochem. J.*, **49**, Proc. Biochem. Soc., x (1951).
10. McIlwain, H. *J. Gen. Microbiol.*, **2**, 288 (1948).
11. Knox, W. E., and Mehler, A. H. *J. Biol. Chem.*, **187**, 419 (1950); Mehler, A. H., and Knox, W. E. *Ibid.*, 431.
12. Wiss, O. *Helv. Chim. Acta*, **32**, 1694 (1949).
13. Braunshstein, A. E. Goryachenkova, E. V., and Paskhina, T. S. *Biokhimiya*, **14**, 163 (1949).

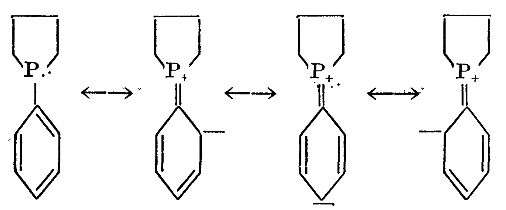
The Ultraviolet Absorption Spectra of Some Heterocyclic Phosphorous Compounds[1]

Arthur Furst and Robert J. Horvat[2]

Department of Chemistry,
University of San Francisco, San Francisco, California

It is becoming increasingly evident that the phenomenon of resonance is not an exclusive property of any group of atoms in the periodic chart. For the ε max value of 1-phenylcyclotetramethylenephosphine (I), its 2-methyl (II), or its 2,5-dimethyl (III) homologues can best be explained in either of two ways; both explanations involve the concept of resonance.

As 1-phenylcyclotetramethylenephosphine (I) is an isologue of a substituted aniline, an analogous postulate can be made:



This hypothesis (A) should predict the following: (*a*) The ε max should have a lower value if the compound is measured in hydrochloric acid; (*b*) the 2-methyl homogogue (II) should not have the phenyl group completely planar with the phosphorous group, and hence some interference with the resonance should be manifested by lower ε max values; (*c*) the 2,5-dimethyl homologue (III) should have very little resonance, if any, other than the usual Kekule resonance of the benzene ring. No effect should be noted when hydrochloric acid is added to this compound. All these predictions are borne out (Table 1).[3]

TABLE 1

	I*	I in HCl†	II*	II in HCl†	III*	III in HCl†
λ(mμ)	250	251	249	247	252	No
ε max	6,500	2,830	4,050	3,020	865	Change

* I and II as 2 mg % and III as 10 mg % in 95% ethanol.
† For second measurement, one drop of concentrated hydrochloric acid was added.

An alternate explanation (B) for the high ε max values compared to aniline (*1*) may lie in the extreme ease of oxidation of these compounds by the oxygen of the air. These phosphorous compounds may tend to exist partly as free radicals. The lone electron can resonate with the benzene ring. This hypothesis should predict that on standing the ε max should rapidly decrease. Observations show this, too.

Additional work is being done to see if the phosphorous group will direct a new group to the *ortho* and *para* positions on the benzene ring in support of hypothesis A, and if these compounds are associated in support of hypothesis B.

The values reported here were taken from compounds kept in sealed tubes, but opened occasionally for withdrawal of samples. It is possible that measurements taken under completely anhydrous and oxygen-free conditions would show that the ε max values for these compounds would be much higher.

Details of preparation will be published elsewhere.

Reference

1. Kumler, W. D., and Strait, L. A. *J. Am. Chem. Soc.*, **65**, 2349 (1943).

[1] A Frederick Gardner Cottrell grant from the Research Corporation is gratefully acknowledged.

[2] Taken from the M. S. thesis of Robert J. Horvat.

[3] The authors wish to thank Michael K. Hrenoff for the spectra data.

The Effect of Aureomycin and Vitamins on the Growth Rate of Chicks

Jacob Biely and B. March

Poultry Nutrition Laboratory,
The University of British Columbia, Vancouver

Following the discovery by Stokstad and Jukes (*1*) that the feeding of aureomycin had a stimulating effect on the growth of the chick, several reports have appeared on the effects of feeding antibiotics to chicks and to various other animals. It was found that with animals other than ruminants the inclusion of an antibiotic in the feed almost invariably resulted in a marked increase in the rate of growth. There are, however, reports of instances where the addition of antibiotics to a ration had no effect on the growth rate. Speer *et al.* (*2*), for example, reported an experiment in which the addition of aureomycin to a ration fed to young pigs had no effect on the growth rate. The

TABLE 1

COMPOSITION OF BASAL RATION

Ingredient	Lb/100 lb	Ingredient	G/100 lb
Ground yellow corn	78.34	Manganese sulfate	10.0
Casein	12.0	Ferric citrate	5.0
Gelatin	4.8	Copper sulfate	0.5
Bone meal	2.0	Riboflavin	.16
Limestone	1.0	Nicotinic acid	.8
Iodized salt	0.5	Calcium pantothenate	.5
Feeding oil (3,000 A, 400 D)	.25	Pyridoxine hydrochloride	0.16
Choline chloride (25%)	.44	*Para*-aminobenzoic acid	1.6
Arginine hydrochloride	.05	Folic acid	0.02
DL-methionine	.60	Menadione	.02
DL-tryptophan	0.02*	Vitamin B_{12}	0.0015

* In Expt 3, 0.01% DL-tryptophan was added.

authors explained the lack of response to the aureomycin by the "disease level" theory. Scott and Glista (*3*), working with chicks, noted only a slight insignificant response to aureomycin for the first few weeks with *ad lib* feeding, and no response when feed intake was limited. The chicks in this experiment "originated from a well fed group of breeding hens and hence were not depleted of APF reserves." Oleson, Hutchings, and Whitehill (*4*) found that APF-depleted chicks showed no response to aureomycin in the absence of vitamin B_{12} in the diet, although there was a marked response to the antibiotic when vitamin B_{12} was present in suboptimal or optimal amounts. There appeared to be a mutual sparing action between aureomycin and vitamin B_{12}.

Experiments conducted in this laboratory have shown considerable differences in the response of chicks to aureomycin, apparently as a result of differences in the composition of the diet fed to the breeders and/or the chicks.

In feeding a chick ration (Table 1) containing vitamins at levels above those recommended by the N.R.C., it was noted that the addition of aureomycin resulted in no increase in the rate of growth of chicks fed the experimental ration (Expt 1, Table 2).

In order to determine the effect of aureomycin on the growth rate of chicks fed a ration deficient in one of the vitamins, a test was set up in which a folic acid–deficient ration was fed with and without crystalline aureomycin (Table 2). At 4 weeks of age the chicks on the folic acid–deficient ration averaged only 308 g in weight and were poorly feathered. The birds receiving aureomycin, in spite of a suboptimal amount of folic acid in the diet, averaged 410 g and were well feathered (Expt 2, Table 2). It would therefore appear that the feeding of aureomycin to chicks lowered their dietary requirement for folic acid.

In a further experiment (Expt 3, Table 2), rations that were deficient in riboflavin, nicotinic acid, and folic acid, respectively, were fed with and without crystalline aureomycin. It will be seen from the data that the growth rate of the chicks fed the basal ration was not stimulated by the addition of aureomycin. However, when riboflavin, nicotinic acid, or folic acid was omitted from the basal ration, there was a significant decrease in the rate of growth. The addition of aureomycin to these vitamin-deficient rations stimulated the growth rate in each case to the extent that the chicks fed the vitamin-deficient rations containing aureomycin attained weights similar to those fed the complete basal ration.

It would appear from the data of the above experiments that dietary levels of nicotinic acid, folic acid, or riboflavin that are suboptimal for maximum growth rate of the chick under normal conditions may be adequate when aureomycin is fed. It is quite probable that the effect of aureomycin, in lowering the dietary requirements for certain vitamins, is brought about through a reduction in the numbers of intestinal microflora which might compete with the host for members of the vitamin B complex and/or by permitting the proliferation of microorganisms which synthesize these vitamins. The feeding of aureomycin would thus make available to the chick a larger proportion of the vitamins supplied by the diet and/or increase the amounts of vitamins available as a result of favorable microbiosynthesis.

TABLE 2

AVERAGE WEIGHTS OF NEW HAMPSHIRE COCKERELS FED EXPERIMENTAL RATIONS

Expt No.	Ration*	No. chicks	Average wt (g) at
			28 days
1	Basal	21	377
	Basal plus aureomycin†	19	377
			30 days
2	Basal without folic acid	18	308
	Basal " " " plus aureomycin‡	18	410
			21 days
3¶	Basal	18	243
	Basal plus aureomycin‖	15	247
	Basal without riboflavin	18	211
	Basal " " plus aureomycin‖	17	251
	Basal without nicotinic acid	16	211
	Basal " " " plus aureomycin‖	15	243
	Basal without folic acid	18	211
	Basal " " " plus aureomycin‖	20	234

* Composition of basal ration is given in Table 1.
† 0.3% Lederle APF supplement containing aureomycin.
‡ Crystalline aureomycin HCl, 16.66 mg/lb.
¶ Minimum significant difference at 5% level, 20; at 1% level, 27.
‖ 0.25% Lederle APF supplement "aurofac."

References

1. STOKSTAD, E. L. R., and JUKES, T. H. *Proc. Soc. Exptl. Biol. Med.*, **73**, 523 (1950).
2. SPEER, V. C., *et al. Arch. Biochem.*, **29**, 452 (1950).
3. SCOTT, H. M., and GLISTA, W. A. *Poultry Sci.*, **29**, 921 (1950).
4. OLESON, J. J., HUTCHINGS, B. L., and WHITEHILL, A. R. *Arch. Biochem.*, **29**, 334 (1950).