

100 Years of Carl Zeiss Tessar®

Exactly 100 years ago, Carl Zeiss was granted a patent for an invention which became the most famous camera lens of all times: the Tessar® lens.

Until the death of *Carl Zeiss*, the company's founder, in 1888, the firm almost exclusively manufactured microscopes with one exception: the Abbe refractometer. In the early days of the company's history, outstanding developments were made by *Ernst Abbe* who was first a scientific colleague, then a partner and finally the founder of the Carl Zeiss Foundation, thus increasingly determining the fortunes of the company. *Ernst Abbe* was not only a scientist, but also an entrepreneur. Currency crises occurring around 1893 negatively affected the export of microscopes which induced *Abbe* to think about extending the product line, thus reducing the company's dependence on only one product. From 1888, *Ernst Abbe* started to diversify the product line. Camera lenses became a new business division. However, *Ernst Abbe* also granted licenses to companies outside Zeiss. This procedure avoided an abrupt growth of the new division at the expense of the other divisions. He deliberately accepted the disclosure of development and manufacturing know-how to competitors.



Fig. 1:
Dr. Paul Rudolph
the inventor of the
Tessar® lens

Fig. 2:
Cutaway of a Tessar® and
30 cm Tessar f/4.5 lens for
Ica 13 x 18 cm reflex camera



2

Fig. 3:
4.5 x 6 Sonnet with a 7.5 cm
Tessar® f/6.3 lens
Contessa Nettel, Stuttgart,
1921



A few highly talented scientists which he had employed played a major role in making this strategy a success. *Paul Rudolph* was one of these scientists. He is the father of some camera lenses which are still produced to this very day. He created the Anastigmat camera lens which was produced from 1890 and renamed Protar® in 1900. *Paul Rudolph* designed two further lenses during this period, the Planar® lens – produced from 1896 – and the Tessar® lens which has been produced since 1902. The name Tessar gives a clear indication of the structure of the lens: "tessares", Greek for "four", indicates that the lens consists of four lens elements.

What is the outstanding feature of Tessar®? In the early days of photography, pictures were taken in black and white. Glass plates were the "image storage media" used by serious photographers. The light sensitivity of the emulsions used was so low that shutter speed was counted in minutes. The preferred lenses at this time were two-element systems with a low speed and rather modest image quality. A few high-speed lenses existed with an aperture of about f/3.5 which cost more than a saddle-horse, provided pictures smaller than a post-

card, and whose definition was limited to the center of the image.

Paul Rudolph used new types of optical glass provided by the Jenaer Glaswerk Schott & Genossen: for example, glass types with finer grading of the refractive indices at a given color dispersion. The use of these types of glass made it possible to achieve excellent color correction, including the correction of astigmatism, spherical aberration and field curvature in the Planar® lens. However, the lenses were large and heavy. As anti-reflective technology was still unknown at this time, the pictures also lacked brilliance.

Paul Rudolph found an ingenious solution to solve some of the prob-

lems. The Tessar® lens belonging to the type of "Triplet lens" was created. The design using a dispersive element placed between two collective elements results in anastigmatic imaging. Instead of individual elements, it is also possible to use cemented components. In this case, the image-side component consists of a dispersive and a collective element. The lens with its initial aperture – "speed" – of f/6.3 was patented in 1902. The redesign performed by *Ernst Wandersleb* in 1904 resulted in the Tessar® f/4.5 lens which was available from 1907.

This was soon followed by an f/3.5 version for cinematography and projection. In 1908/1909, *Ernst Wandersleb* designed the precursor to the convertible lens sets of the Tessar® lens with an exchangeable front element. *Willy Merté's* development resulted in the Tessar® f/2.8. lens in 1932. A year later, the Tele-Tessar®K lens (f/6.3/180 mm) with its sensationally high speed was introduced for the Contax® camera built from 1932.

A "quantum leap" in the image contrast provided by optical systems resulted from the "anti-reflective coating" invented by *Alexander Smakula* at Carl Zeiss, a thin, reflection-reducing, vacuum-deposited layer. A patent application for this procedure was filed in 1935.

The Tessar lens was launched on to the market in many versions. High-quality stereo lens pairs were part of the Carl Zeiss product spectrum at an early stage. For example, *Paul Franke* and *Reinhold Heidecke* used precisely paired 55 mm Tessar f/4.5 lenses in their first Heidoscop stereo camera as early as 1920, the year when they founded their company which was later to achieve world renown as "Rollei-Werke Franke & Heidecke". Worth mentioning is also the 500 mm I.R. – Tessar® f/5 lens for aerial photography in the 30x30 cm format. An interesting design created in 1951, the Zeiss-Ikon Panflex® mirror box, combined with the 115 mm Panflex-Tessar®f/3.5 lens launched in 1953, made it possible to use the Contax® viewfinder camera like a reflex camera.

Standard lenses like the current 45 mm Tessar® T* f/2.8 lens for the Contax reflex camera are generally achromats featuring correction of chromatic longitudinal aberration for two wavelengths. This also applies to the Tele-Tessar® lenses which became available for the 35 mm and the 6x6 cm formats from 1968. The modern lenses of the Tele-Tessar® T* type for the Contax® and Hasselblad Series 200 cameras are also achromats. The Tele-Tessar® HFT lens is available for

the Rolleiflex System 6000. T* and HFT stand for enhanced transmission thanks to multilayer coating.

Higher demands made on color correction are met by apochromatic lenses which are corrected for three wavelengths. As early as 1923, the Apo-Tessar® lens was the most often used lens in reproduction photography. From 1982, a 500 mm Tele-Apotessar® f/8 lens was provided for the Hasselblad 550C camera. There are now different versions of the Tele-Apotessar® T* lens for cameras such as Contax®, Contax® 645 Autofocus from Yashica and cameras from Hasselblad and Rollei.

The image definition and brilliance provided by the Tessar® lens resulted in the slogan "the eagle eye of your camera" in 1931. The image-side cemented component was the original from which the "lens logo" was derived and used for many decades as a trademark of the company. To this day, Carl Zeiss has produced about 5 million Tessar® lenses for image sizes mea-

suring from half a fingernail to the door of a room. All over the world, lenses are produced which are based on the Tessar® design, some licensed by Carl Zeiss. The result: more than 150 million units sold to this day.

Note: Tessar® is a registered trademark

Dr. Wolfgang Pfeiffer, Aalen
Kornelius Fleischer, Camera Lens Marketing
k.fleischer@zeiss.de
Dr. Dieter Brocksch, Corporate Communications/Technical Information
brocksch@zeiss.de

Fig. 4: Contax® Aria with a 45 mm Tessar f/2.8 lens



"Star of Vision Award"

Ahead of the biggest ophthalmic exhibition in the USA, the "Vision Expo East Award", pioneering achievements in the optical industry are awarded prizes. In 2002, the panel of specialists presented the Star of Vision Award to Carl Zeiss, for a trail-blazing invention made in 1935: the anti-reflective coating of optical surfaces developed by *Prof. Alexander Smakula*. Since then, the anti-reflective coating has also improved the results obtained with the Tessar lens as is illustrated by the two historic photos taken with and without AR coating. It is not unusual for pioneering inventions to remain in use for a long time, but it is certainly not an everyday occurrence for them to be honored with an award many decades after they have been made.