Some unremembered chemists:

Francis Brian Shorland, OBE, PhD, DSc (L'pool), Hon. DSc(VUW), FRSNZ (1909-1999)*

B Halton†

Francis Brian Shorland (known as Brian) was born on 14 July 1909 in Island Bay, Wellington, New Zealand. His father John Olive Shorland (1864–1946) had been a long-distance cycling racer in the South Island and subsequently owned and operated a cycle shop in Cuba Street in Wellington.[1] However, John's career was as diverse as it was engaging. It encompassed building, architecture, furniture and three years as a City Councillor (1917–1920). His wife, Edith Sophia Perry, was a school teacher from the South Island West Coast and they met while she was a student at Canterbury University College. They were married in 1898 and had four children, of whom three survived to adulthood, Brian being the youngest.

Brian's education began in the Miss Hills' Kindergarten in Island Bay, where he stayed for two years before moving to Island Bay School at six years of age. There he had the usual rudimentary primary education prior to entering Form 3D at Wellington College in 1920. It was the lowest available, as he was not a gifted student. For him, college education lacked a good grounding in everything but Latin, at which he excelled, and he only just managed to pass the state examinations in English and Physics (Chemistry was not taught at that time). Despite this, his school teacher-trained mother and sister had him back to the college for an extra year in Form 6B, and at the end of that 1926 year he gained a partial pass in the Matriculation exams. He stayed on, gaining another partial pass the following year, and full Matriculation was awarded in January 1928 with Engineering and Solicitor's general knowledge. Having missed out on a job in a Christchurch wireless shop that would have let him attend Canterbury University College, and on the advice of his sister Jessie, he was engaged in the Agriculture Department Accounts Office in 1927. After a few months, a vacancy became available in the Agriculture Department Laboratory, and Brian was transferred there as a cadet (trainee scientist).

At that time Victoria University College (VUC) had moved to daytime lectures and the Agriculture Department and the newly established Department of Scientific and Industrial Research (DSIR) allowed their cadets to spend up to seven hours per week for tertiary study. Brian enrolled at Victoria, registering for Physics 1 and Pure Mathematics 1, and subsequently moved to chemistry and zoology in his second year, graduating with a BSc in chemistry in June 1931. He was able to take six months leave of absence and, with a Jacob Joseph Scholarship, he undertook an MSc the following year. He graduated with 1st Class Honours in chemistry from work studying the reactions of glycols and dibasic acids. His thesis was entitled: 'The rate of esterification of isoamyl alcohol and glycol by dibasic acids',[2,3] and was subsequently published in the *Journal of the American Chemical Society* in 1935.[4]

Dr Francis Brian Shorland (from *Brian Shorland – Doyen of New Zealand Science*, p. iii; courtesy of the New Zealand Association of Scientists)

Professor Robertson (see: Chemistry in New Zealand, 2015, 79: 51–55) was the sole organic chemist at that time and the thesis followed tradition by neither naming nor acknowledging him as supervisor.

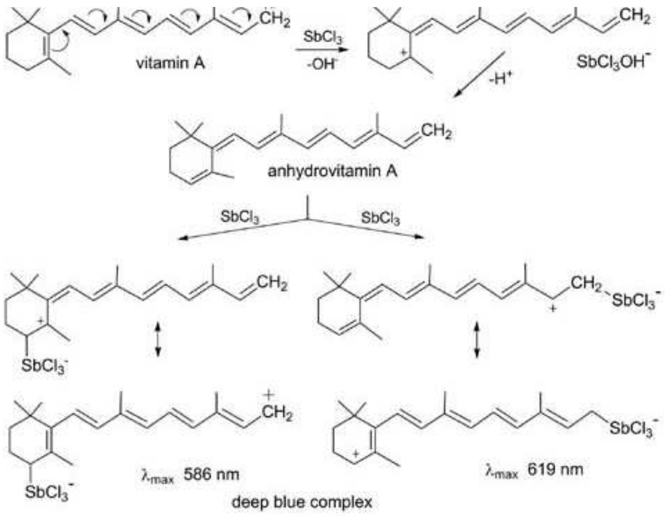
The MSc studies did not provide Shorland with his first publication. His work at the Agricultural Laboratory as a cadet was to assist staff in their projects under Bernard Aston as chief chemist. One of those there was Dr J.A. Bruce. At that time Bruce felt that New Zealand geothermal resources could be utilised, and especially steam, in energy production. Young Shorland became interested and collected samples from Wairakei for analysis and the results gave him his first two publications.[5] However, the managers of the time had little or no interest, and the work lay dormant until the late 1940s, when the science was advanced and a pilot plant subsequently constructed, producing 20 MW power by late 1952.

Following contributions to a range of projects, Shorland and his cadet colleague Frank Denz were asked to test dried and processed eel from a farm on the basis that it might provide food for pigs. The tests with the oils product proved difficult and it was suggested that the project be abandoned. However, having

*First published in *Chemistry in New Zealand* (2018) vol. 82(3): 139–144, and reproduced here with permission, this is one of a series of articles that explores the lives and work of selected chemists who have made a significant contribution to the advancement of the discipline, the profession, and the well-being of mankind, yet who are little remembered.

†Deceased 23 February 2019. Professor Brian Halton studied chemistry at the University of Southampton, graduating BSc(Hons) in 1963 followed by a PhD in 1966. Moving to New Zealand in 1968, he was appointed to the Department of Chemistry at Victoria University of Wellington, eventually becoming professor there. When he retired in 2004, he was conferred the title of professor emeritus. His research was centred on the synthesis and investigation of highly strained and fused aromatic compounds. The New Zealand Association of Scientists awarded him its Research Medal in 1974, and the Shorland Medal in 2001. He was active in the New Zealand Institute of Chemistry and was elected a Fellow in 1977, and most recently was advisory editor for its journal, *Chemistry in New Zealand*. He became a Fellow of the Royal Society of New Zealand in 1992. In his retirement, he pursued his interest in the history of chemistry, writing a history of the chemistry department at Victoria University, and co-editing with his colleague, Professor Emeritus Neil Curtis, a biography of Brian Shorland written by Dr Joan Cameron and published by NZAS.

assisted in setting up the equipment for the Carr-Price test[6] for vitamin A (something new to the department at that time), the two cadets tested the eel meal for the vitamin. It involved preparing a standard solution of 30% antimony trichloride ($SbCl_3$) and adding it to the vitamin A in chloroform to give a complex whose deep blue colour was measured colorimetrically (Scheme 1). Their success led them to examine the livers of fish caught off the Wellington coast, and the results of their unofficial project was the beginning of Brian Shorland's lifelong adventures into fats and lipid chemistry, and the first paper he wrote.[7]



Scheme 1. The chemistry of the Carr-Price test

Following his MSc degree, Brian continued with studies at VUC, taking and passing Philosophy III, Statistical Methods, and Economics, and became a classified scientist in the Agriculture Department working on his own projects. His first two years led to 12 publications on diverse topics that included geothermal heat utilisation, pampas grass as a supplement for cattle, aluminium as a causative agent in pasture bush sickness, and fish oils, one jointly with Aston. Yet the young man, now in his mid-20s wanted to progress his education to the PhD level and advance his interest in fish oils, something not then possible in New Zealand. With this intention, he applied to the Liverpool School of Fats Research to carry out PhD studies with Thomas P. Hilditch, the inaugural professor of industrial chemistry. His application was successful and he was granted leave from the Agricultural Lab with a Council of Scientific and Industrial Research National Research Scholarship. Although he was by this time engaged to Betty Purvis of Wellington, he left for London, boarding the 12 passenger-carrying ship, the twin-screw motor vessel (TSMV) *Port Fairy* in September 1935, arriving in London some 35 days later. His arrival in industrial northwest England and Liverpool was by train, and the city was something he had never seen the likes of before. Settling was far from easy, though he had accommodation with a sensible family.

The work Brian undertook for his doctoral degree was the study of fats from farm animals and fish liver oils, which he had brought with him from New Zealand with Hilditch's approval. At that time Hilditch ran the foremost group studying fats, waxes and oils, and was writing his major work *The Chemical Constitution of Natural Fats* published in five editions from 1940. The group's approach to characterising lipids was to hydrolyse them to their fatty acid components, esterify these (methanol) and separate the esters by fractional distillation. A lipid is a substance of biological origin that is soluble in nonpolar solvents. It comprises a group of naturally occurring molecules that include fats, waxes, sterols, fat-soluble vitamins, e.g. A, D, E, and K, mono-, di- and triglycerides, phospholipids, and others. The glycerides are the mono- di- or triesters formed from glycerol (1,2,3-trihydroxy-propane), and animal and fish fats are triglycerides.

The phospholipids have one carboxylic ester function replaced by a hydrophilic phosphate ester (Charts 1 and 2 and below). Chromatography was still little known; the Russian-Italian botanist Mikhail Tsvet had developed paper chromatography early in the 20th century, but it was not until the pioneering work of Martin[8] and Synge[9] in the early 1940s that partition chromatography became popular. In that era the constitution of fats and oils was determined using the saponification number and iodine value. The saponification number represents the number of milligrams of KOH required to hydrolyse (saponify) one gram of fat under specified conditions. It is a measure of the average molecular weight of all the fatty acids present. The long-chain fatty acids (see, e.g. Chart 2) present in fats have

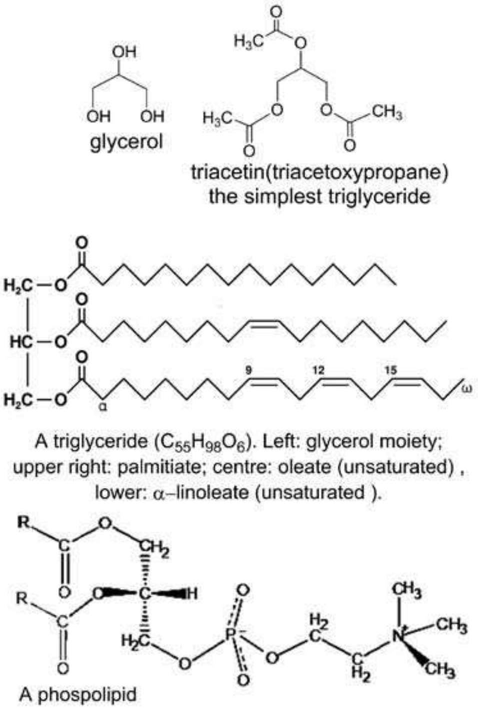


Chart 1. Glycerol, and examples of triglycerides and a phospholipid

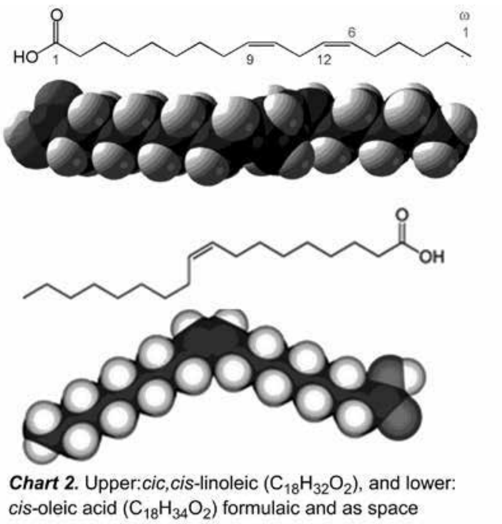
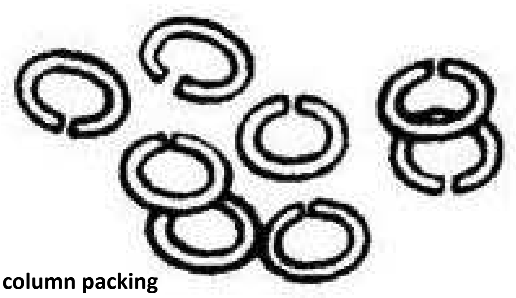


Chart 2. Upper:*cic,cis*-linoleic ($C_{18}H_{32}O_2$), and lower: *cis*-oleic acid ($C_{18}H_{34}O_2$) formulaic and as space filling models

a low saponification value because they have relatively fewer carboxylic acid groups per unit mass of the fat as compared with short-chain fatty acids. If more moles of base are required to saponify N grams of fat, then there are more moles of the fat and the chain lengths are relatively small. The iodine value is the mass of iodine in grams that is consumed by 100 grams of the unsaturated compound and provides a measure of the unsaturation in fatty acids. The higher the iodine number, the greater the number of C=C double bonds present in the fat.

These tests were pivotal to Brian Shorland's doctoral studies[10] as illustrated in his 1937 and 1938 papers with Hilditch.[11,12] Moreover, Brian and an Indian doctoral candidate named Minocher Bomonji Ichaporia[13] spent Saturdays in the Hilditch lab achieving more than the local students who were at sporting events. Frenske spiral packing in columns, introduced to Liverpool by American postdoctoral fellow Herbert Longeneker, was particularly effective and the two graduate students discovered that the longer the column the more efficient the separation.

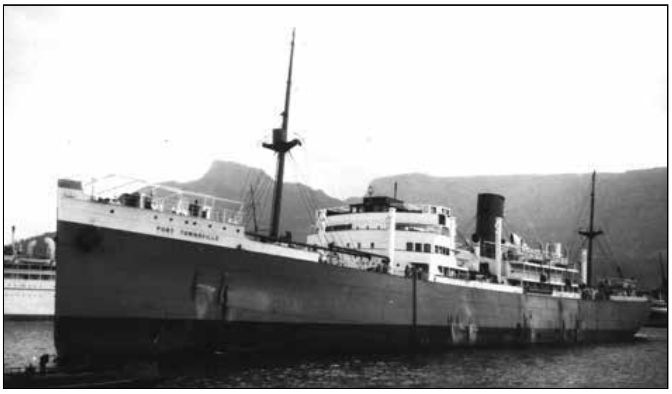


Fenske spiral column packing

Between 1934 and 1938 Brian's father, by then retired, prepared and exported as much as 144 gallons of fish-liver oil annually from Island Bay to British Drug House Ltd in London. With the contacts that this established, Brian was able to spend his vacations in the company laboratories and use one of the first spectrophotometers to aid in determining the vitamin A content of the oils from New Zealand.[14]

Brian's 1937 doctoral thesis was in essence in two parts, both of which involved triglycerides. That which formed his first paper[11] with Hilditch was a determination and comparison of the composition of the component fatty acids present as glycerides and phospholipids (Chart 1; phospholipids are major components of cell membranes) in the livers of ox, cow, pig, and sheep. The second was more closely related to Brian's prime interest, namely a study of aquatic (fish) fats[12] and gave a further four papers from Brian and his New Zealand collaborators.[15] At that time all such studies had involved species inhabiting the Northern Hemisphere and it was of particular interest to examine the fish oils of New Zealand species because many were (and are) peculiar to the Southern Hemisphere. The oils selected were from the livers of red cod, 'English' hake, and groper, as well as the head oil from this last species. The groper showed a marked seasonal variation from spring through winter in its vitamin A, iodine value, and non-hydrolysable matter content.

The external PhD examiner was Professor J.C. Drummond (later Sir Jack), the inaugural Professor of Biochemistry at University College London. His report was favourable and, with his PhD, Brian returned to New Zealand on the refrigerated cargo ship, the MV *Port Townsville*, which left London's Tilbury Docks on 12 October and called at a number of ports including ones in Australia before arriving in New Zealand in the spring of 1937.



The MV *Port Townsville* (from The AllenCollecton – Port Line, courtesy B. Watson; see http://www.benjidog.co.uk/allen/Port%20Line.html)

On return to the Agricultural Chemistry laboratory in Wellington, Brian Shorland was faced with change. Aston had retired, and the deputy since 1927, R.E.R. (Dick) Grimmett, who had tutored Brian in his cadetship, was Director.

With his doctoral degree in hand, Shorland was appointed as Chemical Advisor – Grimmett held his qualifications in zoology – and was largely able to choose his own research topics. He became recognised for expanding his horizons, not just scientifically at the bench but in terms of the space he and his projects occupied,[1] a trait that continued even into his later life and office in Victoria University's Biochemistry Department (see below).

His studies continued the interest in fish and eel oils with his Director's support. The work turned to exploring the eel oil content during maturation and an examination of both types of New Zealand eel, the log-finned *Anguilla aucklandii* and the short-finned *Anguilla australis* at various stages of their life cycle. The former matures at about 20 years of age and 5 kg in weight, while the latter does so at 5 years old and 1 kg; significant results followed. Study also included the body fat composition of farm animals, especially pigs and then sheep. These studies were extensively published and provided proof that fat was incorporated from diet, and that this fat was deposited uniformly in the storage fat of the animal. The composition of fatty acids did not change throughout the body; diet was then accepted as the important factor in determining the structure of body fat in an animal. This work led Brian to question the nature of diet and take him on to become a world recognised expert in the area. Between 1932 and 1949 Shorland had some 42 publication on the fats of fish and mammalia, and of grasses and other forage plants mainly of New Zealand origin.

In 1946, the Agriculture Department laboratories were moved from Wellington and amalgamated with the Ruakura Research Station near Hamilton, where Dr C.P. McMeekan, its first director, specialised in research to define the most productive management systems on dairy farms. The move was made for added focus on the facial eczema problem, but it did not include Brian Shorland. He transferred to the DSIR where he was appointed Director of a newly established Fats Research Laboratory.

It was established as a separate division of the DSIR to determine the fundamental nature of economically important fats, then a major source of New Zealand overseas income. At that time, more than one-third of the weight of everything New Zealand exported was fat, and the initial emphasis was on the vitamin A content of New Zealand butter, so as to comply with a short-lived British requirement.[3] The laboratory grew to a staff of 20, of whom half were chemists, and it soon became recognised as a leading centre for lipids research. Before the 1940s, lipids research was in its infancy to the extent that lipids were proffered as having no physiological purpose other than for energy storage. Fats were considered to comprise even-numbered straight carbon chains with no nutritional value save for the essential linoleic acid present (see Chart 1).

It was the work of the DSIR Fats laboratory and Brian Shorland that proved that fats were markedly more diverse than had been thought, with odd numbers of carbon atoms and branched chains common. Phospholipids (Chart 1) and galactolipids (Chart 3) were present in addition to the common glycerol-lipids. The essential feature of a glycolipid is the presence of a monosaccharide or oligosaccharide bound to a lipid moiety whereas the galactolipid has galactose as its carbohydrate moiety (Chart 3). Shorland's work at the Fats Research laboratory (the Food Chemistry Division from 1966) demonstrated the presence of fatty acids from C_4 to C_{26}, that common fats were much more diverse than previously thought and that they included branched chain and unsaturated examples that could be either of E or Z configuration. Their studies established that the depot fats of ruminants reflected their dietary intake modified by the ruminant organisms largely saturating the unsaturated fats, whereas those of non-ruminants were directly reflective of their diet. They showed that lipid structures have a variety of important physiological roles. They went on to show that theories held relating to carcass fat composition were incorrect and that the then-held evolutionary theory of animal fats was wrong and a new one was developed.

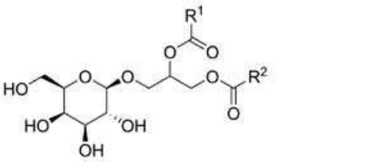


Chart 3. A monogalactosyl diacylglycerol - a galactolipid

As time and export markets evolved, Shorland and his team explored why the odour of mutton fat was unacceptable to the Japanese. In essence, the laboratory team made significant and important discoveries to the understanding of lipids, their nutritional value of particular importance to the New Zealand industries dependent on them. And Shorland's international reputation grew.

The DSIR Fats Research Laboratory, Sydney Street East, Wellington and original home of the New Zealand Dominion laboratory (from *Brian Shorland – Doyen of New Zealand Science*. p.87; courtesy of the New Zealand Association of Scientists).

When the United Nations General Assembly asked its protein Advisory Group to increase the production and use of edible protein,[16] Shorland devised high-protein food from wool, at which time the country had a vast excess.

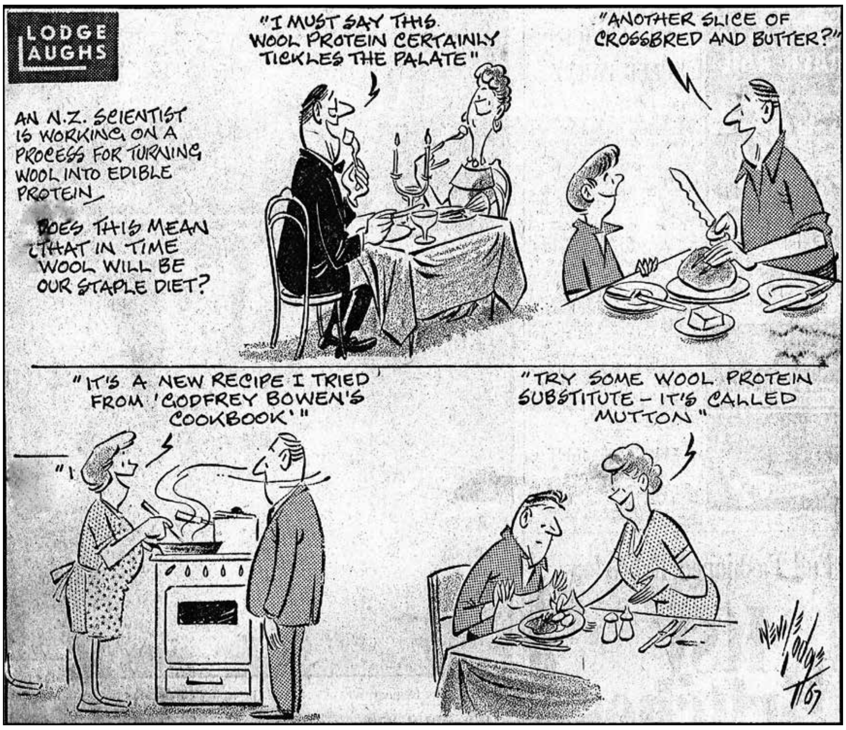
He subjected wool to a chemical and a biochemical treatment and in his 1969 paper,[17] he stated: 'Edible protein derived from wool is assessed with respect to its suitability for human food. Compared to the FAO (Food and Agriculture Organisation of the UN) reference pattern for human requirements of amino acids, wool protein is deficient mainly in methionine, and less so in lysine and tryptophan. … It is estimated that edible wool protein can be manufactured for <25 cents/lb'. The chemical process involved use of sodium sulfide-sodium sulfite followed by precipitation with acetic acid and the biochemical process[18] employed the kiwi fruit enzyme actinidin (a member of the papain family). Irrespective of the method, the amino acids solutions were dried to a white powder that lacked the essential dietary sulfur-containing acids, and so the most important of them, methionine, was added.

The successful outcome with laboratory rats led to human trials with the powder added to standard whole-meal breads, ginger nuts and sponge cakes; the products were fully edible. Up to 35% of baking flour could be replaced without affecting product acceptability. Shorland and his colleagues gained widespread publicity, as exemplified by the Lodge Cartoon in the Wellington evening paper (next page). What was perhaps more remarkable was that the processing could be applied to used and dyed woollen knitted clothing including socks!

His conversion of protein into food did not stop there. He published three papers on the equivalent production of food from feathers. Feathers contain 85–90% keratin that must be hydrolysed to make it digestible. In that process the disulfide and amide bonds in the keratin are broken to form more digestible smaller proteins, peptides and amino acids. Rendering the feathers was the traditional method of hydrolysis,[19] but it was Draper[20] who first tried treating feathers with sodium sulfide and sodium hydroxide. Interestingly, in 2012, biotechnologists at Lund University (Sweden) refined a micro-organism to convert chicken and turkey feathers into soluble protein.[21] Their spin-out company Bioextrax now provides 900 g of protein from 1 kg of feathers, and it has a patent pending for their conversion into animal feed.[22]

In Shorland's era, government service employees retired on pension at 60 years of age, and so, at the end of 1969, retirement was forced upon him. He was fortunate, however, in having professional colleagues at Victoria University and he was able to transfer and become an unpaid Honorary Lecturer in Biochemistry, a role he held until 1987, when he was redesignated an Honorary Research Fellow. He remained there, filling his office with papers and files, until his death in 1999.

The year 1971 had seen Brian appointed as convener of the Government-requested panel on coronary heart disease established by the Royal Society of New Zealand (RSNZ). The study took over a year, with a final report clearly suggesting that cholesterol and heart disease were not causally related. Replacing butter by margarine did little but aggravate the problem while increasing the intake of ω-3 fatty acids as in fish oil and olive oil



Neville Lodge cartoon, *The Evening Post*, Wellington, 11 December 1967 (from *Brian Shorland – Doyen of New Zealand Science*, p. 121; courtesy of the New Zealand Association of Scientists).

(which contains up to 1.5% of the ω-3 fatty acids linolenic acid) was beneficial. He continued with his dietary thrust, concluding in 1987 that the results of the various cholesterol-lowering regimes had been misinterpreted. More importantly, by then the biochemical understanding of the clotting mechanism was soundly based and could not support cholesterol as causative.[23]

As time passed, science in New Zealand came under government scrutiny, resulting in major reorganisation in the 1990s. Brian Shorland had joined the New Zealand Association of Scientific Workers in 1945 and remained involved with it through its morph into the Association of Scientists (NZAS) until his death. As a senior scientist he took it upon himself to be a critic of government, and he wrote and spoke widely on the topic of reorganisation. He served on the Association's Council from 1963 until the mid-1990s, was Vice-President 1965–1967, and President 1954–1955. He was Editor of the Association's Journal, *New Zealand Science Review* from 1985 until the mid-1990s. He was awarded his DSc by Liverpool in 1950, elected Fellow of the Royal Society of New Zealand in 1951, gained an OBE in 1959 and given an honorary DSc by Victoria University in 1970. He was awarded the NZAS premier award, the Marsden Medal, in 1970 and was Patron of the organisation from 1955 until his death in 1999. The Association established the Shorland Medal for lifetime contribution to scientific knowledge in his honour later that year.

Brian Shorland was married three times. His first wife, to whom he was engaged while in Liverpool and married on 27 January 1938 shortly after his return, was Betty Purvis. The couple had twins, John and Alison, in 1948 and the New Zealand Institute of Chemistry announced the event in the March 1948 issue of its Journal as: 'We congratulate Dr and Mrs F.B. Shorland of Wellington on the discovery of two new isomeric compounds, one trans and one cis'. The second marriage was for eight years and the third for some five years. Brian Shorland died in his sleep at his Karaka Bay Road home on 8 July 1999, some five days before his 90th birthday. His daughter continues to live in the old family home in Derwent Street, Island Bay, Wellington.

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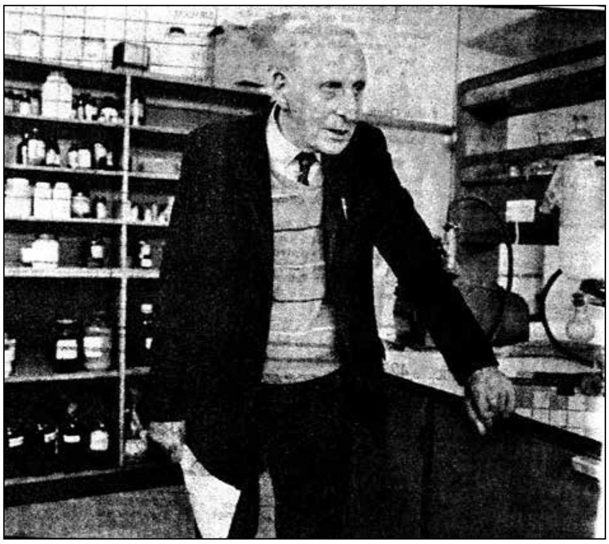

Brian Shorland – the Doyen of New Zealand Science, ca. 1995 (from *Brian Shorland – Doyen of New Zealand Science*, p. 131; courtesy of the New Zealand Association of Scientists).

Brian and Betty Shorland, 27 January 1938 (from *Brian Shorland – Doyen of New Zealand Science*, p. 143; courtesy of the New Zealand Association of Scientists).

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