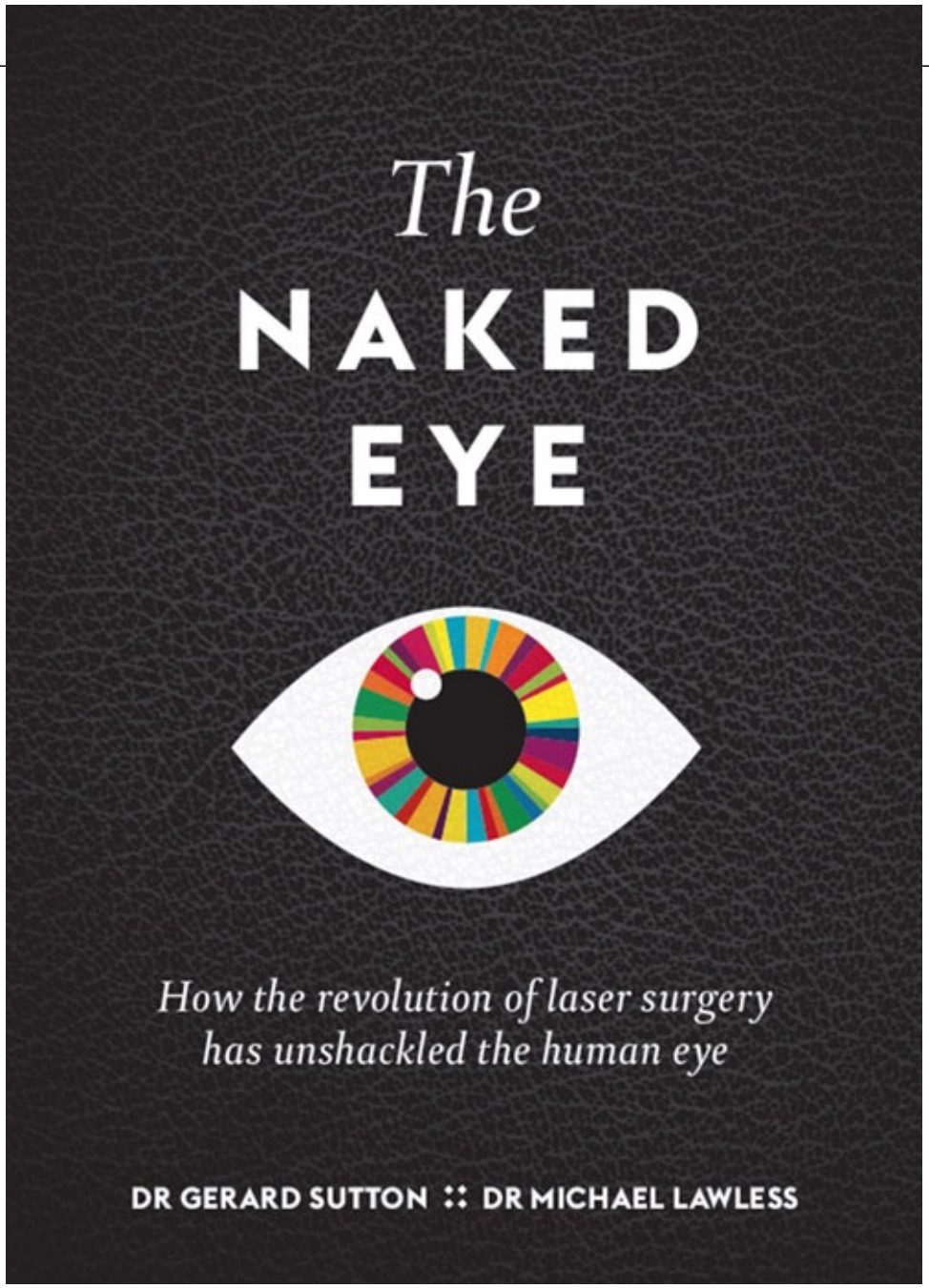
The
NAKED
EYE
How the revolution of laser surgery
has unshackled the human eye
DR GERARD SUTTON :: DR MICHAEL LAWLESS

PRAISE FOR THE NAKED EYE

"This book admirably serves its purpose to educate prospective patients, as well as medic practitioners in ophthalmology and optometry, regarding laser vision correction. It avoids th complicated technical details of the procedures and uses examples of their application for the mo common eyesight problems as well as some of the more complex ones that have recently bee successfully treated with advances in instrumentation and techniques."

Dr Richard C. Troutman, MD DSc(Hon) FACS FRCOph
Founder of the *International Society of Refractive Surge*

"Initially the use of lasers for vision correction was controversial and many ophthalmologists were the opinion that it was a passing fad which would disappear in due course. It is now universally agree that laser vision correction is within the realm of mainstream ophthalmology. The many myth relating to laser vision correction are explored and constructively debunked in this book.

The insight from reading this book will give confidence to the reader to be in the position to make a informed decision relating to laser vision correction on their eyes which could possibly change the life.

This book should be read by anyone contemplating having the procedure performed on their eyes an who wishes to understand what is current in this field of ophthalmology. It recognises the past an gives thought to what the future may hold in the use of technology, especially lasers, in the correctio of visual problems."

Professor Frank Martin, A
Chairman of the Board of the Children's Medical Research Foundatio
Past President and council member of The Royal Australian and New Zealand College
Ophthalmologists (RANZCO

The Naked Eye

A.K.A. Publishing

The NAKED EYE

How the revolution of laser surgery has unshackled the human eye

G.S *Dr Gerard Sutton*

M.L *Dr Michael Lawless*

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the naked eye

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the human eye, unassiste
by an optical instrumen
such as a telescop
microscope, or spectacles.

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The Naked I

FOREWORD

Despite my gratitude to Dr Gerard Sutton for the laser eye surgery he performed on me around t years ago, I approached his invitation to write a brief foreword to his co-written book about t subject with a feeling of dread, expecting to find the work about as exciting as listening to Australian parliamentary broadcast or watching a Superhero movie. I was surprised to find myse engrossed.

Firstly, I found the history of laser eye surgery – a very recent history – to be fascinating, especially the two pioneers of the process were working under relatively primitive conditions; Fyodorov Russia, and Barraquer in Colombia. I remember being in London some years ago when Fyodorov h organised a Russian ship, replete with eye surgeons, to be parked in the Channel, presumably out reach of government authorities. At that time the operation had not been officially approved and w categorised along with the Mexican witch doctors who offer cancer "cures". The more intrepid Bri with eye problems visited in fairly large numbers, I'm told, hopefully on days when the sea was cal as the procedure is a delicate one, preferably not performed when the patient is unstable.

This book, by Dr Lawless and Dr Sutton, is written, mercifully, in layman's language and shou answer the questions and allay the fears of those who are convinced that (a) there is a chance blindness resulting from the operation (b) the operation has a chance of failure even without blindne resulting (c) the operation is painful and (d) the eyes are removed from the socket while the horrifi patient is awake.

Speaking from personal experience with the calm and reassuring Dr Sutton, a master of the bedsi manner, I can vouch that none of the above fears are valid. At the time of my visit to the practice I w wearing bifocals, having failed miserably with contact lenses. (I used to spend hours trying to g them into my eyes and finally thought of laser eye surgery after dropping the hundredth pair down t washbasin). Dr Sutton and his team examined my eyes thoroughly and I was told that the ide solution was for one eye to be set for distance vision and the other for reading. This alarmed m initially but I was assured it is quite common and that "the brain adjusts so that there is no problem Despite worries about the capability of my own brain I gave Dr Sutton the go-ahead.

A week or so after the operation I went to renew my driver's licence. The lady at the counter, lookin at my application, said "It says here you need to wear glasses". "Not any more", I replied suavely. Sh pulled out an eye-chart and told me to read the bottom line. I read it so fluently that she looke dubious, convinced I had somehow managed to sneak a look at the chart and memorised it. On fil sets now I have noticed the crew look on with bewilderment as, at age 73, my eye goes from the acto in front of the camera to the script in my hand without any pause, hesitation – or glasses.

I have recommended a number of people to Dr Sutton over the years, including my daughter, Trilb At twenty-one she was wearing glasses so thick that she was actually legally blind. I went with her the operation and sat beside her. The procedure took only a couple of minutes. She had to wear da glasses (standard practice) for the remainder of that day. The next morning she woke in astonishmen Her vision was now perfect. She is now twenty-seven and this is still the case. The operation literal changed her life.

Bruce Beresford

INTRODUCTION

If you want a book that explains all the pros and cons of laser eye surgery in an unbiased manner, in language that you can understand and, as a result, make a decision as to whether or not this is for yo then you have found it.

This book is unique in that it is not the usual textbook whereby doctors massage their egos b bombarding the reader with complex and often irrelevant clinical information, and compound th further by intimidating you with the unnecessary technical language of ophthalmology. In crysta clear and precise language it delivers all the information that anyone requires prior to considerin laser eye surgery. Even as an expert in this field, I sometimes think that all the acronyms for visio correction procedures such as PRK, LASIK, LASEK and ASLA are entries in a secret competitio between ophthalmologists and the military to see who can produce the least understandab combinations of letters . Ophthalmologists have a reputation amongst doctors for using words th even other doctors don't understand. However, the utmost attention has been paid throughout th book, through its jargon-free approach, to make sure that the lay reader understands everything.

This book is written by two special doctors who represent the very best of Australian medicine an who, at the same time, have achieved rightful positions of leadership in the international world ophthalmology. Michael Lawless has played a major role in the International Society of Refractiv Surgery and was the first ophthalmologist to really appreciate that the tests we carry out in clinics e.g. reading the letter chart - are in reality hopeless measures in terms of determining the quality vision after laser eye surgery. He designed a very special questionnaire rapidly adopted throughout th world to truly measure the quality of visual life before and after laser eye surgery. For the first tim patients actually had a say and could provide feedback as to how clear their vision really was in tern of this surgery.

Gerard Sutton realised that a major problem in the first technique in the early days of visio correction surgery was a transient loss of clarity of the cornea. He went on to carry out research whic removed this problem and which has had profound implications for our understanding of woun healing in all parts of the eye. The innovation, open-mindedness and clear thinking of these tw individuals are the secrets of the future success of this volume.

Michael and Gerard have a great advantage in putting this text together in that they were two of th early pioneers in this field, having been there almost from the beginning. As a result they kno personally all the major players who contributed as pioneers, and have lived through the history an development of vision correction surgery. They also jointly possess the ability to assimilate technic information in a rapidly changing field with the powers of discrimination to determine between goo and bad advances. They have shared their considered opinions in the various chapters of this volun and have done so with their own remarkable brands of humour. By stamping their personalities o every page of this book they allow the reader to view the behind-the-scenes trials and tribulations th went on to perfect the most successful form of surgery in all fields of medicine. Their ov contributions are immense and cannot be over-emphasised and are greatly appreciated by both the peers and their patients. I consider it a great honour to be invited to write this introduction an commend the book to you as I'm sure you will enjoy it as much as I did, and you will certainly use as a lifelong reference for laser eye surgery for both yourself and all your friends interested in th

field.

Professor John Marshall
Moorfields Eye Hospital, London, August 2013

THE NAKED EYE

One day in 1974, a 15 year old boy presented as a patient at an eye clinic in Moscow. His problem wa unusual. He'd fallen from his bicycle and some pieces of glass had gone into one eye. For whatev reason, the boy received no medical treatment and although he appeared to have recovered, he no complained that one eye was 'different' to the other. It was presumed that the glass had damaged th cornea of one eye and, as it had been untreated, now affected his vision.

The doctor who treated him, Svyatoslav Fyodorov, examined the boy's eyes, and what he saw was t lead to the greatest revolution in eye surgery in hundreds of years. One eye, the boy's uninjured ey was still short-sighted. The other eye, which had been cut by the piece of glass externally, had heale with a scar, yet incredibly the optical error had been fixed. He was no longer short-sighted in this ey Fyodorov realised that the glass cut to the cornea had healed in a certain way that had repaired th short-sightedness in that eye. From this Fyodorov developed a new surgical technique and went on make some of the greatest advances in the field of vision correction surgery.

Even though the evolution of laser vision correction is a truly fascinating story, there has been ver little written about it. It is a mere fifty years since the first vision correction procedures we performed by José Barraquer in Colombia. But since then, vision correction surgery has had turbulent history. The famous words of French physiologist, Claude Bernard, are very apt for th story: "The science of life is a superb and dazzlingly lighted hall which may be reached only b passing through a long and ghastly kitchen." Over the course of the past fifty years, a stead procession of pioneering doctors have stuck their necks out and risked their reputations to bring u closer to that nirvana for so many people – the ability to see with the naked eye – *without* correcti eyewear i.e. glasses and contact lenses. The entire story has played out across the globe, from Japan Colombia, from Britain to Russia and the USA.

Both of us were, as young men, drawn to the exciting things which were happening in the world ophthalmology. A lot has happened since that fifteen-year-old boy walked into Fyodorov's surgery and we'd like to share that with you – particularly the advances of the last five years. Within our lif times, these extraordinary doctors around the world have advanced the field of vision correctio surgery, often through very rocky territory, until we have reached the pinnacle of progress, today procedures which, in the right hands and for the carefully chosen candidate, are the epitome of mode science – fabulously safe, predictable and accurate.

We feel very fortunate to be continuing the work of those brave ophthalmologists who set out to cu this age-old problem. We have interfaced with some of the biggest players in the history of th procedures and we have been privileged to be involved in setting new standards in surgical technique raising the bar to an all-time high in terms of safety.

If, like many people, you've noticed that your eyesight isn't what it used to be, this book should giv you a better understanding of the surgical procedures currently available to reduce or eliminate yo dependence on glasses. Of course this isn't meant to be a do-it-yourself or a self-diagnosis book. N does it constitute an informed consent for surgery. Each person deserves their own unique visio correction plan to achieve the best possible outcome and it is absolutely imperative that you discu your particular situation with your doctor.

There are many misconceptions and myths about laser surgery and laser surgeons, one being that v
are *against* spectacles. Almost *everyone* will require spectacles at some stage of their life – if not f
distance vision then certainly for reading vision from mid-life onwards. Current life expectancy
heading for ninety years in developed countries, so you can expect to need reading glasses for ha
your life. In addition to this, we are seeing an epidemic of short-sightedness, particularly in East Asi
with recent studies showing 80-90% of their school leavers being short-sighted.[1] But it wasn't alway
like this. As you will read in the next chapter, short-sightedness is thought to be a fairly recer
phenomenon – as is middle-age and its associated deterioration in near vision. Spectacles are current
the default solution for these eye conditions and while many people are happy to wear glasses if the
need to, for some people (ourselves included) it is the *complete dependence* on glasses that
unacceptable. What has happened in the past decade is that a revolution has taken place in the mar
solutions available to provide freedom from glasses for everyday activities. Some of us may look bac
on the era of spectacle-wearing as an eyesight solution in the same way that we now fondly look bac
at the horse and cart as a mode of transport. With laser vision correction we are entering an excitin
new era in medical science. And we'd like you to be part of that story.

> *What has happened in the past decade is that a revolution has taken place in the many solutions available to provide freedom from glasses for everyday activities.*

We wanted to create a book that was accessible to everyone, as well as being of interest to th
prospective patient, and also something that industry professionals may find helpful in their practice
Whilst this book is clinically correct, we have avoided as much as we can complicated explanation
and technical jargon. Also, it's a dip-in dip-out book and not necessarily meant to be read from cove
to cover. You can pick and choose what interests you. This book will tell you the story of visio
correction science – where it has come from, where it is today and perhaps what the future may hol
It will also enlighten you on what is involved in having laser eye surgery today. You'll learn about th
various procedures available, gain some insight into the history of eye surgery, and hopefully b
entertained along the way.

We trust that, having read this book, you will be better informed as to the range of choices availabl
how they work, and what you can anticipate if you have a vision correction procedure. Also, we hop
that our book tells you things you never knew, introduces you to some of the wonderful stories of ou
patients, and opens your eyes to the world of ophthalmology.

Dr Michael Lawless | Professor Gerard Sutton

A REMARKABLE INSTRUMENT

I see trees of green … red roses too
I see 'em bloom … for me and you
And I think to myself … what a wonderful world.

As you read the evocative lyrics of Louis Armstrong's wonderful song you are using the mo incredible device in the human body. Vision is part of the bedrock of our daily lives and yet most of take it for granted. As ophthalmologists we specialise in looking after people's eyes and wanted share with you some of the fascinating history of vision science and vision correction surgery and t interesting characters that made it happen.

Arguably Australia's most famous ophthalmologist was Professor Fred Hollows, who, in the 196 and 70s, conducted tests that recorded the best vision anywhere in the world. When he journeyed the Australian outback and put Aboriginal people in front of an eye chart he couldn't believe t results. Short-sightedness was unknown in Aboriginal people and in those eyes without disease th achieved the best test results ever recorded. It was such an unexpected outcome. It is believed that t Australian Aboriginal people lived virtually in isolation from the rest of the world for at least 40,0 years. During that time their eyes evolved excellent distance vision, which was ideal for the Australi climate and geography and their hunter-gatherer life-style. They developed better distance vision a better quality of vision than people in other parts of the world – people with more 'modern' lifestyl living in agrarian societies where there was division of labour and a lot more close work involved. that sense, Hollows' data on the Australian Aboriginals is the best understanding we have of how t eye might have been for our species – Homo sapiens – before modern times. When Governor Phill and the First Fleet landed in Sydney in 1788, the 'savages' they encountered had far superior visi than theirs.

The Aboriginals had incredibly sharp vision for hunting and seeing in the distance over large area They had no refractive error – no short-sightedness or astigmatism – it just didn't exist in the people.[2]

Superior vision was once the difference between life and death. And for most species it still is. conferred a great advantage on humans in pre- modern times because we had what is known predator vision – and we still have this today. The eyes of all living creatures can be divided basica into two sorts. There are creatures that eat other creatures – the predators, and creatures that get eat – the prey. That's basically what it comes down to. The eyes of predators and prey are fundamenta different. For example, the human eye is a bit like an eagle's eye so we can see very sharply at lo distances. And we have very good depth perception, so we can see objects in 3D. But we don't ha particularly good peripheral vision or night vision. In contrast, an antelope (or any creature that g preyed upon) doesn't have very good depth perception but what it does have is great peripheral visi so it can see something approaching and then run away or hide. When our ancestors stood up millio of years ago – evolving from apes to early man – they could see a long way. They could see prey. Th was an evolutionary advantage.

Another evolutionary advantage was our ability to continuously see stationary objects. You cannot s

it happening, but your eye is never perfectly still. Even when your eye is staring – fixated on an obje – small, jerky, involuntary movements called micro-saccades occur every few seconds. If we go bac millions of years to how eyes evolved, this is to do with how the brain actually detects movement. (was very useful to be able to tell something moving from something still because that somethi could be food. Or we could be food for it…). We have specialised nerve cells called 'edge detector built into our retina and our visual cortex. They 'fire' when they detect the edge of an object and v 'detect' it. A scientist called Troxler noticed that if we stabilise all eye movements and stare at a non moving image it will fade from view after several seconds. However, our micro-saccades cause th image of the object we are looking at to 'jump' slightly on our retina so we can continue to observe without fading.

Reptile's eyes can't continuously see something unless that something is moving, a fact which played out in the movie *Jurassic Park*… "Don't move! He can't see us if we don't move (Incidentally, it is actually believed that T-Rex *could* see stationary objects because of the size of th visual cortex of his brain and the placement of his eyes, but that doesn't make for good cinema… This is certainly true of a frog's eyes. A frog will starve to death surrounded by food if that food is no moving. If something is insect-sized and it moves then a frog will eat it. But our eyes, like the eyes many mammals, *can* continuously detect stationary objects because of those tiny eye movements – th micro-saccades. Later, in this book we'll talk more about how the laser surgeon deals with th continuous eye movement during a vision correction procedure.

Even if you have no genetically passed-on eyesight problems, as you advance in age your near visio will deteriorate to the extent that you need something to compensate for it. In evolutionary terms, th is a fairly recent phenomenon. In pre-modern times (50,000 to 10,000 years ago, before the advent agriculture), it is estimated that life- expectancy was 54 years of age. This is based on data fro hunter- gatherer populations.[3]

As life expectancy increased rapidly over time we faced the problem of living through the latt decades of life without clear near vision. Sometime around the year 1000 AD it was noticed th curved glass could magnify the size of objects viewed through that glass. By about the year 1200 A two pieces of magnifying glass had been attached to a frame and worn as glasses.

Apart from refinements in grinding and developing the lenses, glasses were used in essentially th same way for the rest of the millennium. Nothing much changed for almost 800 years. And then in th relatively brief period from the 1950s to today, there were the most amazing advances in technolog and surgical procedures in ophthalmology. In 1949 hard contact lenses made from Perspex wer invented.

These were designed to sit on the cornea – the front surface of the eye – and could be worn for up sixteen hours a day, but not without adverse effects on the eyes over time. Over the following decade the materials were improved and soft lenses were introduced. In the very first Sean Connery Jam Bond film, *Dr No* (1962) one of the villains from *Spectre* appears wearing soft contact lenses. Th arrival of the soft contact lens was a boon for many as they were more comfortable than hard lense but when you took them out, you still had the original problem. Surgical intervention was the on way to permanently improve a person's vision and what is now regarded as the pivotal moment i ophthalmology happened by accident, because of an accident.

Svyatoslav Nikolayevich Fyodorov, an ophthalmologist in Moscow, treated a fifteen-year-old bo who'd fallen from his bicycle and had had some pieces of glass in one eye. What Fyodorov saw an

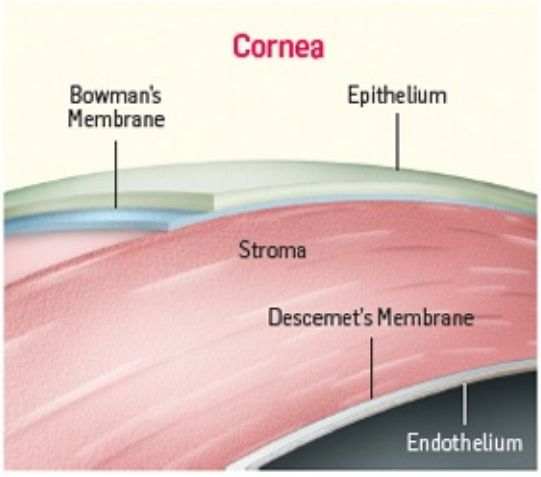
what he did led to the greatest revolution in eye surgery in hundreds of years. Fyodorov realised th the eye's surface had healed in a certain way, which had repaired the short-sightedness in that ey From this Fyodorov developed a new surgical technique and went on to make some of the greate advances in the field of corrective surgery.

If you're reading this book then you probably want to know more about laser vision correction. order to do so you need to understand a little bit about the eye itself and how it works. The eye is o of the most amazing organs in our body. It is responsible for our sense of sight and is constructed materials not found anywhere else in our bodies. The rest of our tissues are made up of bone muscles, blood vessels and various kinds of connective tissue. However, our eyes have *clear* structur i.e. the cornea and the crystalline lens, which allow light to pass straight through them and onto t retina at the back of our eye. The eye is almost like something artificial that has been put in the bo because it has these clear tissues that are not present anywhere else. But the eye is also an organ, although it resembles an optical instrument, it is actually flesh and blood and prone to a range diseases and infections.

Think of the eye as being like a camera. The eyelid is like the lens cap and when you open it you s
the cornea, which is like the main lens of the camera. What you see is captured at the back of the e
by the retina, which acts like the film in a camera. From there it is sent to the 'lab', the visual cort
of our brain, situated right at the back of our head in the occipital lobes. This is where the image
'developed' and we can make sense of the world we see.

One of the most remarkable things about the eye is the transparency of several of its structures. How it happens to be transparent is a fascinating subject.

Light travels in waves of a certain wavelength. The way the cornea and lens of your eye a
constructed allows for light waves to simply pass right through them. The cornea and lens a
constructed of collagen fibres arranged in a very orderly fashion – much like very orderly stacke
drainpipes. The wavelength of light is such that it literally weaves its way through the orderly spac
between the fibres and passes right through. If the cornea or lens gets damaged through eye disease
accident, the collagen fibres lose their orderly arrangement and we develop a scar and light can
longer pass through.



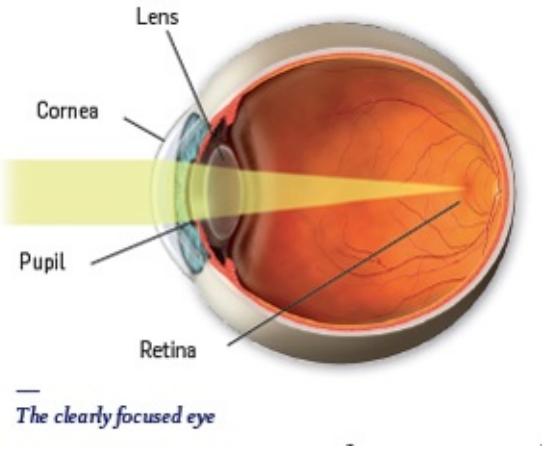
The cornea consists of five layers

The collagen fibres make up almost the entire thickness of the cornea apart from a thin layer of cel
at the front (the epithelium) and the back (the endothelium) and two membranes separating these th
layers from the main body (the stroma) of the cornea. The natural lens within the eye (which is calle
the crystalline lens) is also made up of neatly ordered collagen fibres and has an outer layer called t
capsule.•

HOW THE EYE SEES

It is a simple fact that light changes direction when it moves f rom one transparent medium to anothe
If we look at a drinking straw in a glass of water it seems to bend, and objects underwater appear to l
in a different place to where they really are.

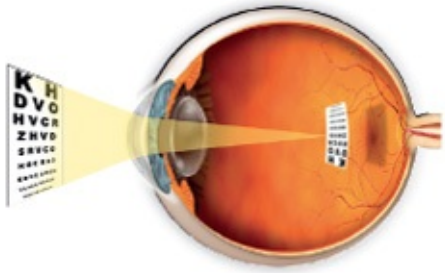
When light moves from air to water it changes direction. As the cornea, crystalline lens and variou
fluids within the eye all bend light in a very similar way, the main change in direction occurs when th
light passes through your cornea. If your eye is optically perfect, light from distance objects reach
the front surface of the eye and is bent so that it comes to a clear focus on the retina at the back
your eye. This requires the curvature of your cornea to be precisely in tune with the length of your ey
(from cornea to retina).



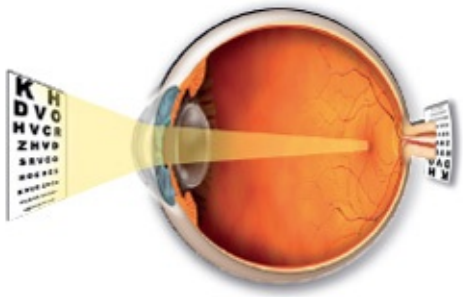
The clearly focused eye

However, if the eye is longer or shorter than this ideal or if the cornea is more or less curved, then th
image will not be in clear focus. There are four main conditions which are usually diagnosed in the
situations: myopia, hyperopia, astigmatism and presbyopia.

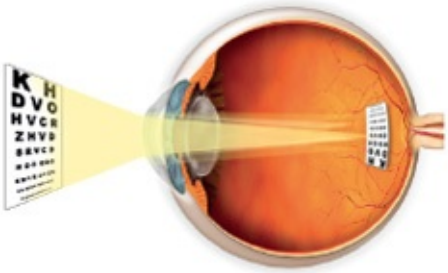
Short-sightedness – or **myopia**. Here the cornea is *too steeply curved* (relative to the length of th
eye) to focus the image clearly onto your retina and vision is blurred in the distance. An advantage
short- sightedness is the ability to see up close without spectacles. Short- sightedness common
develops as you grow and typically is detected in childhood or adolescence. It may progress into yo
twenties or in extreme cases even later.



Short-sightedness or myopia



Long-sightedness or hyperopia



Astigmatism

Long-sightedness – or **hyperopia**. Here the cornea is *too flat* (relative to the length of the eye) focus the image clearly onto your retina. Your distance vision will be better than your near visio although as you get older your distance vision will also become blurred. While your natural lens ca compensate for some degree of long-sightedness when you are younger (keeping you out of glasses f a while), long-sightedness is the most common reason that glasses are prescribed for full-time use mid to later life.

Astigmatism usually occurs in combination with either short-or long-sightedness. Here the cornea more curved in one contour than the other, resulting in vision that can be blurred for both distance an close up. It requires a more complex correction which is not usually a problem for glasses but can be problem in obtaining satisfactory vision with contact lenses. Astigmatism is usually not a impediment to a surgical vision correction solution. If you are long-sighted, short-sighted or hav astigmatism, you may be suitable for a vision correction procedure, to either eliminate or great reduce your dependence on glasses or contact lenses. Whether you are suitable for vision correctio surgery depends on a number of factors – not just your glasses prescription.

Presbyopia comes from the Greek word *presby*, meaning ‘elder’ and *opia*, meaning ‘sightedness

Presbyopia is a fact of life for all of us. Even when you are clearly focused for distance vision, t
natural lens within your eye is constantly working to fine-tune your focus from distance to near –
much the same way as the zoom lens on a camera. However, as you approach your mid-forties yo
natural lens is no longer able to work as hard and your near vision becomes blurred. This is call
presbyopia. Good lighting can help for a while but it is not long before you need the help of readi
glasses to see small print. If you are already wearing glasses or contact lenses for distance then y
will need to change to multifocal or bifocal lenses so that you can see in the distance *and* close u
Short-sighted people often just take off their glasses to read, as they naturally have good close vision

If you have presbyopia, objects that are near you, such as a computer, smart phone or menu will b
difficult to see.•

***See Presbyopia and Vision Correction,* page 32, and *The Beauty of Blended Vision,* page 76.**

20/20 VISION

AN ADULT WITH PERFECT VISION CAN READ THE SMALL LETTERS OF THE EYE-TEST CHART AT SIX METRES (OR TWENTY FEET, AS IN 20/20 VISION). THESE LETTERS ARE VERY SMALL — RIGHT AT THE LIMIT OF WHAT THE HUMAN EYE CAN SEE — AND ARE ROUGHLY A LITTLE UNDER A CENTIMETRE IN HEIGHT.

I wish I'd caught a fish for every person who's ever asked me to explain 20/20 vision (or 6/6 metric as Australian ophthalmologists and optometrists refer to it). I guess it's something that everyone's heard of, but no one has a clue what it means. So here goes: The first 20 is simple. It is just the distance from your eye to where the letter chart is – 6 metres in Australia (or 20 feet in the US – hence the 20). All ophthalmologists' and optometrists' consulting rooms are designed to have a distance of exactly 20 feet between the patient's eyes and the letter chart. That's why they almost always use a mirror. When you look at the letter chart reflected in a mirror the room only needs to be 10 feet long instead of 20 feet. Much more affordable for premises in the High Street!

The second 20 (in 20/20) is a bit trickier to explain. If you can read the letters on the 20/20 line of the vision chart at 20 feet then you are seeing the smallest letters that the average adult can read with a fully healthy eye. (In fact, most human eyes have a visual potential of slightly better than 20/20). In this way you can think of 20/20 as meaning 20/normal. Some people can see those letters without glasses, so their uncorrected vision is 20/20. This is usually what most people want to achieve from laser vision correction; 20/20 vision with the naked eye.

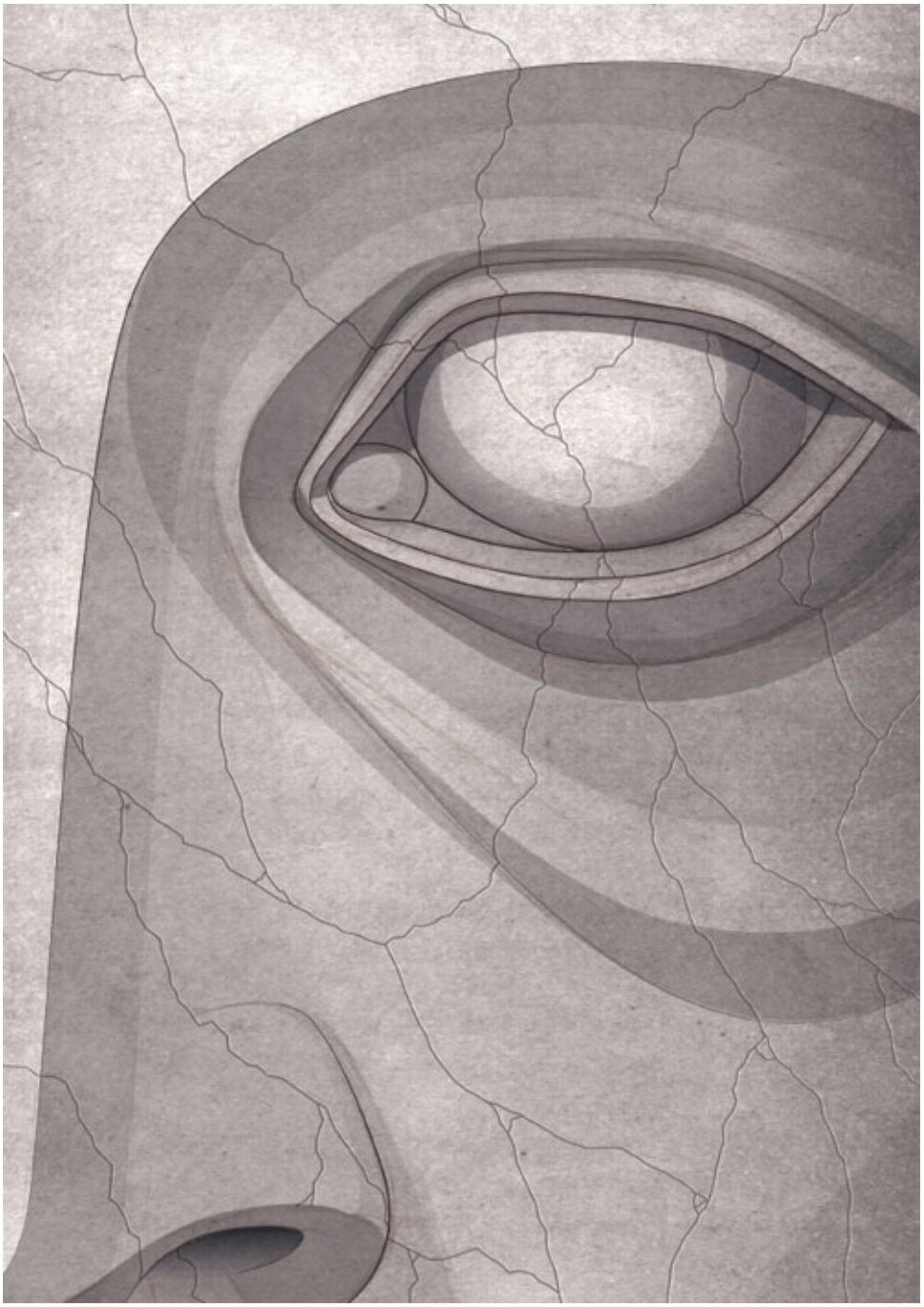
Others can only see those little letters with corrective lenses in place – we call this their **best-corrected** vision. The average adult with a healthy eye should be able to read 20/20 with or without corrective lenses. If their eye is not healthy, for example due to a cataract or macular degeneration, then they will not be capable of reading the letters on the 20/20 line of the vision chart, **even with** their corrective lenses. They might have a best corrected vision of 20/40. This means that they can see from 20 feet away what a healthy eye could see from 40 feet away. Some people have very sharp vision – better than average. They may be able to read even smaller letters than most. Their vision might be 20/15, meaning that they can read from 20 feet away what most people can only read from 15 feet away.

20/20 vision is considered the best level of vision for humans. So if you're in the 20/20 category and feeling pleased with yourself, think about this: The tiny letters you can see on the bottom of the chart from 20 feet, a wedge-tail eagle can see from 100 feet – its vision is the same as ours at five times the distance. (If a human could see as well as an eagle they would have 20/4 vision, meaning that from 20 feet they could read letters that the average adult with a healthy eye and the best corrective lens could only read from a distance of 4 feet). However, I should also explain that the eagle has a different kind of eye as well as a different way that it is hardwired to their brain. So, now you know.

THE ANCIENTS

“People’s desire to get out of their glasses is not a recent phenomenon. They have been thinking about alternatives to wearing glasses for hundreds of years. Why? Because, for the majority of people, it feels like a handicap. It is rarely a cosmetic issue. The issue is that if you wear glasses, you are dependent on something that is like a crutch. It is like having hearing loss. You can hear with a hearing aid, but you would prefer not to have the hearing aid.”

Dr Michael Lawless



THE EYE IS ONE OF SURGERY’S OLDEST INTERESTS. WE KNOW FROM TH
BABYLONIANS THAT SOME FORM OF EYE SURGERY WAS HAPPENING AT LEAST AS FAR

BACK AS 1750 BC.

One of their kings, Hammurabi, enacted a code of 282 laws which governed a wide cross-section issues including family relationships, inheritance, divorce, legal responsibilities and penalties f breaching the code. No 215 states, “If a surgeon has operated with the bronze lancet on a patrician f a serious injury, and has cured him, or has removed with a bronze lancet a cataract for a patrician, ar has cured his eye, he shall take ten shekels of silver.” This is the earliest known reference to ey surgery and confirms that the Babylonians used lens depression for the treatment of cataracts almo 4,000 years ago.

The first recorded surgical technique for treating cataracts, known as ‘couching’, was documented b the Indian physician, Sushruta, in his book, **Compendium,** in 800 BC. He describes an operation which a curved needle is used to push the “opaque phlegmatic matter” out of the way of vision. Th “phlegm” was then blown out through the nose, or pushed into the back of the eye. Sushru recommended using breast milk to irrigate the eye during the procedure to assist the recovery proces What the Indian physician does not mention in his **Compendium** is that although the patient could se again, their vision was limited and would only deteriorate. Also, the risk of complications leading permanent loss of vision was considerable.

There are no surviving records of any new eye-surgery techniques for the next 800 years until th Roman era. Physicians working in Ancient Rome recorded in 29 AD various remedies for cataract short-sightedness and conjunctivitis. For the treatment of cataract, Roman physicians used a range variously sized needles, which were carefully inserted into the eye to break up the cataract in smaller particles. The sharp end of the needle would assist in the surgical process, whilst the blunt en would be used to cauterise the wound. Peculiarly, this was accompanied by administering blows to th patient’s head to assist the extraction process.

Then, approximately 800 years later, in the 10th century, the Persian physician Muhammad ib Zakariya al-Razi, detailed a cataract procedure where the lens was removed using a bronze or suction instrument. Zakariya al-Razi generously attributed the procedure to a 2nd century Gree physician, Antyllus. When performing this operation, the physician needed “an assistant with a extraordinary lung capacity” to suck the lens out of the eye.

This suction procedure was also described by the Iraqi ophthalmologist Ammar ibn Ali in his **Choi of Eye Diseases**. In this 10th century work, ibn Ali also provided case histories of a number of patien whom he claimed to have treated successfully.

It was to be another 800 years before French medical practitioner Jacques Daviel successful extracted cataracts from the eye. Dr Daviel set up an ophthalmology practice in 1728 and performe the first extra-capsular cataract extraction in 1747. This procedure involved the removal of almost th whole of the patient’s natural lens, leaving just the back of the lens’ very thin capsule (or skin) intac The patient’s natural lens was manually removed through a centimetre-wide incision in the fro surface of the eye. This was acknowledged as being the first significant advance in cataract surge since couching became known over 2,000 years earlier.

The more things change, the more they stay the same. When ophthalmologist and African missio worker, Dr Wendy Hofman was conducting a clinic in Gabon (West Africa) in 2010, she came face-to face with a patient who had undergone the ancient cataract surgical procedure known as ‘couching The patient seen by Dr Hofman advised that he had been to a ‘medical practitioner’ in Pointe Noir

sample content of The Naked Eye - How the revolution of laser surgery has unshackled the human eye