

This Week's Citation Classic®

Henriksen A & Selmer-Olsen A R. Automatic methods for determining nitrate and nitrite in water and soil extracts. *Analyst* 95:514-8, 1970.

[Norwegian Institute for Water Research, Oslo, and Agricultural College of Norway, Vollebekk, Norway]

Automatic methods for determining nitrate and nitrite in freshwater and seawater and in soil extracts with the Technicon AutoAnalyzer are described. The methods are based on a modification of the manual procedure by Wood, Armstrong, and Richards,¹ which consists of reduction of nitrate with copperized cadmium and, with the nitrite thus produced, diazotization of sulphanilamide, the product being coupled with N-1-naphthylethylenediamine to form a highly coloured azo dye, which is measured at 520 nm. [The *SCF*® indicates that this paper has been cited in more than 165 publications.]

Environmental Chemistry in Oslo

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Alf Reidar Selmer-Olsen and I were close friends during our many years at the University of Oslo. He went to the Agricultural University at Ås, where he took charge of the Central Chemical Laboratory. I joined the Norwegian Institute for Water Research (NIVA) in 1961. Although my chemical background was synthetic organic chemistry, I soon ended up in charge of our chemical routine laboratory. During the years we met only occasionally.

Because of the increasing number of routine water analyses at NIVA, we bought our first Technicon AutoAnalyzer in 1963. During the following years, we automated many manual methods and published them in international journals. During the 1960s Technicon invited users of the AutoAnalyzer to present their methods at their conferences arranged in Europe and the US. I became one of the frequent travellers to these conferences, which gave me the opportunity to see the world.

Nitrate and phosphate were among the most popular compounds at our laboratory in the

1960s. Because of the low concentrations in our waters, we needed reliable and sensitive methods.¹

Nitrate also is an important component in soil. Reidar also used the Technicon AutoAnalyzer in his routine laboratory. At that time the need for large numbers of analyses was increasing both for water and soil. When nitrate is extracted into solution from soil, the differences between the analytical steps are small. We found that we had common interests in developing an automated method for nitrate in water and soil extracts.

We published our method at a time when need for nitrate analyses both in soil and environmental pollution work was increasing, and this may explain the great response to our paper. The method is simple and rapid and gives good reproducibility and good results. Ammonia can also be determined in the same soil extract. These facts may explain the great interest in and use of our method, with the result that it has become one of the most heavily cited papers in its field.

Our original method processed only 20 samples per hour, but this was a great achievement at that time! Newer generations of automatic analyzers have much higher capacities. Also, with the introduction of ion chromatography, we expect that our paper will not be referred to as often in the future.

In 1976 I changed topic, and since then I have been working full-time with freshwater acidification due to acid precipitation, a problem of much concern in parts of Europe (particularly Scandinavia) and North America.^{2,3} I have especially dealt with empirical modelling of lake acidification.⁴ The sulphur in acid precipitation has until recently received most attention as the acidifying anion, but today there are strong indications of increasing nitrate leaching from soil into freshwaters due to atmospheric deposition of nitrate and ammonia.⁵ Consequently, I am again very interested in the analysis of nitrate in freshwater, but now from another angle than in 1970!

1. Wood E D, Armstrong F A J & Richards F A. Determination of nitrate in seawater by cadmium-copper reduction to nitrite. *J. Mar. Biol. Assn. UK* 47:23-8, 1967. (Cited 455 times.)
2. Wright R F. Acidification of freshwaters in Europe. *Water Qual. Bull.* 8:137-42, 1983. (Cited 10 times.)
3. Likens G E, Wright R F, Galloway J N & Butler T J. Acid rain. *Sci. Amer.* 241:43-51, 1979. (Cited 185 times.)
4. Henriksen A. Acidification of freshwaters—a large scale titration. (Drables D & Tollan A, eds.) *Ecological impact of acid precipitation*. Ås, Norway: Norsk Institutt for Skogforskning, 1980. p. 68-74. (Cited 70 times.)
5. Henriksen A & Brakke D F. Increasing contributions of nitrogen to the acidity of surface waters in Norway. *Water Air Soil Pollut.* 42:183-201, 1988. (Cited 5 times.)

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