Stable primary N-nitrosamines of the benzimidazole series were obtained by the action of sodium amide and isoamyl nitrite on 1-substituted 2-aminobenzimidazoles and subsequent acidification of the resulting benzimidazole-2-diazotates. The effect of the acidity of the solution on the activity of the benzimidazole-2-diazonium salts formed from the nitrosoamines was traced.

Although primary N-nitrosamines of azoles have been known for a long time (see [1] for the literature data), the study of the structure and properties of diazo compounds of azoles with three or more heteroatoms in the ring was begun only recently [2-7]; they were unknown in the imidazole series.

Considering the ease of conversion of the various forms of diazo compounds of azoles to nitrosamines [8], we synthesized their nitroso derivatives (III) from 2-amino-1-substituted benzimidazoles (I) through the intermediate diazotates (II).* We were able to synthesize diazotates II by the Bamberger method [9] by the reaction of excess isoamyl nitrite with the Na derivatives of amines I. In contrast to the diazotates of the benzene series, which are converted to diazo anhydrides at pH 5.5-7.5 [10], benzimidazole-diazotates II under these conditions give N-nitrosamines III, which are yellow crystalline substances that are only slightly soluble in organic solvents and burst into flames on heating (see Table 1). Nitrosamines III are amphoteric and readily soluble in dilute acids and alkalis, ammonium hydroxide, and alcohol solutions of alkoxides. When they are added to concentrated sulfuric acid they cause an intense blue coloration; this may be used as a qualitative reaction.

The structure of III† was confirmed by reduction of some of them to substituted hydrazines V, which were identified as the benzylidene derivatives (VI).

\[ \text{R'=CH}_3, \text{R''}=\text{R'''=H;} \quad \text{b R'=R''=CH}_3, \text{R'''=H;} \quad \text{c R'=R''=R'''=CH}_3; \quad \text{d R'=CH}_3, \text{R''=OCH}_3, \text{R'''=H;} \quad \text{e R'=CH}_3, \text{R''=OC}_4\text{H}_5, \text{R'''=H;} \quad \text{f R'=C}_6\text{H}_5, \text{R''=}\text{R'''=H;} \quad \text{g R'=C}_4\text{H}_5\text{CH}=\text{OCH}_3, \text{R''=}\text{R'''=H} \]

*Direct nitrosation, which was successful for the preparation of 2-(N-methyl-N-nitrosamino)-1-methylbenzimidazole IV, did not give positive results in the remaining cases.
†Most of these compounds were analyzed for their nitrogen content only, inasmuch as they explode during attempts to determine C and H.
The use of IR spectroscopy to prove the structure of III proved to be difficult because of the absence of information on the absorption of primary nitrosamines and because of their poor solubility in organic solvents. Only the intense band at 3250 cm⁻¹, which is absent in the spectra of amines I and nitrosamine IV, can be considered to be sufficiently characteristic for nitrosamines III. In analogy with the corresponding band of secondary amides [11], it can be assigned to the absorption of a bonded NH group, although this band may also be due to the vibration of the NH group of the imidazoline ring of the tautomeric imino form [12]. The second assumption is also confirmed by the similarity between the UV spectra of III and 2-N-nitrosimino-1,3-dimethylbenzimidazolone (VII) [13], which is a compound with a fixed imino structure.

The stability of primary nitrosamines III proved to be quite high; they are stable on prolonged storage in the dark at 20°C (see [1]). Bases of the diethylamine type do not induce denitrosation of these compounds; the addition of amines I even promotes stabilization of III. Rapid denitrosation is observed during the action of concentrated hydrochloric acid. In addition to amine I, small amounts of the 2-chloro derivative and the corresponding benzimidazolone are formed in this case.

Concentrated sulfuric acid has a different effect on III. Partial denitrosation is apparently also observed in this case; the resulting amine I then undergoes diazo coupling with the simultaneously generated diazonium salt, and a mixture of isomeric 5- and 6-azobenzimidazoles (of the VIII type) is obtained. The latter also give the above-mentioned blue coloration in concentrated sulfuric acid.

Azo compounds VIII were isolated from nitrosamine IIIa in 73% yield and proved to be identical to the products of "self-coupling" of amine I previously obtained in [15]. The yields of azo compounds VIII fall when the sulfuric acid is diluted (50 and 42% for 75 and 50% acid, respectively, and only traces of products in 25% acid solution). Products VIII are apparently formed only at acid concentrations adequate for the generation of the active benzimidazole-2-diazonium salt, which contains a protonated imidazole ring [16]. The nitrosamines are not converted to azo compounds VIII in acetic acid, but diazo coupling with active azo components is possible. Thus IIIa and IIIc react with β-naphthol to give the corresponding benzimidazoleazonaphthols (IXa, b), while the formation of azo compounds with mesitylene can be detected only by chromatography. In the absence of acids, nitrosamines IV do not undergo diazo coupling. Compounds IV are apparently converted to diazonium salts with an unprotonated imidazole ring in acids with a low protonating capacity. The activity of these salts should not be anomalously high, as also in the case of thiazole-2-diazonium salts [17].