

mixed with the supposed 11-hydroxytetrahydro-carbazolenine.

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<sup>1</sup> Bucherer and Groïé, *Ber. deut. chem. Ges.*, **39**, 991 (1906).

<sup>2</sup> Plancher and Bettinalli, *Gazetta*, **29**, 1, 115 (1899).

<sup>3</sup> Betts, Muspratt and Plant, *J. Chem. Soc.*, 1311 (1927).

<sup>4</sup> Perkin and Plant, *J. Chem. Soc.*, **123**, 676 (1923).

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<sup>6</sup> Beer, McGrath, Robertson and Woodier, *Nature*, **164**, 363 (1949).

### A Yellow Pigment Formed from Para-Aminobenzoic Acid and Para-Aminosalicylic Acid by Various Strains of *Mycobacterium*

We have previously shown that *para*-aminobenzoic acid is transformed into a yellow pigment by various species of mycobacteria<sup>1,2,3</sup>. The chemical composition of this pigment is unknown; but it has been established as an oxidation product of *para*-aminobenzoic acid. The pigment is insoluble in water and in most of the usual organic solvents, but is very soluble in phenol and glacial acetic acid. Various substances related to *para*-aminobenzoic acid, with the exception of procaine, were unable to form this pigment.

We have found, as with *para*-aminobenzoic acid, that *para*-aminosalicylic acid is transformed into a yellow pigment by *Mycobacterium smegmatis* and the closely related strain, *Mycobacterium tuberculosis* var. *hominis* No. 607, both of which organisms are naturally resistant to *para*-aminosalicylic acid. The conditions under which the *para*-aminosalicylic acid pigment is formed closely resemble those described for the formation of *para*-aminobenzoic acid pigment. It is noteworthy that replacement of glycerol by glucose strongly inhibits the formation of the pigment. In the presence of *para*-aminobenzoic acid, the biosynthesis of riboflavin by mycobacteria<sup>4</sup> is more rapid and the amount formed appreciably increased. *Para*-aminosalicylic acid has the same influence as *para*-aminobenzoic acid on the production of riboflavin.

*Para*-aminosalicylic acid pigment differs from the *para*-aminobenzoic acid pigment in several respects: (1) its colour is more reddish; (2) it is partially soluble in water and especially soluble in diluted acids and

alkali; (3) it is much less stable than *para*-aminobenzoic acid pigment. The colour of the pigment rapidly changes to a dark brown within the first few days of growth.

In the accompanying table are named a number of substances capable or incapable of pigment formation.

A great number of related substances had definite antibacterial activities. The following substances were bacteriostatic in concentrations of 0.025 per cent or greater: 3,4-diaminotoluene, 2,5-diaminotoluene, 2,4-diaminotoluene, catechol, resorcinol, *para*-phenylenediamine, *o*- and *p*-aminophenol, 1,2,4-triaminobenzene, *p*-aminoacetophenone.

In the presence of salicylic acid and acetyl salicylic acid, another pigment is produced which differs from the *para*-aminobenzoic acid pigment, as seen from its behaviour to fluorescent light.

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<sup>1</sup> Mayer, R. L., *Science*, **98**, 2539 (1943).

<sup>2</sup> Mayer, R. L., *J. Bact.*, **48**, 337 (1944).

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<sup>4</sup> Mayer, R. L., and Rodbart, M., *Arch. Biochem.*, **11**, 49 (1946).

### Solar Noise and Ionospheric Fading

A STUDY of the correlation between the occurrence of bursts of solar noise and anomalies in ionospheric wave propagation was initiated at the Radio Research Station, Slough, by Mr. R. E. Burgess in 1948 and continued during that year by Messrs. C. S. Fowler and R. W. Mason. Some interesting effects on radio transmissions in the low-frequency band at times of sudden ionospheric disturbances have been observed.

In the course of this work simultaneous recordings were made of the relative intensity of solar noise at frequencies of 30, 42, 73 and 155 Mc./s. and of the strength of signals from the stations of Klipheuevel, South Africa, on 18.89 Mc./s., and Königswusterhausen, Germany, on 191 kc./s. On a number of occasions a burst of noise was accompanied by a complete fade-out (of the Dellinger type) of the high-frequency signal and a marked fluctuation in the level of the low-frequency signal. The most outstanding example occurred at about 1130 G.M.T. on May 21, 1948, at the time of a large solar flare which has already been reported<sup>1</sup>. The records for the two stations and for the noise on 30 Mc./s. are reproduced in the accompanying figure.

The main feature of the record to which I wish to direct attention is the variation of the low-frequency signal during the fade-out. As pointed out by Dr. B. G. Pressey, the nature of this variation is characteristic of interference between the ground and ionospheric waves caused by a change in the phase and amplitude of the ionospheric wave; and this could be explained by a change in the equivalent height of reflexion together with an increase in the effective reflexion coefficient of the ionosphere. Normally the intensity of the ionospheric wave from a low-frequency station at this distance (975 km.) is relatively small at noon; but the record shows a considerable increase of intensity over a period of ten minutes which is approximately the same as the duration of the noise burst. The relative phase-change during the disturbed period is seen to be about two cycles, which corresponds to a change in equivalent height of reflexion of about 10 km., if a

Pigment production by *Mycobacterium smegmatis*

Pigment produced	Colour of pigment	No pigment produced
<i>Para</i> -aminobenzoic acid	Yellow	In addition to substances already mentioned (Mayer <sup>2</sup> ):
Acetyl <i>para</i> -aminobenzoic acid	Yellow	<i>o</i> - and <i>m</i> -Aminobenzoic acid
<i>Para</i> -aminobenzoyl-diethyl-amino-ethanol (procaine)	Yellow	<i>m</i> - and <i>p</i> -Hydroxybenzoic acid
<i>Para</i> -aminosalicylic acid	Orange-yellow	<i>o</i> -Hydroxybenzyl alcohol
<i>Para</i> -nitrobenzoic acid	Yellow	2,4-Dihydroxybenzoic acid
3,5 Dinitrobenzoic acid	Orange-yellow	<i>o</i> - and <i>m</i> -Phenylenediamine
3,5 Dinitrosalicylic acid	Orange-yellow	<i>m</i> -Aminophenol
Folic acid	Orange	2,4-Diaminophenol Acetyl derivatives of <i>o</i> -, <i>m</i> - and <i>p</i> -toluidine 2,4,6-Triaminotoluene 3 and 5-Nitrosalicylic acid