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This Week's Citation Classic™

Brooks R R & Rumsby M G. The biogeochemistry of trace element uptake by some New Zealand bivalves. *Limnol. Oceanogr.* **10**:521-7, 1965. [Dept. Chemistry and Biochemistry, Massey Univ., Palmerston North, New Zealand]

Twelve trace elements were determined in New Zealand oysters, scallops, and mussels. Abundance patterns were specific for each shellfish. Very high enrichment factors (ratio of elemental levels in dried shellfish and seawater) were observed for cadmium in scallops (2.3×10^6) and zinc in oysters ($1.1X10^5$). [The *SCI*® indicates that this paper has been cited in over 130 publications since 1965.]

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"About 20 years ago, I became the proud owner of an emission spectrograph and, as is usual with instruments of multielement analytical capability, looked around for work for it rather than using it to satisfy a preexisting need for a research project. My interest in trace elements in shellfish was sparked off by perusal of a somewhat ancient classic redolent in unreliable analytical data but edited by the eminent biogeochemist A.P. Vinogradov[1] and concerned with a compilation of trace elements in marine organisms.

"A colleague (M.G. Rumsby—now at the University of York) and I wrote to a somewhat bibulous fisherman in Nelson (a fishing port in South Island, New Zealand) requesting 'a few' shellfish. To our surprise, a very large sack containing 100 or so each of scallops, mussels, and oysters arrived in the department. Having selected a dozen of each species for analysis, we ate the rest and to this day do not care for any of these three 'delicacies.'

"Our analysis of the three species (*Ostrea sinuata* — oyster; *Pecten novaezelandiae* — scallop; *Mutilus edulis aoteanus* — mussel) resulted in two main findings. The first of these was that all species could be identified from their trace element content (just looking at them is a much easier method) and the second was that there were extraordinarily high levels of cadmium in scallops and of zinc in oysters. The oven-dried soft portions of these two species contained 249 µg/g cadmium in scallops and 1,103 µ*g*/*g* zinc in oysters. These values were so high that we did not believe that these shellfish had not been contaminated by industrial effluent, but this did not stop us from publishing the data and then quietly pulling out of a field that we had so incautiously entered. We little realized at that time that we had produced a benchmark paper on high levels of cadmium and other toxic elements in shellfish that later was to be extensively cited because of a worldwide growing awareness of this problem.

"Publication was a trauma. I well remember the hammering we had from one of the referees (a Dr. Bowen— I wonder if he still remembers), who poured scorn on our lack of taxonomic knowledge in this field, but somehow we managed to satisfy the referees.

"Some years later, I met S.J. Thrower[2] of Tasmania, who had found similarly high elemental levels in scallops and oysters from local waters. He found background concentrations of cadmium in oysters of about 5 µg/g with a maximum of about 50 µg/g (expressed on dry weight basis) whereas for zinc the levels were 600 and 12,000 µglg (1.2 percent), respectively. The high values were for specimens obtained from an oyster farm, downstream from the greatest zinc (and cadmium) smelter in the Southern Hemisphere. The zinc levels were so high that six oysters were enough to provide an emetic dose. At first, the locals blamed the Tasmanian beer (normally consumed with the oysters) for the induced vomiting. The work of Thrower was responsible for removal of the oyster farms to more favourable localities.

"Thrower later took up one of the many offers of employment which he received from the US and as I sadly think of lost opportunities, it seems to me that the moral of the story is: 'Never disbelieve your own data.' "

1. **Vinogradov A P.** *The elementary composition of marine organisms.* New Haven, CT: Sears Foundation, 1953. 647 p.
2. **Thrower S J & Eustace I J.** Heavy metal accumulation by oysters grown in Tasmanian waters. *Food Technol. Aust.* **25**:546-53, 1973.