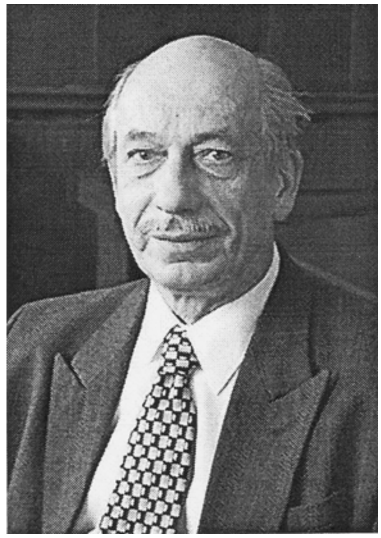
Chemistry of Heterocyclic Compounds, Vol. 44, No. 9, 2008

ANNIVERSARIES AND DATES



ACADEMICIAN
BORIS ALEKSANDROVICH TROFIMOV
(To his seventieth anniversary)

Academician Boris Aleksandrovich Trofimov is an outstanding member of the school of Academician Aleksei Evgrafovich Favorsky, the classic of organic chemistry and founder of the chemistry of acetylene.

In 1961 after graduation from Irkutsk State University (with honours) Boris Aleksandrovich was taken on as a senior laboratory assistant in the recently set up Irkutsk Institute of Organic Chemistry, Siberian Branch of the Academy of Sciences of the USSR (currently the A. E. Favorsky Irkutsk Institute of Chemistry, Siberian Branch of the Russian Academy of Sciences). Since that time his scientific career has been always associated with this institute, of which he has been a director for already 15 years.

Boris Aleksandrovich defended his candidate's thesis at Irkutsk State University (1965) under the leadership of Mikhail Fedorovich Shostakovskii, a Corresponding Member, Academy of Sciences of the USSR,– the nearest student of A. E. Favorsky. In these years close ties were formed between B. A. Trofimov and other companions, students, and students of students of Aleksei Evgrafovich, especially, in Leningrad (T. A. Favorskaya, I. A. Favorskaya, T. I. Temnikova, I. M. Domnin, R. M. Kostikov, B. A. Ershov, A. S. Dneprovskii, and others).

In 1970 at Leningrad State University B. A. Trofimov defended his doctor's thesis. The subjects of his candidate's and doctor's theses were, of course, associated with the chemistry of acetylene. The scientific work of the 32-year-old doctor of sciences continued to develop under the strong influence of the ideas and methodology of A. E. Favorsky, whose work he knows well and never tires of studying. Around him there soon developed a galaxy of young scientists – S. V. Amosova, N. K. Gusarova, A. I. Mikhaleva, S. E. Korostova,

Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 9, pp. 1283-1287, October, 2008.

V. K. Stankevich, A. G. Mal'kina, N. A. Nedolya, V. A. Potapov, A. M. Vasil'tsov, L. M. Sinegovskaya, M. V. Sigalov, L. N. Sobenina, S. F. Malysheva, L. N. Parshina and others. Today they are all doctors of sciences, professors, and prominent scientists.

A considerable part of the research carried out by B. A. Trofimov and his school is associated with the chemistry of heterocyclic compounds and its new areas driven by the chemistry of acetylene. It must be stressed that this refers to the novel acetylene chemistry based on the use of superbasic reagents and catalysts [1-6]. Boris Aleksandrovich and his students have made a fundamental contribution to the chemistry of a wide range of heterocycles. Even a highly condensed list of the achievements of B. A. Trofimov's school in the chemistry of heterocyclic compounds is impressive.

In the chemistry of **three-membered heterocycles** the synthesis of the "anchor" oxiranes (epoxides) based on hydroxyl-containing vinyl ethers is well known today [2]. The simplest of such epoxides "vinylox" (the vinyl glycidyl ether of ethylene glycol) was brought into industrial use. This general concept made it possible to produce dozens of new epoxide monomers, resins, and compositions [7]. During the development of this concept thiiranes with a vinyloxy group having high reactivity were synthesized, and simple paths were opened up to novel functionalized representatives of this series [2].

1,3-Dioxacyclanes, **1,3-oxathiacyclanes**, and **1,3-dioxa-2-silacyclanes** were prepared on the basis of acetylene, diols, and their sulfur analogs, and their reactions with electrophiles (hydrolysis, acid-catalyzed hydrothiolysis, acylation with ring opening) [2] and organometallic reagents (ring opening by Grignard, Norman, and Iotsich reagents) were studied systematically – the last group of reactions was previously almost unknown. In the course of these investigations fundamental new information was obtained on the role of the Schlenk equilibrium in the reactions of Grignard reagents [2]. The corresponding silicon analogs were brought in for comparison [2].

Bis(methylene-1,3-dioxolan-2-ones), which are promising monomers and cross-linking agents for the synthesis of specialized polycarbonates, were first produced by the reaction of diacetylene glycols and carbon dioxide [8].

"Anchor" **vinyloxyalkyl-1,3-dioxolan-2-ones** – previously unknown hybrids of vinyl ethers and cyclocarbonates (the more known is vinyloxyethoxymethyl-1,3-dioxolan-2-one "cyclovin" [2]) – were synthesized for this purpose.

2-Vinyl-1,3-oxazolidines and **2-methylenemorpholines** were synthesized by the cyclization of 2-hydroxyethylpropargylamines in the presence of strong bases, the regioselectivity of the reaction was studied, and its general character was demonstrated [2].

A new chapter was written in the chemistry of functionalized **thiazines** and **dithiazines**, produced by the cyclization of divinyl sulfide [3] and divinyl sulfoxide [9] with ammonia, amines, and thiourea.

1,3,2-Dioxaphospholanes with vinyloxyalkyl radicals (the peculiar "centaurs"), synthesized in B. A. Trofimov's laboratory, first linked the chemistry of Favorsky (vinyl ethers) and the chemistry of Arbuzov (trialkyl phosphites) [2].

Alkylenylphospholanes and **alkenylphosphorinanes** were obtained directly from red phosphorus and α,ω-dihalogenoalkanes by the Trofimov–Gusarova reaction [10].

The chemistry of **thiophene** was substantially expanded by a simple and elegant method for its synthesis from diacetylene and hydrated sodium sulfide; **2,5-dihydrothiophene** and the previously unknown **vinylcyclobutanodihydrothiophene**, in which the dihydrothiophene ring is condensed with cyclobutane, were accordingly produced from vinylacetylene. **Tetraphenylthiophene** was synthesized from diphenylacetylene [3].

Functionalized **1,3-dithioles**, **1,3-diselenoles**, and **1,3-ditelluroles** were obtained in one pot from phenylacetylene and elemental sulfur, selenium, and tellurium in a superbasic system [11].

However, the most significant contribution by B. A. Trofimov and his school to the chemistry of heterocyclic compounds is the **new synthesis of pyrroles** by the reaction of ketoximes with acetylenes in the presence of superbasic catalytic systems of the MOH–DMSO type (where M = alkali metal) [4, 12, 13]. Today this is the simplest and most effective path to **pyrroles** and **N-vinylpyrroles** having various structures, including those with alkyl, cycloalkyl, aromatic, and heteroaromatic substituents. Pyrroles condensed with macrocycles and steroidal structures and also linked with terpene, framework, polycyclic, and heteroaromatic systems became available for the first time. The possibility of obtaining previously almost unknown N-vinylpyrroles – monomers and synthons for the design of novel compounds of the pyrrole series – easily and in one stage was an important development. Today this reaction, which is featured in monographs [14, 15] and textbooks [16, 17] as the named **Trofimov reaction**, has been widely used by many scientific teams working in the field of pyrrole chemistry, is repeatedly cited in the literature [18-22], and has been further developing [23]. It forms the basis of the world's first pilot plant for the production of **indole** by the dehydrogenation of **tetrahydropyrrole** [24] – the product from the reaction of cyclohexanone oxime and acetylene [25] – currently being established in Lithuania (by the firm "Valdis" with scientific consultations from B. A. Trofimov).

Together with Prof. L. Brandsma (the Netherlands) B. A. Trofimov has proposed a new general strategy for the synthesis of fundamental heterocycles (**pyrroles**, **pyridines**, and **azepines** with a rare set of functional substituents), based on the cyclization of the adducts of metallated acetylenes and allenes with heterocumulenes (isothiocyanates) [26].

For a number of years B. A. Trofimov and his school have been developing the original chemistry of functionalized **dihydrofurans**, produced by the addition of various nucleophiles to cyanoacetylene alcohols [27, 28]. For the cycle of researches in this field B. A. Trofimov was awarded the A. M. Butlerov prize. In recent years B. A. Trofimov has discovered and extensively developed a new original direction in the chemistry of **pyridine**, **quinoline**, and **imidazole**. In reaction with cyanoacetylenes these heterocycles generate a special class of superbasic reagents – zwitterions and their carbene tautomers – which are easily converted under biomimetic conditions and, as a rule, at physiological temperatures into previously unknown heterocyclic systems [29-34].

B. A. Trofimov is the author of 19 monographs and chapters in monographs, 60 major reviews, and more than 900 papers. (The total number of his publications, including 540 Russian and foreign patents, exceeds 2500.) 72 Candidates and 25 doctors of sciences are among his students.

B. A. Trofimov is continuing his scientific and management activities. While fulfilling his demanding duties as a director of a large chemical institute that has gained worldwide recognition, he daily attends his laboratory (in which 13 doctors and 26 candidates of science are working), designs specific experiments, and discusses their results with colleagues. B. A. Trofimov shares his ideas and experience generously with his students.

REFERENCES

1. B. A. Trofimov, S. V. Amosova, A. I. Mikhaleva, N. K. Gusarova, and E. P. Vyalykh, in: *Fundamental Investigations. Chemical Sciences* [in Russian], Nauka, Novosibirsk (1977), p. 174.
2. B. A. Trofimov, *Heteroatomic Derivatives of Acetylene. New Polyfunctional Monomers, Reagents, and Intermediates* [in Russian], Nauka, Moscow (1981).
3. B. A. Trofimov and S. V. Amosova, *Divinyl Sulfide and its Derivatives* [in Russian], Nauka, Novosibirsk (1983).
4. B. A. Trofimov and A. I. Mikhaleva, *N-Vinylpyrroles* [in Russian], Nauka, Novosibirsk (1984).
5. B. A. Trofimov, *Contemporary Problems of Organic Chemistry* [in Russian], Issue. 14 (2004), p. 131.
6. B. A. Trofimov, *Curr. Org. Chem.*, **6**, 1121 (2002).
7. B. A. Trofimov and N. A. Nedolya, *Rev. Heteroatom Chem.*, **9**, 205 (1993).
8. K. A. Volkova, A. N. Nikol'skaya, E. P. Levanova, A. N. Volkov, and B. A. Trofimov, *Khim. Geterotsikl. Soedin.*, 1617 (1979). [*Chem. Heterocycl. Comp.*, **15**, 1296 (1979)].
9. N. K. Gusarova, M. G. Voronkov, and B. A. Trofimov, *Sulfur Reports*, **9**, 95 (1989).
10. S. F. Malysheva and S. N. Arbuzova, in: *Modern Organic Synthesis* [in Russian], Khimiya, Moscow (2003), p. 160.

11. B. A. Trofimov, *Sulfur Reports*, **11**, 207 (1992).
12. B. A. Trofimov, *Adv. Heterocycl. Chem.*, **51**, 177 (1990).
13. B. A. Trofimov, in: R. A. Jones (editor), *The Chemistry of Heterocyclic Compounds*, Vol. 48, Wiley, New York (1992), p. 131.
14. G. P. Bean, in: R. A. Jones (editor), *The Chemistry of Heterocyclic Compounds*, Vol. 48, Wiley, New York (1992) Pt. 2, pp. 105-130.
15. R. J. Tedeschi, in: *Encyclopedia of Physical Science and Technology*, Vol. 1, Acad. Press, San Diego (1992), pp. 27-65.
16. A. F. Pozharskii, V. A. Anisimova, and E. B. Tsupak, *Practical Work on the Chemistry of Heterocycles* [in Russian], Izd-vo Rost. Un-ta, Rostov-on-Don (1988), p. 9.
17. M. A. Yurovskaya, *Methods of Synthesis and Chemical Properties of Aromatic Heterocyclic Compounds* [in Russian], Izd. MGU, Moscow (2005), Part 1, p. 21.
18. F. Gonzalez, J. F. Sanz-Cervera, and R. M. Williams, *Tetrahedron Lett.*, **40**, 4519 (1999).
19. J. Chen, A. Burghart, A. Derecskei-Kovacs, and K. Burgess, *J. Org. Chem.*, **65**, 2900 (2000).
20. E. Abele and E. Lukevics, *Heterocycles*, **53**, 2285 (2000).
21. L.-X. Wang, X.-G. Li, and Y. Y.-L. Yang, *React. Funct. Polym.*, **47**, 125 (2001).
22. F. Bellina and R. Rossi, *Tetrahedron*, **62**, 7213 (2006).
23. B. A. Trofimov and N. A. Nedolya, in: A. R. Katritzky, C. A. Ramsden, E. F. V. Scriven, and R. J. K. Taylor (editors), *Comprehensive Heterocyclic Chemistry III. A Review of the Literature 1995-2007*, Vol. 3, Elsevier, Amsterdam, Boston, Heidelberg, London, New York, Oxford, Paris, San Diego, San Francisco, Singapore, Sydney, Tokyo (2008), p. 45.
24. B. A. Trofimov, A. I. Mikhaleva, E. Yu. Shmidt, O. A. Ryapolov, and V. B. Platonov, RF Pat. No. 2307830; *Byul. Izobr.*, No. 28 (2007).
25. B. A. Trofimov, A. I. Mikhaleva, E. Yu. Shmidt, O. A. Ryapolov, and V. B. Platonov, RF Pat. No. 2297410; *Byul. Izobr.*, No. 11 (2007).
26. B. A. Trofimov, *J. Heterocyclic Chem.*, **36**, 1469 (1999).
27. B. A. Trofimov and A. G. Mal'kina, *Heterocycles*, **51**, 2485 (1999).
28. B. A. Trofimov, A. G. Mal'kina, O. A. Shemyakina, A. P. Borisova, V. V. Nosyreva, O. A. Dyachenko, O. N. Kazheva, and G. G. Alexandrov, *Synthesis*, 2641 (2007).
29. B. A. Trofimov, L. V. Andriyankova, S. A. Zhivet'ev, A. G. Mal'kina, and V. K. Voronov, *Tetrahedron Lett.*, **43**, 1093 (2002).
30. B. A. Trofimov, L. V. Andriyankova, S. I. Shaikhudinova, T. I. Kazantseva, A. G. Mal'kina, and A. V. Afonin, *Synthesis*, 853 (2002).
31. L. V. Andriyankova, A. G. Mal'kina, L. P. Nikitina, K. V. Belyaeva, I. A. Ushakov, A. V. Afonin, M. V. Nikitin, and B. A. Trofimov, *Tetrahedron*, **61**, 8031 (2005).
32. B. A. Trofimov, L. V. Andriyankova, R. T. Tlegenov, A. G. Mal'kina, A. V. Afonin, L. N. Il'icheva, and L. P. Nikitina, *Mendeleev Commun.*, **15**, 33 (2005).
33. B. A. Trofimov, L. V. Andriyankova, A. G. Mal'kina, L. P. Nikitina, A. V. Afonin, I. A. Ushakov, L. M. Sinegovskaya, and T. I. Vakul'skaya, *Eur. J. Org. Chem.*, 1581 (2006).
34. B. A. Trofimov, L. V. Andriyankova, A. G. Mal'kina, K. V. Belyaeva, L. P. Nikitina, O. A. Dyachenko, O. N. Kazheva, A. N. Chekhlov, G. V. Shilov, A. V. Afonin, I. A. Ushakov, and L. V. Baikalova, *Eur. J. Org. Chem.*, 1018 (2007).

Academician M. G. Voronkov

The editors of the journal warmly congratulate B. A. Trofimov on his seventieth jubilee and wish him long years of creative enthusiasm, joy in the fulfillment of his dreams, unfailing support of his colleagues and students, new achievements and successes, sound health and happiness, insight and kindness by all around him.