



# A Clear View of Life

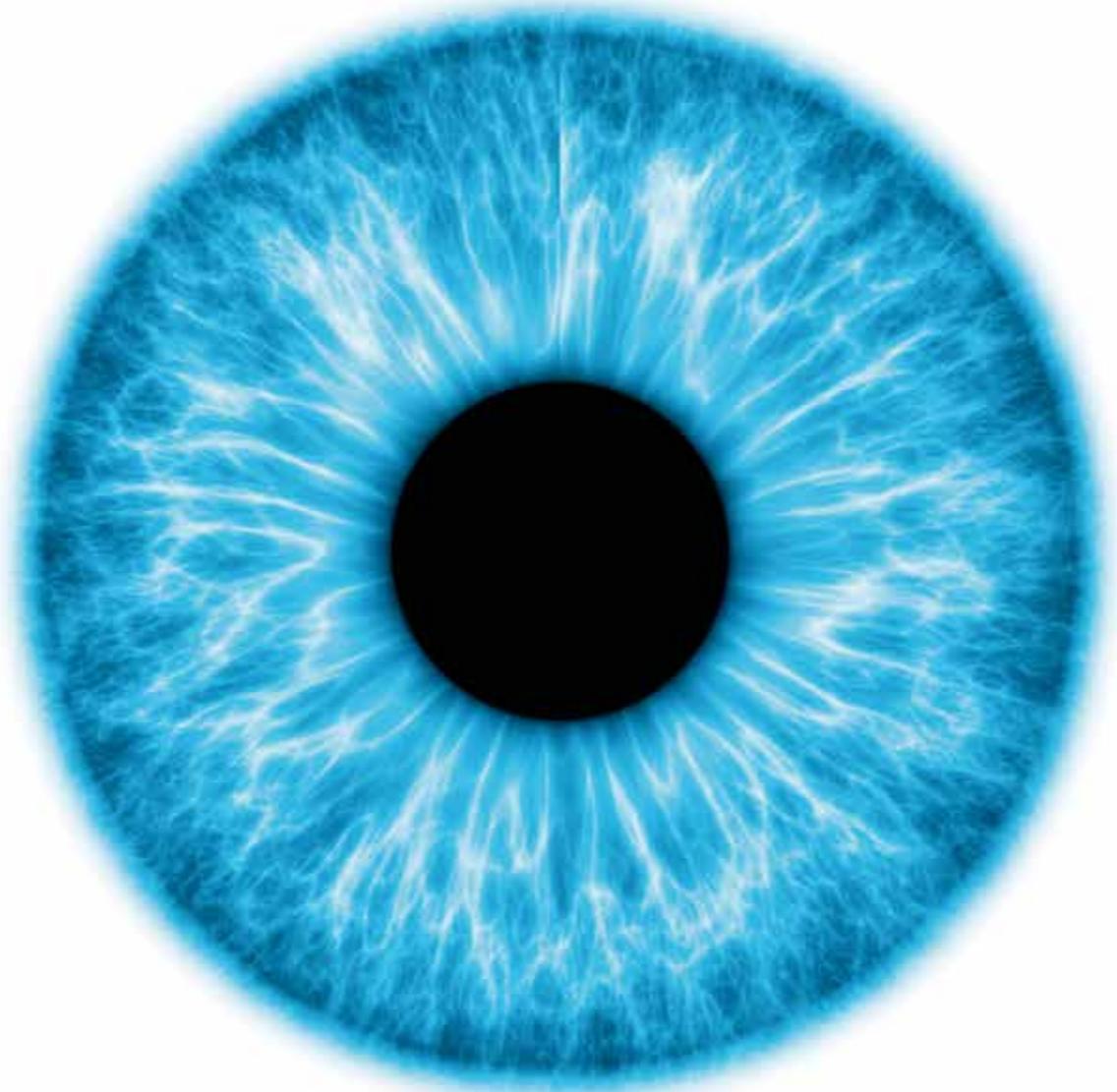
What Everyone Needs to  
Know about Good Vision



## The Miracle of Vision

We get 80 percent of our sensory input through our eyes. We use our eyes to gather information. We can see on the darkest of nights and in bright sunlight. We can distinguish between 10 million shades of colors and we can see things that are incredibly far away, like the stars in the sky, or the tiniest of specks. Our eyes are our most powerful sensory organ. When we communicate, our eyesight provides us with factual and emotional information. Our eyes prompt us to take action, for example, after looking at the clock, when something falls over, or when we are in danger. What's more, the

images we receive can melt our hearts, such as when we look at a baby's face. We take all this for granted as long as our eyes are healthy. The miracle of vision is based on complex interactions between the eye, the optic nerve and the brain. The light stimuli on the retina are passed to the optic nerve which delivers the information directly to the brain. In this way we can process about 55 images per second. These provide us with important information which allows us to see, understand and assess what is happening in the world around us.



### The Scientific Advisory Board

A scientific advisory board, consisting of three renowned ophthalmologists, has checked the information contained in this brochure. These experts ensure that the contents reflect the current state of knowledge.



**Prof. Dr.  
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After working in Heidelberg, Aachen, Cologne and London and at the Harvard Medical School in Boston, Professor Jousen became director of the Charité University of Medicine Berlin eye clinics in 2010.



**Prof. Dr.  
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Ophthalmologist Professor Richard has been Director Emeritus of the University Medical Center Hamburg-Eppendorf (since 2015), and a Past-President of EURETINA (European Society of Retina Specialists) (2014).



**Prof. Dr.  
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Professor Cursiefen is Managing Director of the Eye Center at the University Hospital in Cologne, spokesman of the DFG FOR2240 research group and board member of the Cornea Section of the German Ophthalmological Society.

Copywriter Esther Langmaack wrote the informative texts in this brochure, the eye-catching images come from photographer Dennis Williamson and the Bentele & Glomb agency is responsible for the graphic design.

## Good Vision

### Things We Can Do Ourselves

We are constantly taking a good look at the world around us: the painting in the gallery with the bright colors and the sunset with its varying shades of red. As long as our eyes remain healthy, few of us think very much about how precious good vision is. Even if we have to wear glasses from a young age because we are near or far-sighted, most refractive errors can be almost completely corrected. But then the story changes. From the age of about 40 to 50, almost

everyone needs a visual aid as the lens and iris muscles lose their elasticity over the course of time. Even before that, some people's eyesight gradually deteriorates without their even noticing it. Possible signs are irritated eyes caused by working too long at a screen or headaches attributable to tired eyes. Timely check-ups with an ophthalmologist or optometrist help to identify such complaints at an early stage, with the goal of seeing as well as possible for as long as possible.



### Sunglasses – More than just an Accessory

They can be sexy, chic or cool. Yet sunglasses should be able to do two things above all else: offer maximum protection to the eyes against aggressive solar radiation and prevent you from being dazzled by bright light. The sun harms not only the skin but also the cornea, the conjunctiva and the retina of the eyes. One day without protection is enough to cause watery,

irritated eyes. In the long term, the risk of developing cataracts or age-related blindness due to retinal disease (AMD) increases. The damage is painless, which is why it is only noticed after a number of years. That is why it is important to ensure that sunglasses are worn that offer maximum protection to the eyes beginning from childhood.

### Regular Check-ups

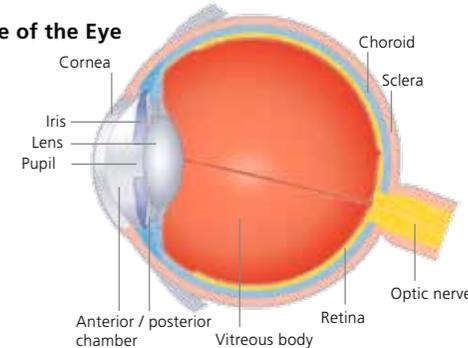
Even people who don't wear glasses or contact lenses should consult an eye specialist regularly. This is because the brain can compensate for some eye disorders for a while, and those affected can remain symptom-free for many years.

### Sunglasses – What to Look out for

*Sunglasses are decorative "face furniture," but in many situations they are also a medical necessity. The fact that the glasses are tinted doesn't necessarily mean that they have a UV filter! There are many dark glasses that do not offer 100 percent UV protection. These are dangerous because the darkening causes the pupil to dilate, leading to more light falling on the lens and the retina.*

- Always look out for the 100% UV protection label. The CE mark indicates compliance with European safety standards.
- The lenses should not be too small.
- Plastic lenses are suitable for children.

### Structure of the Eye



## Help for the Eyes – Which Lenses Help in what Circumstances?

Eagle-eyed or blind as a bat? People see things differently. Everyone has their own eye color and the performance of their eyes is just as individual. Some people always have clear vision, even at night. Others have difficulty recognizing colors correctly and some have problems with seeing at all distances. Sometimes headaches and/or irritated or watery eyes indicate that there is a problem. This is because our vision usually changes gradually, over a long period of time.



## Near and Far Sightedness

In younger people imperfect vision is usually caused by a refractive error of the eyes. That is why most deficiencies can be resolved with single-vision lenses. These glasses can correct vision across all fields of view – from near to far. Someone who is near-sighted has difficulty seeing in the distance. Road signs and people who are further away appear blurred. Far-sighted people find reading difficult or they have problems seeing the display of their cell phone clearly.

## Astigmatism

It is more difficult to identify vision defects which are caused by curvature of the cornea (astigmatism) because the brain can compensate for these. However, this additional mental effort often results in eye-strain or headaches. Glasses with single vision lenses can relieve the strain on the eyes and on the brain.

## A Strain on the Eyes

Similar symptoms of eye strain also occur as the result of frequent work at a computer screen. The eyes constantly have to refocus from the monitor to objects at other distances, such as a piece of paper lying on the desk. This is surprisingly hard work for your eyes! Computer glasses ensure optimum vision between approximately 18 inches and 13 feet. Each job has its own visual requirements. Just as anyone working on a computer can see better and more comfortably with the appropriate glasses, so too can people in other lines of work – beauticians or dentists, for example. Eyewear tailored to the needs of the workplace can make everyday life much easier and ensure carefree evenings.

## Glossary

**Accommodation:** *This is the ability of the eye to adapt the point of focus actively to different distances by means of its flexible lens.*

**Astigmatism:** *This word is Greek in origin and means “without point.” In ophthalmology, it describes an irregular curvature of the cornea, a refractive error of the eye.*

**Diopter:** *This unit indicates the refractive power of optical systems. It is used primarily in ophthalmic optics where it indicates how strong a lens must be to compensate for defective vision. Positive values indicate far-sightedness, negative values indicate near-sightedness. The higher the respective value, the greater the required compensation of the refractive error.*

**Presbyopia:** *This refers to age-related far-sightedness. It is not due to a disease, but rather to the natural ageing of the eye. From the age of 45, most people find it difficult to see close objects well without reading glasses.*

**Visual acuity:** *This term refers to the clarity of vision. It can be measured in a vision test. Visual acuity can diminish with advancing age.*

## Frames and Lenses – Total Clarity

Cool frames with large lenses or elegant rimless glasses? Each frame makes its own fashion statement: glasses are always an important accessory. The frames are actually even

more important than jewelry, scarves or ties because they are always at the center of attention and should match your personality, style and personal preferences.

### Anti-reflection

Each glass or plastic surface reflects light. This can be tiring on the eyes of eyeglass wearers and be a source of irritation for anyone around them. A good anti-reflective coating minimizes light reflection.

### Coatings

Some coatings are dirt and water-repellent and make it easier to clean plastic glasses to extend their useful life.

### Areas of Varying Refractive Power

Progressive lenses combine zones of different refractive power in a single lens, meaning that you don't have to change glasses to have clear vision in the near, middle and far distances.



## Plastic or Glass?

In the past, all lenses were made of glass. Nowadays more and more plastic lenses are being used. That does not mean that these modern lightweight lenses are always the best choice. Plastic or glass: each material has its advantages and disadvantages. Glass breaks more easily, is always heavier in comparison to plastic, but it is also significantly less sensitive to scratches.

And in progressive glasses, the different vision zones transition better. Plastic scores high due to its lighter weight, tintability, greater sun protection and ultimately, its resistance to breakage.

It is not as scratch-resistant as glass, but special coatings can be used to harden plastic, minimize reflections and make the lenses dirt-repellent.

## Presbyopia – A Pair of Glasses for All eventualities

Age-related far-sightedness affects us all. A presbyopic eye lens finds it increasingly difficult to accommodate close-up objects or different viewing distances. Modern progressive lenses offer a solution. They allow clear vision close-up, in the distance, and in the intermediate range. Modern manufacturing methods take patients' individual needs, their face shape, their choice of frame and lifestyle into consideration. These glasses are comfortable right from the moment they are first put on. Long adaptation periods, which were once common, are now a thing of the past.

### After Purchase

*After buying a pair of glasses you need to ask yourself some critical questions:*

- *Do you have good overall vision?*
- *Have the lenses and the frame been optimally fitted?*
- *Are the extras OK (tint, coating)?*
- *Progressive glasses: Are they perfectly aligned? Are the vision fields correct?*

*If the answer to one or more of the questions is no, contact your eye care professional for assistance.*

## Contact Lenses – Invisible Vision Aids

There are some situations in which glasses can be a nuisance. The pressure on your nose, the risk of losing your glasses during sports or frequent lens fogging are typical annoying problems. Contact lenses can make life easier in these situations. The small plastic discs float on your tear fluid. They are practically invisible to others – and the wearer scarcely notices them. Just like glasses they correct almost all vision defects, and multifocal contact lenses work in a similar way to progressive lenses. Soft contact lenses are more common than

hard lenses. Contact lens wearers should maintain a comprehensive lens care and hygiene regime and have regular check-ups to avoid infection and damage to the eye. In some cases, glasses or contact lenses are not enough. The severely visually impaired often need additional aids such as a magnifying glass, magnifying glasses or telescope glasses. In addition, filter lenses can be used to block specific parts of the light spectrum to protect the retina. These visual aids are fitted by eye care professionals.

## When your Vision Deteriorates

### Refractive Correction – Optimized Vision after Lasering

When their sight deteriorates, many people have a further option open to them for restoring their vision: refractive laser surgery. Vision defects of between -8 and +3 diopters can generally be remedied permanently in a single procedure. Various lasers and techniques are available for this. The doctor decides which is the best option in each case. Femto LASIK is the best known. A femtosecond

laser cuts a thin flap in the cornea which is then folded open to one side. Then an excimer laser is used to ablate the upper layer of the exposed corneal tissue. The flap is then folded back. This technique can also be used to correct patients with presbyopia. A newer procedure, SMILE, does away with the need for a flap. A tiny four millimeter incision is sufficient for the correction.

### Three Generations of Refractive Laser Correction

*Lasering away tissue on or below the surface of the cornea causes the light to refract differently, thus optimizing the quality of your vision.*

#### **1st Generation: PRK**

*PRK stands for photorefractive keratectomy.*

*An excimer laser is used to ablate tissue from the corneal surface of the eye.*

#### **2nd Generation: Femto-LASIK**

*The doctor uses a femtosecond laser to cut a circular flap with a circumference of roughly 20 mm in the cornea; the flap is then folded to the side and an excimer laser is used to remove tissue from the cornea. Afterwards the flap is folded back into place again.*

#### **3rd Generation: SMILE**

*The surgeon uses the femtosecond laser to make a corneal incision of less than 4 mm. The SMILE side-cuts incision is therefore approximately 80 percent smaller in comparison to LASIK. This helps to preserve much of the corneal stability.*



### Cataract – No Clouds on the Horizon

Cataracts develop gradually and remain unnoticed at first. In later stages, colors fade and contours become blurred, veiled and distorted. In 90 percent of cases the cause lies in the aging process. In rare cases, however, cataracts can be hereditary or acquired. Alcohol, diabetes and UV rays are risk factors. There is no known drug-based therapy as yet.

The eye lens surgery to remove cataracts is the most common procedure worldwide and is often performed on an outpatient

basis. Even if both eyes are affected, only one is operated on at a time. First the eye is anesthetized with an injection or drops. Then small incisions are made to remove the patient's clouded lens, normally using ultrasound. The natural lens is replaced with an artificial intraocular lens, inserted using an injector. Soft artificial lenses are folded before being inserted into the lens capsular bag. Because the cut is so tiny, it heals by itself and does not have to be stitched.

### Routine Procedure

*Often the idea of cataract surgery frightens patients, although it is one of the safest operations and is a routine procedure for experienced eye surgeons. Cataract surgery is the most commonly performed operation in the world.*

### Modern Lens Implants

*Just like eye glasses and contact lenses, there are multifocal versions of lens implants which ensure clear near, intermediate and far vision (assuming that the eye itself is suitable for these). When inserted in the eye, these modern lenses work in the same way as progressive glasses. Trifocal and bifocal lenses are available. These can provide cataract patients a life without glasses in many cases.*

## Keep Your Eyes Open! Why Early Diagnosis is so Important

They are very small yet absolutely crucial. Our eyes are only about 2.5 centimeters in diameter, but we use them to discover the whole world around us. However, the older we get, the higher the risk of our most important sensory organ suffering from disease. The risk of developing glaucoma increases from the age of 40. What is insidious about eye diseases such as glaucoma is that they usually develop unnoticed. The German Federal Association of Ophthalmologists (BVA) therefore recommends having your eyes examined on a regular basis. Just how

often depends on your age and other risk factors, such as smoking and high blood pressure.

Early diagnosis is often crucial for successful treatment; the damage caused by glaucoma, for instance, is irreversible. If the disease is caught at an early stage, its progress can be halted. In many cases, it is treated with both medication and surgery. In the case of pharmaceutical treatment, frequent check-ups are necessary to decide what form of treatment is most appropriate.



**Normal Vision**



**AMD**

Blurred vision, distorted lines and gray spots are possible warning signs. In age-related macular degeneration (AMD), it is primarily the photoreceptor cells in the part of the retina responsible for the sharpest vision that gradually die. The consequence is the brain receives insufficient visual information, or none at all. If AMD is treated early, the progression of the disease can be delayed.  
At increased risk:  
people over 50



**Glaucoma**

This is particularly dangerous because there are hardly any symptoms. The first cells to fail are at the edge of the field of vision. The loss of vision often goes unnoticed until a very late stage. Glaucoma is caused by damage to the optic nerve due to increased intraocular pressure and lack of blood supply. An operation or eye drops can stop the disease.  
At increased risk:  
people over 40



**Diabetic Retinopathy**

This is another dangerous disease because blurred and distorted vision are late symptoms. Changes to the vessels on the retina caused by diabetes reduce the supply of blood to the photoreceptor cells, resulting in blindness. Drugs and laser treatment can slow the progression of the disease. Diabetics should have an annual check-up.

## Diabetes – Danger to the Eyes

Diabetes is a high-risk metabolic disorder and has many inherent dangers. The likelihood of heart attack, stroke and kidney damage increases significantly. But that is not all: diabetes alters the supply of blood to the small vessels throughout the body, which also greatly affects the eyes.

The increased levels of glucose in the blood cause fats and proteins to accumulate on blood vessel walls. Pockets form which can then harm the retina. In most cases the damage to vision is irreversible, meaning that the goal of therapy is to retain existing visual acuity.

### Identifying Retinal Diseases at an Early Stage

*Precisely because vision problems caused by retinal diseases are often not noticed until a late stage, everyone – with good or defective vision – should have regular check-ups with an eye care professional.*



## Spotlight on the Retina

Wafer-thin, but incredibly important, the retina is only 0.1 to 0.5 millimeters thick, yet it consists of about 130 million cells. These collaborate to create images from light pulses which are then routed through the optic nerve to the brain. The area of sharpest vision of this thin and important innermost layer is the “yellow spot” called the macula. When we look at an object, a healthy eye adjusts so that the light rays are bundled at this point. The retina contains no pain cells, so the body’s early warning system does not function

here. This makes it all the more important to see a doctor at an early stage.

Various options are available for the treatment of retinal diseases. Surgery, lasering and medication can help retain the remaining vision for as long as possible. Drugs are increasingly being injected directly into the center of the eye to achieve a highly targeted result. This is how doctors treat, for example, AMD (page 15), retinal damage resulting from diabetes and vein blockages which cause swelling of the middle of

the retina (macular edema). Treatment is performed as an outpatient procedure under local anesthetic.

### Hope from the Lab

Researchers worldwide are working on treatments for retinal diseases. Scientists at University College, London, have already succeeded in growing new retinas from embryonic stem cells. It is not yet possible to restore eyesight to people who have gone blind as the result of retinal disease, yet this may well be the case in the future.

## In Perspective Eye Health Worldwide



The world is not a fair place when it comes to good eyesight. There is a significantly higher risk of going blind or having to live with severe visual disability in poor countries than in industrialized nations, despite both conditions being avoidable. 90 percent of all people who are blind or severely visually impaired live in developing countries. 39 million people worldwide are blind and 285 million are visually impaired. Yet four out of five cases could be prevented – if those affected received the necessary medical care.

### VISION 2020 – A Special Partnership

VISION 2020, a global initiative led by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB), has set itself the goal of eradicating preventable blindness. Cataract (clouding of the lens), is one of the most common causes of blindness. After surgery, people who had this disorder can see again. The problem: in the poorest countries of the world there is neither enough money for treatment nor a suitable health care structure. VISION 2020 wishes to address this and

other injustices. Everyone in the world should receive the preventive care and treatment they need in order to reduce blindness and visual impairment. To achieve this goal, VISION 2020 is working closely together with various non-governmental organizations and companies. The initiative has reduced the number of blind people worldwide by 13 percent since 2004.

### A Good Investment

Every dollar that flows into the prevention and treatment of eye disease pays for itself four times over. That was the finding of a comprehensive study\*. This is because the fewer visually impaired people who have to rely on the help and care of relatives, the more people there are who can work and support the economy. At the same time, good vision and therefore better integration into community life (especially in less developed regions of the world) is invaluable for the individuals themselves and for the community.

### Scholarships – Help that Makes a Difference

*Scholarships from the ICO Fellowship Program of the International Council of Ophthalmology (ICO), give young ophthalmologists from emerging economies the opportunity to receive further training in Western countries. As part of an internship at a hospital they are introduced to new technical equipment and techniques and given the chance to try them out themselves. The goal is for them to use their acquired knowledge for the benefit of patients in their home countries. Institutions, foundations and companies like ZEISS support this program.*

\*PricewaterhouseCoopers "Investing in vision" study. [https://www.cbm.de/static/medien/Summary\\_Investing\\_in\\_Vision.pdf](https://www.cbm.de/static/medien/Summary_Investing_in_Vision.pdf)



### United Against Preventable Blindness

The Christoffel-Blindenmission (CBM) and its partners helped restore eyesight. More than 430,000 people in 2016 alone received a cataract operation. CBM has been supporting people with disabilities in developing countries for more than 100 years – dedicated to the goal of improving the quality of life of the

world's poorest people. CBM has consultative status at the United Nations and is recognized as a professional organization by the World Health Organization (WHO). CBM initiated the VISION 2020 campaign together with the WHO and other partners.

### Practical Help on Every Continent

Local partners examine and treat the patients, restoring or improving the eyesight of countless numbers of visually impaired people. With its five newly established diagnostic, treatment and training centers in Africa, Indonesia and Paraguay, it is succeeding in providing better treatment to patients, and giving doctors in these

regions the opportunity to obtain sound training. CBM, the International Agency for the Prevention of Blindness (IAPB) and the Prevention of Blindness Union are turning the goals of VISION 2020 into reality. All for a world in which preventable blindness and visual impairment will soon be history.



\*The setup of the training center in Asunción/Paraguay was financed by ZEISS in collaboration with the CBM. The sites in Moshi/Tanzania and Bandung/Indonesia are also CBM collaboration partners.



### CBM Successes\*

In addition to its strong commitment to combating blindness and visual impairment, the CBM also helps people with hearing disabilities and physical dis-

abilities, providing them with access to medical and other assistance – fighting for equal rights and opportunities in the world's poorest countries.



**17.8 mill.**

people received comprehensive assistance from CBM and its partners



**533,185**

people received rehabilitation and/or schooling



**433,894**

cataract operations



**569,868**

ENT examinations and treatments

### Internet Links

[www.icoph.org](http://www.icoph.org)

[www.cbm.org](http://www.cbm.org)

<https://www.iapb.org/vision-2020/>

\*The current edition is an updated version of the brochure "A Clear View of Life" which was published for the first time in German in 2015. The facts and figures listed here refer to the 2016 Annual Report of the CBM.

**Want to make a donation to the CBM?**

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This brochure has been jointly created by CBM and ZEISS.

