

ANIONIC NAMES OF ACIDS—AN EXPERIMENT IN CHEMICAL NOMENCLATURE

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“*Die wahre Heimat ist eigentlich die Sprache* (The true homeland is certainly the language),” said Wilhelm von Humboldt (1769-1859). This was more than true for Germans, who in that time were not *ein Volk, ein Reich* but were dispersed in hundreds of independent kingdoms and duchies. The same holds true for the Balkan “South Slavic” peoples (“Yugoslavs”), but with a crucial difference: they share principally the same language, but neither national (Croatian, Serbian, Montenegrin, Bosnian) feelings nor religion (Catholicism, Orthodoxy, Islam). On the one hand, there were strivings to make Croatian and Serbian one standard language, and even one nation from the Croats and Serb (1, 2). On the other hand, there were effortful attempts to make the two languages as different as possible. The latter tendency went to extremes in the Nazi-controlled Independent State of Croatia (1941-1945), when all Serbian words in Croatian, as well as the Cyrillic alphabet, were prohibited. Likewise, international words (*radio, automobil, telefon*, etc.) were replaced by made-up Croatian words. It was also prohibited to start a telephone conversation by the usual *halo* (hello); it was ordered to say *spremni* (ready to do) (3).

Making One Language out of Two

It was the same with the chemical language, chemical nomenclature and terminology. Unitarily oriented, Vladimir Njegovan (1884-1971), Professor of Inorganic

Chemistry at Zagreb University, Croatia, was among the first who tried to make a common nomenclature for both Croatian and Serbian chemists despite many striking differences (Croat. *dušik*, Serb. *azot* for nitrogen, Croat. *spoj*, Serb. *jedinjenje* for compound, etc.) (4). In the 19th century, however, Croatian chemists tried to use pure Croatian nomenclature, replacing international words with Croatian neologisms (*smrdik* for bromine, Croat. *smrditi* – to stink; *sumporovina*, meaning “substance obtained from sulfur,” for sulfuric acid, etc.).

In contrast to the majority of European nations, whose languages had only to be learned, Croatian, as a standard language, had yet to be created. It was especially hard to do it in chemistry, because one had to take into account not only the international rules for chemical names but also the differences between Serbian and Croatian. Many and various language experiments resulted from such a constellation of linguistic considerations.

One such experiment commenced with the proposition by Dragutin Strohal (1884-1948), Professor at the School for Education in Zagreb, who in 1942 published an idea for naming acids in a more convenient way (5). Namely he proposed to derive the names of acids from the names of their salts; therefore sulfuric acid should be “sulfatic acid” (Croat. *sulfatna kiselina*), nitric acid “nitric acid” (Croat. *nitratna kiselina*), and hydrochloric acid “chloridic acid” (Croat. *kloridna kiselina*). The rule particularly fitted the Croatian language, because

the names of acids were derived from the Croatian names of elements (H_2SO_4 : *sumporna kiselina*, HNO_3 : *dušična kiselina*, etc.) and the names of salts from their international (i.e., Latin) names. The first intention of Professor Strohal was to help students, because they had to learn unrelated names of acids and their salts. ("As a chemistry teacher, I find that our current names of acids often confuse the beginners in chemistry.") The other argument was a linguistic one: the adjective *sumporasta* (sulfurous) means "like sulfur" whereas *sumporna* (sulfuric) means "of sulfur," and Strohal argued, "One might conclude that there is more sulfur in sulfuric than in sulfurous acid, whereas just the opposite is true." He also claimed his system would be very useful in organic chemistry because the current names of many organic acids were derived from Croatian (e.g. *vinska kiselina* for tartaric acid; Croat. *vino*, wine). However, presumably, Mladen Deželić (1900-1989), editor of the journal *Kemijski vijestnik*, was inspired to add in a footnote: "This interesting proposition is the personal opinion of Professor D. Strohal... But we reckon it would be difficult to replace the names of common acids, which have been used for so long, with new names."

Strohal's or Ostwald's Nomenclature?

Strohal's nomenclature was well known to Croatian chemists, but nobody acknowledged it for decades. Moreover, nobody knew that "Strohal's nomenclature" was not Strohal's at all until 2005, when two authors of this contribution (V. S. and T. P.) discovered that it had been originally proposed by Wilhelm Ostwald (1853-1932) (6). In his book *Die Schule der Chemie – erste Einführung in die Chemie für Jedermann*, Ostwald introduced "Jedermann" into chemistry by a fictional dialogue between the teacher and his student. Among other things, they discuss the names of acids and their salts (7):

Schüler: Warum hat man eigentlich die doppelten Namen?

Lehrer: Das hat geschichtliche Gründe. Anfangs waren nur die deutschen Namen üblich, dann änderte sich die wissenschaftliche Auffassung der Säuren und Salze, und das kamen für die Salze die nichtdeutschen Namen auf. Für die Säuren sind aber nicht entsprechende Namen gebildet worden, so daß hier die deutschen Namen beibehalten worden sind.

Schüler: Aber man könnte doch ganz gut „Chlorat-säure“ und „Hypochloritsäure“ sagen.

Lehrer: Freilich. Wenn du einmal ein einflußreicher Chemiker geworden sein wirst, kannst du diese Namen in Vorschlag bringen und einführen.

Schüler: Tue du es doch!

Lehrer: Einstweilen mußst du die alten Namen lernen, weil sie noch in allgemeinen Gebrauch sind (...).

There is the same problem with naming acids and their salts in German as in Croatian; in German, unlike English, the names of salts are also unrelated to the names of their respective acids (H_2SO_4 : *Schwefelsäure*). But it is not entirely certain that Strohal simply accepted Ostwald's proposal without referencing it. It is very probable that Strohal read Ostwald's book, moreover, because it was translated into Croatian in 1912 (8). Accordingly, a Croatian chemical historian, Snježana Paušek-Baždar, stated that the chemist who introduced "anionic nomenclature" into Croatian was not Dragutin Strohal but the translator of Ostwald's book, Gustav Fleischer (1856-1913), one of the first Croatian chemists (9). Such claims are quite problematic; nobody introduces nomenclature by bare translation or writing the anecdotes in popular books. Strohal might or might have not been familiar with Ostwald's book and its translation, but he certainly wrote the first elaborated and argued proposal for the anionic nomenclature in a scientific journal.

Introducing Anionic Nomenclature

As already mentioned, Strohal's nomenclature was well known to Croatian chemists. Professor Njegovan found, echoing Strohal's argument, anionic nomenclature to be "very interesting and rational, but unfortunately not in use in international literature" (4). This was the major obstacle for its use until the unitary revision of chemical nomenclature and terminology took place. The translators of Wiberg's *Inorganic Chemistry* (10, 11) (Figure 1), headed by Hrvoje Iveković (1901-1991), Professor at the Faculty of Pharmacy in Zagreb, strived to coin chemical terms which should be same for both the Croatian and Serbian languages (12). As chemical terms considerably differ in the two languages, the most plausible way to unify them was to use "international," rather than Croatian or Serbian terms. Therefore Croatian *željezo* and Serbian *gvožđe*, for iron, turned into *ferum*, Croatian *kisik* and Serbian *kiseonik* turned into *oksigen*. (Clearly, if one cannot make one language out of two, one must use another language!)

Strohal's terminology best meets the needs of the new "Yugoslav" chemical nomenclature (13), because the names of acids differ in Serbian and Croatian (e.g. Croat. *dušična kiselina*, Serb. *azotna kiselina* for HNO_3), unlike the names of their salts (Croat./Serb. *nitrat*). Much

Kiseline		Soli	
Formula	Ime	Formula	Ime
HClO	hipokloritna kiselina <i>(hipoklorasta kis.)</i>	MClO	hipokloriti
HClO ₂	kloritna kiselina <i>(klorasta kis.)</i>	MClO ₂	kloriti
HClO ₃	kloratna kiselina <i>(klorna kis.)</i>	MClO ₃	klorati
HClO ₄	perkloratna kiselina <i>(perklorna kis.)</i>	MClO ₄	perklorati

Figure 1. Anionic names of the oxoacids of chlorine in the Croatian translation of Wiberg's *Lehrbuch der Anorganischen Chemie* (Ref. 11, p 134). The traditional Croatian names of acids were printed in italics.

was discussed at the time among chemists about which of the two nomenclatures (the old or the new Strohal's) would be easier to learn (14). However this was not the major reason for its introduction; it was rather the idea of making a unified (Serbo-Croatian) chemical nomenclature (Table 1).

Propagators and Opponents

The anionic nomenclature appeared in conversation lexicons, at first as "the new technical term for sulfuric acid" (*sulfatna kiselina*) (15), as well as in middle, high school and university textbooks. The new chemical names were preferred to the old ones, suggesting that anionic naming of acids was in accordance with the international (IUPAC) nomenclature, in contrast to the old "trivial" names. The chemists, however, were generally

reluctant, seeing in the new names of acids nothing but one of many linguistic innovations, inspired by the whims and pride of their influential colleagues.

The new "Yugoslav" nomenclature found many opponents, especially among Croats. It is noteworthy that it was approved by the Union of the Yugoslav Chemical Societies, but not by its Croatian member, the Croatian Chemical Society. In spite of this, it was also used in Croatia, fortunately without political consequences to its opponents (16).

The most prominent opponent was Vladimir Simeon (b. 1939), Professor of Physical Chemistry at the Faculty of Science, Zagreb. In a round-table discussion on the feasibility of the new nomenclature (among panelists V. Njegovan, V. Simeon, and H. Iveković), Simeon pointed out that Strohal's nomenclature was "unnecessary" (17).

Table 1. Anionic names of acids

Compound	Traditional name (Croatian)	Traditional name (Serbian)	Anionic (Strohal's) name (in both Croatian and Serbian)
hydrobromic acid	bromovodična kiselina	bromovodonična kiselina	bromidna kiselina ("bromidic acid")
nitric acid	dušična kiselina	azotna kiselina	nitratna kiselina ("nitric acid")
nitrous acid	dušikasta kiselina	azotasta kiselina	nitritna kiselina ("nitritic acid")
carbonic acid	ugljična kiselina	ugljena kiselina	karbonatna kiselina ("carbonic acid")
acetic acid	octena kiselina	sirćetna kiselina	acetatna kiselina ("acetic acid")
succinic acid	jantarna kiselina	čilibarna kiselina	sukcinatna kiselina ("succinic acid")

In the foreword of the Croatian translation of IUPAC nomenclature of inorganic chemistry he clearly stated: “Finally, Iveković ‘resurrected’ Strohal’s nearly totally forgotten proposition for the local trivial nomenclature of acids (e.g. ‘sulfatna kiselina’ instead of ‘sumporna kiselina’). It is not clear which reasons induced him—chemical or political—to decline the 1957 Rules, despite the fact that IUPAC was, even in those times, against the introduction of new trivial nomenclatures. It is hard to believe that Iveković was unaware of this categorical IUPAC statement” (18). Moreover, Professor Simeon pointed out that traditional Croatian nomenclature was more in line with IUPAC rules because it was based on the “national” (i.e., Croatian) names of elements.

However, not everybody agreed with Professor Simeon. Stjepan Babić (b. 1925), a linguist, and Vladimir Grdinić (b. 1939), a pharmacist, pointed out that Strohal published his proposition in 1942, long before the unified Yugoslav nomenclature (1966), and—we should add—in a year when Yugoslavia no longer existed (19). “It has to be said that the anionic names of acids are simple, easy to learn, comprehensive, and are logically connected with the constitution of acids,” they said and added that “there is more whim than linguistic arguments” in contradicting the proposition for anionic naming of acids.

But Professor Simeon’s opinion, expressed in such an influential book as *Inorganic Nomenclature*, was decisive for the abandonment of anionic names of acids in Croatia. There is no trace of it left in the new textbooks, nor in lexicons. In schools its usage was judged as inappropriate and erroneous (20). However, it still persists in the commercial names of chemicals, as well as on numerous Internet sites with chemical content, and—because of the influence of Professor Grdinić—in pharmaceutical literature (21, 22, 23), which was criticized for doubling the official chemical names (one for chemists, one for pharmacists) (24).

Interestingly, anionic nomenclature is still in official use in Serbia, Bosnia and Herzegovina, and Montenegro, but the old names of acids are preferred.

Conclusions

There were many proposals worldwide for naming chemical compounds, some even without reference to any traditional nomenclature (25). But it is not enough to create new words or a new language; they necessarily have to be accepted and used by a community, however small. This was the case with the anionic nomenclature.

It is very symptomatic that it was not used in Germany, the United Kingdom, the United States, France, or any country in which Ostwald’s *Die Schule der Chemie* was read. Instead, it was used officially for more than 30 years in the Communist Yugoslavia, but only in the federal units in which “Serbo-Croatian” language was spoken (26). The principal reason for its use was obviously not chemical but political; as federal (Yugoslav) oriented Hrvoje Iveković was its propagator, so was nationalistically (Croatian) oriented Vladimir Simeon its principal opponent. Abandonment of anionic nomenclature in Croatia thus has to be viewed not only as an adjustment of Croatian inorganic nomenclature to the IUPAC recommendations, but also as one of many victories in the fight for the independence of the Croatian language.

References and Notes

1. “If we take his traveler diaries in our hands,” Professor Fran Bubanović (1883-1956) (Ref. 2), a Croatian chemist, wrote of his colleague and friend Fran Tućan (1878-1954), Professor of mineralogy at the Zagreb University, “and also if we attend his speeches and lectures about his impressions he obtained by observing people from a viewpoint of a man of science, a man who really had the opportunity to build his own personal opinion of the world and life, we will be convinced that the mineralogist Fran Tućan in his general statements puts to the light as the most natural and the most sober thought, which stems from the nature and life of our people, that Croats and Serbs, as far as he knows them, are one nation.” (F. Bubanović, *Kemijo, hvala ti! (Thank you, chemistry!)*, Jovana i Vuića, Beograd, 1939, p 110).
2. N. Raos, “Letters of Svante Arrhenius to his Former Croatian Student,” *Bull. Hist. Chem.*, **2008**, *33*, 12-16.
3. M. Tanner, *Croatia: A Nation Forged in War*, 2nd ed., Yale Univ. Press, New Haven, 1997, pp 141-167.
4. V. N. Njegovan, *Osnovi hemije (Foundations of Chemistry)*, Naučna knjiga, Beograd, 1965, pp 110-116. Njegovan made a linguistic mishmash; for instance, a Croatian word for iron would mean iron as a chemical element, and a Serbian word for it would mean iron as a material. He also, as the first editor-in-chief (1927-1933) of the central Croatian chemical journal *Arhiv za hemiju i farmaciju* (now: *Croatica Chemica Acta*), insisted that the journal be published in the Serbian, not Croatian, language (N. Trinajstić, *Ogledi o znanosti i znanstvenicima (Essays on Science and Scientists)*, Matica hrvatska, Zagreb, 1998, pp 125-142).
5. D. Strohal, “Prijedlog za izmjenu kemijskog nazivlja kiselina (Proposition for Revision of Chemical Nomenclature of Acids),” *Kem. Vijest.*, **1941/42**, *15/16*, 126.
6. V. Stilinović and T. Portada, “Je li ‘Strohalova nomenklatura’ doista Strohalova? (Is ‘Strohal’s Nomenclature’ Really Strohal’s?),” *Kem. Ind.*, **2005**, *54*, 347-350.

7. Student: Really, why are there double names?
Teacher: This is for historical reasons. At first, German names were trivial, then the scientific opinions of acids and salts changed, and non-German names appeared. But the names of acids did not change, thus German names are still in use.
Student: But one could also say "chloratic acid" and "hypochloritic acid."
Teacher: Certainly. When you have become an influential chemist, you can propose and propagate these names.
Student: Why don't you do it yourself?!
- Teacher: In the meantime you have to learn the old names, because they are in general use.
(W. Ostwald, *Die Schule der Chemie – erste Einführung in die Chemie für Jedermann*, 3rd revised edition, Vieweg & Sohn, Baunschweig, 1914, p 232. Ostwald's book was published in English under the title *Conversations on Chemistry: First Steps in Chemistry*; however, the German title translates to *The School of Chemistry – the First Introduction to Chemistry for Everyone*.)
8. W. Ostwald, *Uputa u kemiju za svakoga* (G. Fleischer, Tr.), Bjelovar, 1912. It is interesting that Fleischer translated not only the new names of acids into Croatian, but he also "translated" *deutsch* into *hrvatski* (Croatian).
 9. S. Paušek-Baždar, "Kemijski rad Gustava Fleischera (Chemical work of Gustav Fleischer)," *Radovi Zavoda za znanstvenoistraživački i umjetnički rad u Bjelovaru*, **2007**, 1, 205-216.
 10. E. Wiberg, *Lehrbuch der Anorganischen Chemie*, 57th-70th revised edition, Walter de Gruyter & Co, Berlin, 1964.
 11. E. Wiberg, *Anorganska kemija* (H. Iveković, Ed.), Školska knjiga, Zagreb, 1967.
 12. In the Kingdom of Yugoslavia (1918-1941) and Communist-ruled Socialist Federal Republic of Yugoslavia (1945-1991), it was politically very dangerous to speak in the Croatian or Serbian language. The language was called Serbo-Croatian, Croato-Serbian, or Eastern (i.e. Serbian) and Western (i.e. Croatian) standard. As nobody likes to call their native language by strange names, the most popular term was "our language."
 13. *Unificirana jugoslavenska nomenklatura anorganske kemije, izrađena na osnovi preporuka Internacionalne unije za čistu i primijenjenu kemiju (Unified Yugoslav Nomenclature of Inorganic Chemistry, Composed on the Basis of the Recommendations of the International Union for Pure and Applied Chemistry)*, Ed. H. Iveković, Školska knjiga, Zagreb, 1966.
 14. "I am irritated by the names *klorna* (chloric), *klorasta* (chlorous) and *hipoklorasta* (hypochlorous)," responded a participant to an Internet forum in 2010. "*Kloratna* (chloratic), *kloritna* (chloritic) and *hipokloritna* (hypochloritic) sound better." It is easier to learn that *sulfat* is the salt of *sulfatna kiselina* than of *sumporna kiselina*, but one has to learn that *sulfur* is a synonym for *sumpor*.
 15. *Leksikon Jugoslavenskog leksikografskog zavoda (Lexicon of the Yugoslav Lexicographic Institute)*, Zagreb, 1974, p 943.
 16. Another attempt to stop the unification of Croatian and Serbian languages had, however, much more serious consequences. The Declaration Concerning the Name and Position of Croatian Language, signed in 1967 by 140 of the most prominent Croatian writers and intellectuals, was judged "a counterrevolutionary act." Most of the signers were expelled from the Communist party, which practically meant that they were treated as unfit for any responsible job (Ref. 3, pp 184-202).
 17. "Prijedlog Jugoslavenske nomenklature anorganske kemije (Proposition of Yugoslav Nomenclature of Inorganic Chemistry)," *Croat. Chem. Acta*, **1965**, 37, C1-C5.
 18. *Hrvatska nomenklatura anorganske kemije: izradila Komisija za nomenklaturu anorganske kemije IUPAC*, (V. Simeon, Ed.), Školska knjiga, Zagreb, 1996, p XI.
 19. S. Babić, V. Grdinić "Prijedlog za rješenje nedoumica u kemijskom nazivlju (A proposition for solving the uncertainties in chemical terminology)," *Jezičnik*, **2002**, 49(1), 1-40.
 20. "When I said *nitratna kiselina* to my professor, she stared at me in surprise and said: 'Which acid?' She insisted that these (*dušična kiselina* etc.) are Croatian names which sound better and are used in technical literature," said a participant of Internet forum, 2010.
 21. V. Grdinić, *Hrvatsko farmaceutsko nazivlje, prinosi za hrvatsku jezičnu normu i kodifikaciju u ljetopisu, preporuke 1995 (Croatian Pharmaceutical Nomenclature, Additions to Croatian Linguistic Norm and Codification in Annales, Recommendations 1995)*, Hrvatski zavod za kontrolu lijekova, Zagreb, 1995.
 22. *Hrvatska farmakopeja 2007 s komentarima (Croatian Pharmacopoeia 2007 with Comments)*, Hrvatsko farmaceutsko društvo, Zagreb, 2007.
 23. V. Grdinić, "Farmaceutski naslovi u Hrvatskoj farmakopeji (Pharmaceutical Titles in Croatian Pharmacopoeia)," *Farm. Glas.*, **2007**, 63(1), 37-55.
 24. T. Portada, Letter to Editor, *Farm. Glas.*, **2006**, 62(12), 753-754.
 25. N. Raos, "Redefining the atom," *Chem. Brit.*, **1997**, 33, 31-32.
 26. In the Slovenian federal unit, the official language was Slovenian, and in Macedonia Macedonian, similar to Bulgarian. They are also South-Slavic languages, but quite different from Serbian or Croatian. Serbian and Croatian are, however, no more different than British and American English. As Slovenian and Macedonian names of acids are also unrelated to the names of their salts (e.g. Slov. *žveplena kislina* for sulfuric acid), there is no linguistic reason against the introduction of anionic nomenclature in these languages.

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