



Interview by Genis Cardona with **Professor Nathan Efron**

Professor Nathan Efron completed his BScOptom and PhD at the University of Melbourne in 1981, and after two years of post-doctoral studies in Berkeley, USA and UNSW, he returned to Melbourne as lecturer then senior lecturer responsible for contact lens education. In 1990 he took up the foundation Chair of Clinical Optometry at the University of Manchester, England, and established a contact lens research and consultancy unit known as Eurolens Research. In Manchester, he served as Head of Department from 1992-97 and Dean of Research for the university from 2001-2004, and was admitted to the degree of Doctor of Science in 1995. Professor Efron returned to Australia in 2006 and joined the Institute of Health and Biomedical Innovation in the School of Optometry at the Queensland University of Technology, as Research Professor. He has served as President of both the Contact Lens Society of Australia (1981) and the British Contact Lens Association (1997). He lectures extensively world-wide, particularly in the field of the ocular response to contact lens wear, and has published over 650 scientific papers, abstracts and textbook chapters, and has written/edited 9 books — his most recent being 'Optometry A-Z' (Butterworth-Heinemann, 2007). Professor Efron has won a number of prestigious awards, including the Optician journal's 'Contribution to Optics' award (UK, 1997), the Gold Medal of the British Contact Lens Association (UK, 2001) and the Max Schapero Award (USA, 2003).

Professor Efron's current research involves an investigation of novel non-invasive ophthalmic markers of diabetic neuropathy. Specifically, he uses state-of-the-art ophthalmic technology such as corneal confocal microscopy, non-contact corneal aesthesiometry, optical coherence tomography and flicker-field perimetry to monitor deterioration and regeneration of the structure and function of nerve fibres in the cornea and retina of diabetic patients suffering from neuropathy. At QUT, Professor Efron has received funding from the National Health and Medical Research Council, the Juvenile Diabetes Research Foundation International and the George Weaber Foundation Trust.

Genís: According to your wide experience as a scholar in the field of optometry in general and contact lenses in particular, where do you feel the evolution of new contact lens materials is leading to?

Professor Efron: I think it is best to consider this issue in terms of short-term and long-term evolutionary changes. Perhaps the first point to make is that I think we are heading towards a 100% silicone hydrogel lens market, at least in the developed western world. The benefits of this material type in terms of virtually eliminating hypoxic complications demands that all lenses are made from this class of material.

So, in the short term, I think we will see enhancements of the surface characteristics of silicone hydrogel lenses. The manufacturers of primarily 'first-generation' silicone hydrogel materials will probably have to move away from plasma surface oxidation and coatings, as these approaches are expensive and perhaps result in lens surfaces that are inferior, in terms of wettability and lubricity, compared to lenses that have in-built wetting agents as part of the bulk lens properties. We will also see the introduction of lenses that contain (a) anti-inflammatory agents, to assist those lens wearers who suffer from allergic problems like hay fever, and (b) anti-infective agents, to reduce the incidence of contact lens-related infectious keratitis.

In the longer term – say, in another 10 to 15 years – all contact lenses will be daily disposable. This is such a safe and convenient form of lens wear that the market will be inevitably drawn in that direction. In silicone hydrogel materials, we already have daily disposable lenses (released in the UK in May 2008), toric lenses, bifocal lenses, and tinted lenses. The companies who employ 'second generation' manufacturing technology, which obviates the need for plasma surface treatment or coatings, are well-placed to move in this direction. So, the advice I would give to my Spanish colleagues who own shares in contact lens solution companies is to divest of those shares now!

Genís: Which are the main challenges that contact lens manufacturers may have to overcome in the next few years?

Professor Efron: Perhaps the biggest short-term problem facing the contact lens industry lies with solution manufacturers rather than lens manufacturers. We have all paid a heavy price for the ill-conceived prioritization in recent years of developing contact lens solutions that are more comfortable, at the expense of safety.



As a result, there have been a number of much-publicized contact lens solution withdrawals from the market over the past three years, and this has undermined confidence generally in the contact lens sector. So it is the solution companies who need to develop better solutions, with the priority reversed: safety first, comfort second.

Genís: Silicone-hydrogel contact lenses were initially prescribed for extended or continuous wear, even though their surface properties could not be described as optimum. New generations of silicone-hydrogels, with much better surface wettability, are often used in daily wear. How would you explain this apparent paradox?

Professor Efron: What we are seeing here is a third re-run of major practitioner-driven shifts in contact lens prescribing. To understand this, we need to briefly look back at the history of soft contact lens development over the past 35 years. In the early 1980s, after a decade of reasonably safe daily hydrogel lens wear, an extended-wear product known as the Permalens was introduced into the market. This 75% water content hydrogel lens was promoted as being suitable for extended wear because of its then-high oxygen transmissibility. The high rate of microbial keratitis with this lens forced practitioners to revert back to prescribing daily wear lenses. In the late 1980s, the Acuvue lens

was introduced as the world's first disposable contact lens. Being disposable and therefore regularly replaced, this lens was promoted as being suitable for extended wear. However, practitioners were again forced to use this lens primarily for daily wear for the same reason – a higher risk of microbial keratitis experienced when patients slept in these lenses.

Now turn the clock forward to the 21st century. When silicone hydrogel lenses were released onto the world market at the turn of the century, they were initially promoted for extended wear because of their super-high oxygen transmissibility. However, these lenses, according to some studies, have apparently failed to reduce the incidence of microbial keratitis when patients sleep in these lenses, although the severity of inflammation is generally less severe. So, yet again, practitioners have resorted to fitting silicone hydrogel lenses primarily for daily wear, despite these lenses having much better surface wettability, as you say.

Genís: Corneal hypoxia has ceased to play the role it used to in terms of etiology of contact lens complications. Which are the contact lens complications that should cause concern to the 21st century practitioner?

Professor Efron: As noted in response to the previous question, although silicone hydrogel lenses have reduced hypoxic complications, they may not have reduced the incidence of microbial keratitis when used for extended wear. This issue will therefore capture the attention of the contact lens industry over the next few years. Silicone hydrogel materials tend to have a higher modulus of elasticity (i.e. greater stiffness) than conventional hydrogel lenses – a problem that is more apparent in the first-generation silicone hydrogels. The industry has already begun, and will continue in the future, to develop silicone hydrogel lens materials that are less stiff and exhibit better comfort and fitting characteristics. Also, as mentioned above, strategies to reduce contact lens-associated inflammation and infection are high on the agenda of some contact lens manufacturers.

Genís: With the advances in refractive surgery techniques and safety protocols, is the contact lens in serious risk of extinction?

Professor Efron: There have been tremendous advances in refractive surgery over the past decade and we are now at the stage whereby this is a relatively safe procedure. However,

there is still a small risk of vision loss, and it is still a surgical procedure. The majority of the population do not like the idea of surgery on the most precious (or second-most precious!) part of their anatomy, and at the same time understand that modern contact lenses are generally safe, very comfortable and convenient to use. So, refractive surgery is certainly here to stay, but will never pose a commercial threat to contact lenses.

Genís: After 16 years as Professor of Clinical Optometry at the University of Manchester Institute of Science and Technology, some of them as Head of the Department of Optometry and Vision Sciences, and now as Research Professor in the School of Optometry at the Queensland University of Technology, what are the differences between the optometry education institutions in Australia and UK in relation to Optometric education?

Professor Efron: There is really very little difference between UK and Australia in the way optometry is taught, which is understandable in that we live in a 'global village', access the same journal publications, use the same textbooks, are serviced by the same multinational contact lens companies, and frequently attend overseas conferences and visit overseas universities on teaching/research visits. Of course, there are some differences in the way optometry is placed in the national health care systems, but even these approaches are similar. Both Australia and the UK have limited therapeutics rights, and optometry is involved in shared care schemes for diabetes and glaucoma management in both countries. So, the modes of clinical practice and sophistication of vision research in Australia and the UK is very similar.

Genís: External patients are of paramount importance for students during their final years of career. From your experience, what is the ideal vision clinic as part of a department of optometry and vision sciences?

Professor Efron: The ideal clinic facilitates student exposure to the full spectrum of patient types, such as pediatric, geriatric, contact lenses, low vision, eye disease, occupational optometry, and of course conventional refractive error correction and presbyopia correction. This is sometimes difficult to achieve; for example, some university clinics primarily service a young university population, or an old-age pensioner population. So, having the perfect



patient base of a university optometric clinic is almost impossible. An important development that has emerged over the past decade in Australia and the UK is the close collaboration between optometry schools and local hospitals with ophthalmology departments, so increasing exposure of optometry students to disease management and observation of surgery.

Genís: As an extremely prolific article and book author, what are your main research areas of interest?

Professor Efron: I have a long-standing interest in the ocular response to contact lens wear, and I am continuing to work in that area. Over the past decade I have developed an interest in corneal confocal microscopy - initially as a tool to better understand ocular reactions to contact lenses. However, this technique has drawn me into wider fields of research, such as the effects of refractive surgery on the cornea, understanding eye diseases such as keratoconus, and examining changes in the epithelial sub-basal nerve plexus as a marker of diabetic neuropathy. The last of these approaches is particularly exciting because it paves the way for an expanded role of optometry in diabetes management.

Genís: Perhaps one of the most “controversial” aspects of your career as a researcher was the “infamous” Efron-Veys paper on

contact lens defects and their statistical versus clinical significance. Was it, perhaps, a case of “much ado about nothing”?

Professor Efron: No, I think that work made an important contribution in focusing the attention of the contact lens industry on contact lens quality and reproducibility of disposable lenses. Of course, we have moved forward a long way since then, but I believe as a result of the Efron-Veys paper, we now have contact lenses of very high quality.

Genís: What is a DSc (Doctor in Science) as opposed to a PhD (Philosophy Doctor)?

Professor Efron: The degree of Doctor of Philosophy is awarded to a candidate who has successfully completed a supervised period of research in a specific field over a period of at least 3 years full-time. The measure of ‘success’ is that the work has made an original contribution to the field that usually results in about three refereed scientific papers published in reputable journals. The degree of Doctor of Science is a more senior award that is given to a candidate who has made a sustained and significant contribution to a specific field, as evidenced by a long list of high quality research publications in top international journals, typically over a period of at least 15 years.

Thank you very much Professor Efron!