

CHRONICLES

CONFERENCE ON THE REACTIVITY OF AZINES

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A conference on the reactivity of azines, which was organized by the Novosibirsk Institute of Organic Chemistry of the Siberian Branch of the Academy of Sciences of the USSR (AS USSR) together with the Scientific Council on Fine Organic Synthesis of the AS USSR and the Ministry of the Medicinal Industry of the USSR, was held in Novosibirsk from June 6 to June 8, 1979. The conference was devoted to problems in the theory of the structures of heterocyclic nitrogen-containing compounds, the tautomerism and reactivities of pyridines, pyrimidines, and other azines, including quantitative estimates of the effect of substituents and the nitrogen heteroatom, and to the transformations of derivatives of azines. Approximately 90 invited prominent specialists from 43 academic and branch scientific-research and educational institutes of the country participated in the conference.

The conference opened with an address by the president of the organizing committee Associate Member of the AN SSSR V. P. Mamaev, who noted the timeliness of the conference in connection with the intensive development of the chemistry and the ever-increasing practical significance of heterocycles, particularly azines, and emphasized the importance of the search for quantitative principles that describe their reactivities. During the 3 days of the conference, 10 plenary papers with review character and 13 papers and 58 display communications dealing with recent theoretical and experimental results pertaining to the problems under consideration were presented and discussed.

The general problems of the reactivities of azines and azoles were discussed in a plenary paper by A. F. Pozharskii (Rostov-on-Don) in the light of the author's concepts of π -deficient and π -surplus character. In his analysis of these concepts within the quantitative terms of general, averaged, and local π -deficient character, during which he enlisted the aid of quantum-chemical calculations, the results of physical methods [^{13}C and ^{15}N NMR spectroscopy, ^{35}Cl nuclear quadrupole resonance (NQR) spectroscopy, and polarography], and the chemical behavior of azines and azoles, the speaker concluded that to estimate their reactivities one must take into account not only the magnitude of the deficit in the π -electron density in the ground state of the molecules (the π -deficient character) but also the capacity for accepting electrons in the boundary orbitals (the π -acceptor character).

In a paper presented jointly with N. A. Kovach and O. P. Shvaik, Yu. B. Vysotskii (Donetsk) attempted to evaluate the aromatic character and antiaromatic character of azines from unified positions. With this end in mind, they discussed the various indexes for a number of azines and their cations and anions. It was shown that the magnitude of the π -electron ring currents serves as the best criterion for the construction of a unified scale of aromatic and antiaromatic character. The authors proposed a new quantum-chemical index that characterizes the ability of systems to retain their aromatic or antiaromatic character.

A paper by O. N. Chupakhin (Sverdlovsk) was devoted to an examination of the mechanism of the nucleophilic substitution of hydrogen in azines and related systems and an analysis of various reactivity indices and some experimental methods, of which reductive polarography was found to be the most informative. The half-wave potential of polarographic one-electron reduction was used as the quantitative characteristic of the reactivity of the azine in the case of benzo annelation and an increase in the number of aza groups in the ring, as well as in the case of the introduction of activating substituents in the aromatic ring.

Information regarding radicals and anion radicals of azines, their classification, methods for their generation and establishment of their structures, their chemical nature, and their role as active intermediate particles in nucleophilic heteroaromatic substitution was reported in a review paper by A. K. Sheinkman (Dnepropetrovsk).

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The study of the relationship between the structure of azines and their physical and chemical properties is considerably complicated as compared with their carbocyclic analogs by the manifestation of additional factors. One of the most important aspects of this problem, viz., transmission of the effects of substituents in the heteroaromatic ring of azines, was the subject of a plenary paper by V. P. Mamaev (Novosibirsk). The modern state of this problem as applied to azines was illuminated in detail in this paper; in addition, research carried out recently by Soviet and foreign investigators was analyzed thoroughly, and the results of the author's own research on the electronic effects of substituents on the reactivities and some spectral characteristics of pyrimidine derivatives were presented.

A paper by Yu. N. Sheinker (Moscow) was devoted to the tautomerism of azines and the establishment of the relationship between the position of the tautomeric equilibrium and structural and other factors that characterize tautomeric systems in the azine series. The author examined classical types of tautomerism, viz., thione-thiol, lactim-lactam, amine-base equilibria to tautomerism enabled the speaker to examine the pathways of the specific change in the tautomeric equilibria under the influence of structural factors and solvents.

In a review paper entitled "Advances in the photochemistry of azines" A. V. El'tsov (Leningrad) discussed the principal types of photochemical reactions and the modern state of and prospects for the development of the photochemistry of azines, the steric possibilities of which are far from having been completely revealed, and called upon the participants in the conference to enthusiastically undertake the study of this difficult and exciting field of organic chemistry.

In a plenary paper presented in his name and in the name of A. N. Kost (Moscow) R. S. Sagitullin presented voluminous experimental data on the recyclization of azines and a number of condensed analogs, a reaction which was discovered by the authors. The process consists in initial attack by a base on an electron-deficient heteroaromatic ring that is accompanied by ring opening due to cleavage of the nitrogen-carbon bond with the subsequent formation of a new ring with a carbon-carbon bond. The authors attempted to predict the direction of recyclization by the use of quantum-chemical indexes calculated for the ground state of the starting molecule.

L. N. Yakhontov (Moscow) presented a review of the literature data and his own data on the specific behavior of α , α' -substituted pyridines in chemical reactions. By means of voluminous factual data he demonstrated the change in the character of the reactivities of both the substituents and the heterocyclic nitrogen atom, viz., a decrease in the nucleophilicity and ability to undergo protonation, complexing, and solvation, which leads to a change in the reactivity of the entire azine system. Examples of the unusually facile electrophilic substitution reactions of pyridines with electron-acceptor or bulky substituents in the 2 and 6 positions were presented as an illustration.

The results of a systematic study by G. Ya. Dubur and a group of co-workers (Riga) were set forth in a plenary paper entitled "Dehydrogenation reactions of dihydropyridines and other dihydroazines." Some 1,4-dihydropyridine derivatives that are analogs of redox co-enzymes were found to be efficient reducing agents. This property was used for the development of a preparative method for the selective reduction of the double bond in α , β -unsaturated carbonyl compounds. A number of dihydropyridines displayed high physiological activity.

In addition to the plenary papers, reports dealing with problems in the tautomerism and reactivities of azines were also of interest. N. A. Smorygo and B. A. Ivin (Leningrad) used the method of calculation of the vibrational spectra for the establishment of the structures and tautomerism of di- and trihydroxypyrimidines. O. S. Anisimova and Yu. N. Sheinker (Moscow) reported the use of mass spectrometry for the determination of the position of the tautomeric equilibrium of heterocyclic sulfonilamides, and S. A. Stekhova, O. A. Zagulyaeva, V. V. Lapachev, and V. P. Mamaev (Novosibirsk) successfully used the valence MO method for the analysis of the effect of a nitrogen heteroatom on the keto-enol tautomerism of aza analogs of benzoylacetate ester.

V. I. Berezin and a group of researchers (Saratov) calculated the vibrations on the basis of experimental data and proposed assignments of the frequencies in the vibrational spectra of substituted azines.

Data on the basicities and acidities of azine derivatives and their acid-base transformations were used in several reports for the discussion of the reactivities of hetero-

aromatic substances. Yu. B. Vysotskii and V. A. Sokolenko (Donetsk) calculated the electronic structures of the excited states of pyridine and quinoline and their protonated forms. A paper by E. A. Zvezdina and co-authors (Rostov-on-Don) was devoted to the basicities and transformations of pyridinium salts. K. M. Dyumaev, B. A. Korolev, and L. A. Osmolovskaya (Moscow) examined the relationship between the basicities and structures of pyridones, substituted pyridines, and pyridine N-oxides in nitromethane. E. S. Petrov and co-authors (Moscow and Novosibirsk) reported the effect of substituents on the NH acidities of 2- and 4-aminopyrimidines in dimethyl sulfoxide (DMSO).

Problems associated with new advances in the synthesis of azines were touched upon. A. S. Kurbatova, Yu. V. Kurbatov, and D. A. Niyazova (Samarkand) proposed a new method for the diarylhydroxymethylation of N-oxides of azines. Yu. I. Ryabukhin, V. D. Karpenko, and G. N. Dorofeenko (Rostov-on-Don) used 4-keto-1,3-oxazinium salts as new reagents for the synthesis of pyrimidines and sym-triazines. E. Yu. Gudrinietse and A. Kh. Karklinya (Riga) reported the reactions of azides of pyridazines and phthalazines with 1,3-dicarbonyl compounds. A detailed report on the synthesis of aminoazines from nitriles based on literature data was presented by Yu. A. Sharanin (Voroshilovgrad) and V. K. Promonenkov (Moscow).

One of the possible ways to use azines was elucidated by A. V. Kazymov, N. A. Shvink, and S. A. Lerner (Kazan) in a report on the use and mechanism of the action of azines in photographic processes. A number of communications contained data on the biological activity of azine derivatives. A brief account of the communications presented was included in a collection entitled "Reactivities of azines," which was issued at the beginning of the conference.

The rather single-minded subject matter of the conference made it possible to convene scientists occupied with similar problems in the reactivities, tautomerism, and transmission of the effects of substituents in the azine series and interests in the extensive and complex development of the research being carried out in this country. This led to a lively and critical discussion of the concepts advanced and to an exchange of opinions of representatives of various scientific schools and research trends. The necessity for further development of research on the reactivities and tautomerism of azines, particularly in a quantitative respect, and the use of kinetic and quantum-chemical methods is pointed out in a resolution adopted by the conference. The publication of review papers in *Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR* (Bulletin of the Siberian Branch of the AS USSR) was recommended. The next conference on the chemistry of azines is to be held in Sverdlovsk in 1982.