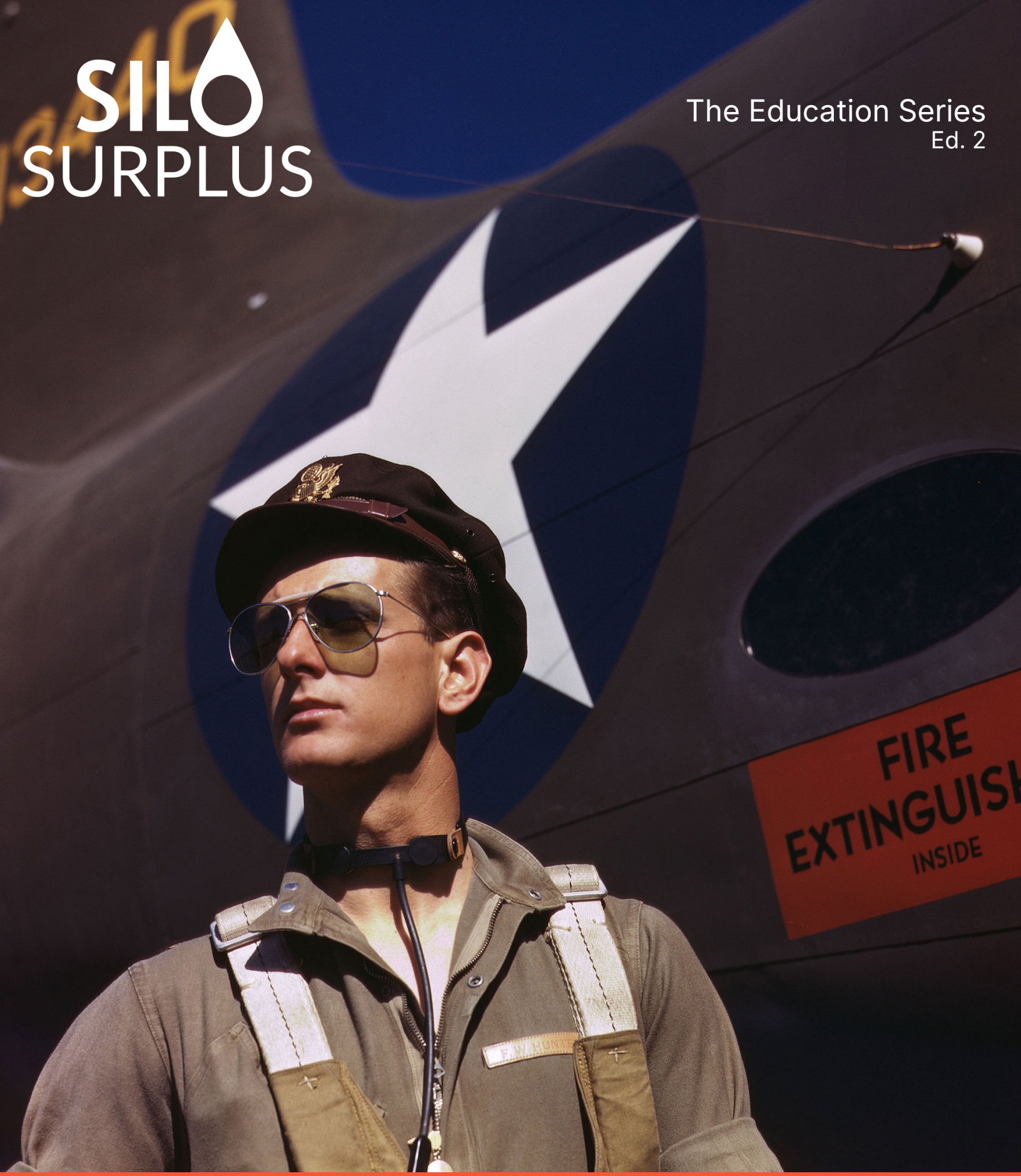
SILO SURPLUS

The Education Series
Ed. 2



Aviator Sunglasses:

The Culmination of Optical Science and its Role in Creating an American Cultural Touchstone

American Army test pilot F. W. Hunter in front of an aircraft at the Douglas Aircraft Company's Long Beach production facility, October 1942.

American astronauts Charles Conrad and Gordon Cooper onboard the USS Champlain following the conclusion of the Gemini V flight, August 29, 1965.

Aviator sunglasses, have been a hallmark of American symbolism for the part of the 20th and 21st centuries. Easily identified by their large, rounded lenses and metal wire frames, they have been a best-selling product of more than a few manufacturers, including, in particular, Ray-Ban and American Optical. Implicitly, their appearance may call to mind imagery of fighter pilots and movie stars, NASA astronauts and world-famous musicians. From these deeply rooted cultural associations, several questions can be derived, namely: how did the specific aviator style become such an enduring one? Are aviator sunglasses in any way actually relevant to the history of aviation? And what makes aviator sunglasses any different from any other type of sunglasses? Sunglasses, on their surface, may appear to be relatively rudimentary devices. Unlike glasses refined for those with eyesight troubles, the purpose of sunglasses is ostensibly to keep the brightest portions of sunlight from being an irritant to their wearer, a task that may not seem to require much in the way of scientific engineering. However, this assumption obscures a more complicated history, one that is defined just as much by the fight against light in the invisible ultraviolet and infrared spectrums as the visible.

Ultimately, the roots of aviator sunglasses and over a century's worth of American iconography trace their way back to the workshop of Dr. Théodore-Édouard Fieuzal in late 19th century Paris. In 1877, Fieuzal, a French ophthalmologist and veteran of the Franco-Prussian War, was working on a vexing problem for the age, that is, how to protect one's eyes from the harmful effects

of unseen light. In the latter half of the 19th century, electricity had enabled the use of new forms of artificial lighting as well as the employment of certain industrial techniques that produced great amounts of light radiation, particularly in the ultra-violet spectrum. It is during this time that the effects of UV radiation on human eyesight and health more generally began to be studied with newly refined scientific scrutiny, with the potential harms presented by UV light making themselves evident quite quickly. Fieuzal specifically became interested in creating protective lenswear that shielded not just the industrial worker from their hazardous work, but the general public from the regular ocular stresses of daily life. Darkened lenses had been a prescription by ophthalmologists for some time for those suffering from hypersensitivity to light, though, by and large, these lenses had operated on the principle of simply darkening one's view and lessening exposure to visible light, both a practical detriment for those preferring to productively see the world around them and often an ineffectual guard against harmful UV light regardless. Following a rebuttal from a medical colleague towards his initial experiments with cobalt blue lenses in 1877, Dr. Fieuzal began experimenting with chromium oxide based yellow lenses from 1880-1881.

"Its first effect is one of surprise; it illuminates, so to speak, nature to which it gives the warm tones reproduced by the masters of the Venetian school."

- Théodore-Édouard Fieuzal, 1885

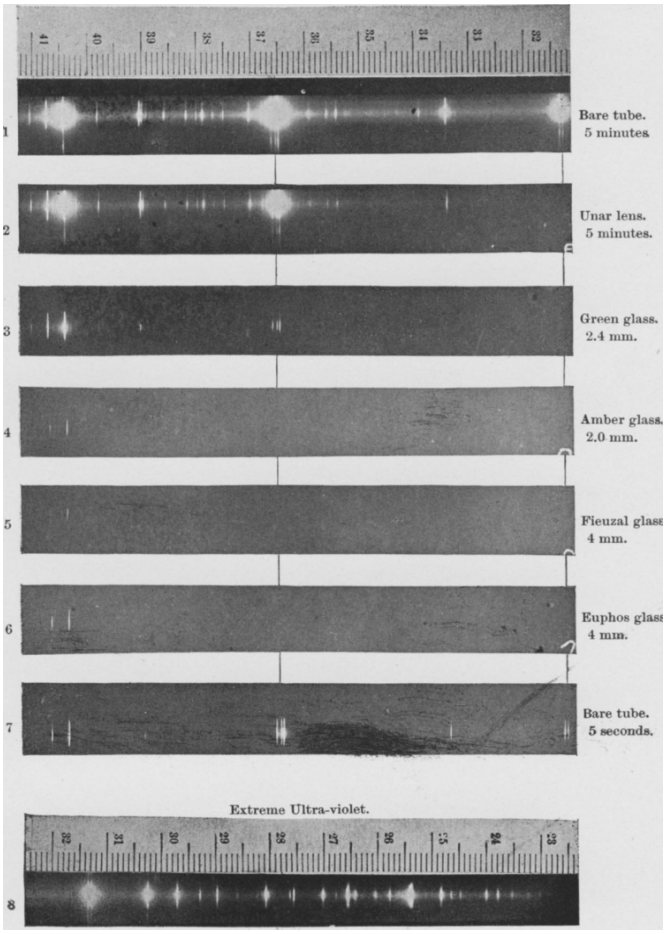
The results demonstrated early promise, apparently immunizing Fieuzal from eye irritation despite spending hours gazing at French countryside under intense sunlight, though, Fieuzal's reservations about the "aesthetic disavantage of this tint" would ultimately send him in search of a new recipe. Some months following Fieuzal's initial yellow lens experiments, he arrived at what would be his more definitive scientific contribution, a grayish-yellow lens that successfully protected against virtually all UV light, diminished visible glare, and did so without overly significant compromises to user visible clarity or color accuracy. In fact, subsequent testing of anti-UV optics by researchers Louis Bell and F. H. Verhoeff in 1916 would find "the last line transmitted by [Fieuzal's] glass from the spectrum of the quartz arc is 404.6 μμ very faintly," hence demonstrating Fieuzal's lens' ability to very effectively restrict light within the UV spectrum.

"The superiority of grey-yellow lenses over the former (chromium oxide), which I prescribed five years ago, cannot be doubted by anyone, and I cannot recommend their use enough, even to people with excellent eyesight, and even more so to those with delicate eyesight."

- Théodore-Édouard Fieuzal, 1885

UV light was not the only form of electromagnetic radiation in contention however, and, beginning in 1909, in company

with the Glass Workers' Cataract Committee of the Royal Society, Sir William Crookes, already a famed chemist for his discovery of the element thallium in 1861, endeavored to create a glass that could limit both ultraviolet and infrared light. Glass workers of the time, among many other industrial laborers suffered from a number of particular ailments, namely cataracts, that were suspected to be a by-product of their work environment. Physicians worried that over-exposure to intense IR radiation from molten materials and UV radiation from industrial tools might have been driving the medical condition. Crookes set off to work on a research project that would span years, culminating in the production of over 300 varieties of glass of different known quantitative compositions. These glasses represented a careful balancing act of chemical composition in an attempt to attune three fundamental qualities, "athermancy, adiactinity, and transparency", or the abilities to stop IR and UV radiation respectively while still being transparent enough to see through. To that end, Crookes would succeed in generating a wide variety of useful lenses, particularly with the incorporation of cerium nitrate to the glass flux which dramatically cut the transmission rate of UV light, somewhat limited IR transmission, and only lightly tinted the resulting glass. Other promising elements in this regard included uranium, lead, and iron. While the glass containing the true trifecta of impermeability to IR and UV radiation with perfect visible light transmission remained out of Crookes' grasp as of his late 1913 presentation to the Royal Society, even he admitted the utility of some opaqueness and tinting relative to visible light, especially when used in contexts of exposure to the sun. Mountaineers, sailors, and those otherwise suffering from overwhelming solar glare could just as well benefit from a reduction in visible light as protection from invisible UV. From Crookes' work, a burgeoning interest grew in using the newfound lens technology for recreational use, what would become the sunglasses industry. Crookes' lenses offered professionals, specialists, and the otherwise relatively well-to-do who could afford them, comfort and scientifically-assured protection from the solar rays that might otherwise do them harm. Within a few years, sunglasses would transition from an ophthalmologist-recommended vision corrective into a fashion statement.



Plates from Verhoeff and Bell's 1916 experiments testing the opacity of different glasses to UV light exposure, including Fieuzal's glass and euphos glass.

"The heat rays are very strong, and if injury to the eye is caused by exposure to radiation from the molten glass, a protective glass should be opaque to the infra-red rays. These being present in the radiation from molten glass in far greater abundance than the ultra-violet rays, the inference is that it is to the heat rays rather than to the ultra-violet rays that glass workers' cataract is to be ascribed. It is, however, certain that exposure to excess of ultra-violet light also injuriously affects the eye. That the ultra-violet rays act on the deeper-seated portions of the eye is shown by the intense fluorescence of the crystalline lens induced by these rays."

- Sir William Crookes, 1913

Refinement of anti-UV ophthalmologic technologies would receive a particular boost during the First World War given the emerging military necessity for anti-light measures, particularly for soldiers fighting in highly reflective, snow-strewn battlefields. In a 1915 article for *Die Umschau*, a German technical publication, a Dr. F. Schanz would describe the UV problem and his proposed solution in lenses created from *euphos* glass, a yellow-greenish tinted glass of German origin that Schanz claimed outstanding results from. Per his writing, during an expedition, polar explorers, "Amundsen and Hansen, who wore the euphos glasses were the only members of the party that escaped snow blindness."

"On several occasions the movement of armies over snow-clad mountain passes has been impeded chiefly by these effects of sunlight.[1]"

- F. Schanz, 1915

Similarly, around 1915, the United States Department of the Navy issued a request to the National Bureau of Standards (now the National Institute of Standards and Technology or NIST) to tighten up industry standards concerning the production of protective lenses and improve upon their absorptive properties. A concern regarding lenses of the time such as Crookes' was the degree to which they absorbed visible light in the yellow-green spectrum, the wavelengths of light the human eye was most sensitive to, hence limiting potential vision. Further refinement of anti-UV glass to be less restrictive in the yellow-green spectrum would prove troublesome, and would take some time, at least over a decade following the United States Navy's initial request before optimal "spectral transmission" was achieved in protective lenses just as efficiently as athermancy and adiactinity had been.

Meanwhile in the civilian market, around 1929, Sam Foster, an industrious Austrian immigrant and founder of the small plastic products company, Foster Grant, made the decision to redevelop his production strategy with the creation of a new product line of celluloid sunglasses. Being mass producible and at a considerably lower cost than traditional glass sunglasses, especially during

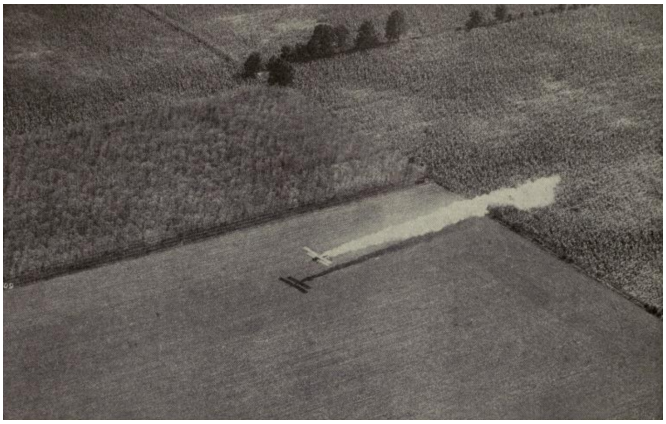
the days of the Great Depression, Foster Grant's celluloid sunglasses rapidly caught on in popularity. Though not the scientifically-constructed anti-UV protective goggles that had come out of Crookes' workshop, Foster Grants were by-and-large, appreciated as good enough for the general public's recreational needs and soon emerged as one of the first major sunglasses brands. It is also by this time that the cultural influence of Hollywood had cemented itself as a veritable socio-economic force on various consumer industries. The frequent appearances of celebrities dawning sunglasses in pursuit of anonymity or simple refuge from the sunny California climate became virtual marketing campaigns unto themselves.

While the consumer sunglass market became driven by the social currents of the day and mass availability provided by newer materials like celluloid, the specialist and military markets still demanded effective UV protection. One field in particular, owing in large part to its relative novelty, brought with it a new set of demands that would ultimately yield its namesake sunglasses, aviators. Aviation by 1929 was, by all accounts, a rapidly developing field. The tail end of the 19th century had seen its fair share of creative endeavors to produce flight, including gliders, airships, and balloons of all variations, already fulfilling centuries of fanciful imagination of joining the birds as guests in the clouds. Further still, even these early forms of flight had already managed to demonstrate themselves useful for practical applications. A notable case study for this would be the formation of the Union Army Balloon Corps during the American Civil War which would prove relatively decisive with the military intelligence it could provide during the Peninsula Campaign of 1862, even if the corps was less appreciated by the wider American military establishment of the time. The successful heavier-than-air powered flight of the Wright brothers in 1903 however utterly redefined the possible boundaries of the enterprise, opening the door to an entirely new school of development that would ultimately constitute the science of aviation as it is generally known to this day. Starting with the Wright brothers' working template, other intrepid engineers and scientists rapidly developed their own airplane prototypes. Risk-taking early pilots sought to overcome ever more challenging milestones, from maintaining flight for more than a few minutes to successfully flying over the English channel as Louis Blériot would accomplish in 1909. Nation-states began to patronize the development of airplanes and sponsor the formation of pilot training programs in the hopes of successfully militarizing the technology. When, following the outbreak of World War I, military leaders found themselves locked into a struggle from which many of the old doctrines of military tactics were woefully outdated, new technologies such as the airplane offered the means of adapting to the new rules of warfare. Amidst the pressure of conflict, the arms race for aviation innovation accelerated. Aircraft were designed to be more resilient; they were built to fly faster, at greater altitudes, and fulfill new roles.

It is into this environment that the essential player of the aviator story, American test pilot, John A. Macready, makes his entrance. John Macready had been born in San Diego, 1887. With the entrance of the United States to the First World War, he enlisted in the United States Army in 1917 and trained as a pilot.

Instead of serving abroad over the skies of Europe however, Macready would come to form the backbone of the United States Army Signal Corps' new, experimental aircraft research and development facility operating out of McCook Field in Dayton, Ohio. Though the airplane had originated in the United States, the American aviation industry lagged behind the combat-experienced European industries of France and Britain. In a bid to catch up, the operation at McCook field was created and given by its patrons, including the famed Brigadier General Billy Mitchell, virtual carte blanche to test new theories of aerial combat, push the limits of aircraft design, and, following armistice, reverse engineer whatever they could, including a large number of captured or otherwise retired European planes. John Macready became one of many, and ultimately, one of the most important participants in the new profession of aviation test pilot, flying the most flights out of any pilot at McCook field and pioneering the development of many aerial innovations recognizable to this day. One such innovation included flying low over an insect-infested grove of trees and releasing insecticide from a custom-designed release, a technique that would later be known as cropdusting. Another such example of Macready's remarkable accomplishments would include an altitude record of 34,500 feet recorded while flying an experimental aircraft with the world's first operational supercharger, a feat that would win him his first Mackay trophy[2].

Macready would continue his work at McCook field as chief test pilot until 1926, and over the course of his thousands of logged flight hours, he would observe a persistent problem. Particularly in high



A photo from MacReady's first cropdusting flight, August 3, 1921.

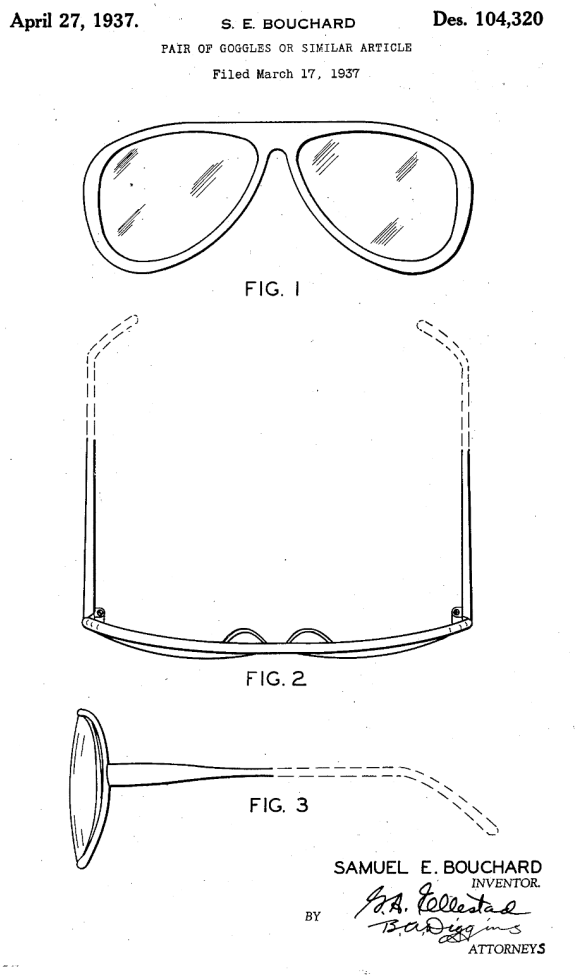
altitude environments, bright sunlight (with high amounts of UV light) and reflected glare were compromising the ability of test pilots to see. Hence, in 1929, John Macready contacted the prominent optical manufacturer Bausch & Lomb and began work on a set of flight lenses that would solve the problem once and for all.

Meanwhile, as Macready's complaints about dangerous high-altitude glare began to be echoed by more and more pilots, the United States Army Air Corps set about creating its own solution. American Optical was contracted to come up with a lightweight, anti-glare set of glasses, to which, in 1935, it produced as the USAC D-1 Sunglasses, the first veritable aviator-style sunglasses intrinsically built for aviators[3]. The type can be easily recognized by the small metal band emblazoned "USAC" tightly binding the two large lenses together.

Bausch & Lomb would, in time, come up with their own prototype, producing by 1936, a plastic framed, green-lensed article that effectively fulfilled Macready's mission requirements: a set of eyewear that could filter out harmful UV and IR light while maintaining optimal visual light clarity.

Early the following year, Bausch & Lomb pursued a patent (see Design Patent 104,320). Beyond just fulfilling the needs of the armed forces, however, Bausch & Lomb saw potential in their nascent creation and simultaneously established a new branch for civilian manufacture of the glasses, a now-famous entity called Ray-Ban. Early Ray-Bans would undergo some modification and refinement over the course of the late 1930s. Namely, the original plastic frames would be swapped in favor of metal-wire and variations would be produced to more specifically cater towards B&L's new civilian customers. The most prominent of these are the Ray-Ban Outdoorsman, noted for its addition of a "brow-bar" feature to prevent sweat from dripping into the wearer's face and the Ray-Ban Shooter, a variety also featuring a brow bar, but with the addition of a circular "bullet hole" metal feature providing structural support and stability to the glasses (see Design Patent 115,877). All the same, Ray-Ban's product line catered generally towards a relatively affluent civilian market, one that would pay for specialist sunglasses that cost dollars while other brands' cost cents.

On the eve of World War II, the sunglasses market in the United States had become saturated. Per an issue of LIFE magazine from the time, over 20,000,000 pairs of sunglasses had been sold in the year 1937 alone, a great many still using substandard pressed glass and tinted so as to simply darken view instead of providing much actual anti-UV effect. American Optical reported a 700% increase in the amount of anti-UV glass being used for sunglasses between 1928 and 1939. Celluloid sunglasses, by Foster Grant or otherwise imported from foreign manufacturers had also come


April 27, 1937. S. E. BOUCHARD Des. 104,320

PAIR OF GOGGLES OR SIMILAR ARTICLE

Filed March 17, 1937

FIG. 1

FIG. 2

FIG. 3

SAMUEL E. BOUCHARD
INVENTOR.
BY
ATTORNEYS

Bausch & Lomb's original 1937 patent for aviator-style glasses, note the use of plastic frames.

to take a prominent place in the American marketspace. However, another important technological development had also come about that would change the entire optical space. In 1936, American inventory Edwin H. Land, after years of experimentation with light polarization created a type of plastic film capable of filtering out polarized light. The film, which could be made relatively cheaply, could be applied to a variety of optical surfaces, hence diffusing anti-glare capabilities to industry and the public at a distinctly diminished cost. In fact, for Land's newly created company, Polaroid, 'Day Glasses', produced in concert with American Optical would constitute the company's foundational early source of income, selling

over a million pairs annually by 1939. Bausch & Lomb would also be early investors in Land's technology, incorporating lens polarization into a number of products, including sunglasses.

However, though lens polarization represented a remarkable development in the fight for better anti-glare optical measures, it would be one excluded from use among pilots. Polarized lenses notably posed the risk for entirely diminishing a pilot's ability to see certain important reflections while flying, such those coming off another aircraft, as well as potentially limiting proper visibility of the instrument panel. Hence, to that end, 'true' aviator sunglasses in the sense of their being used by air crew would continue to be produced sans-polarization, only featuring anti-UV properties and limited anti-glare measures.

The imminent arrival of the Second World War would set the stage, however, for the definitive transformation of aviator-style sunglasses from a tool of the affluent outdoorsman into an icon of the American everyman. This revolution took its first step in November 1941 with the standardization of the AN6531 'Comfort Cable' Flying Glasses. Reminiscent of Ray-Ban's Outdoorsman design, the AN6531 (so designated for use by the Army Air Corps and Navy respectively) represented a design standard for the various optical companies of the country to mass manufacture in order to supply the United States' rapidly rehabilitating armed forces as they transitioned from interwar complacity to a wartime footing. As such, surviving AN6531 glasses can often be found to vary in precise design from manufacturer to manufacturer, but all largely obey the same design principles. They employ metal frames and yellow-green tinted lenses, feature a 'brow-bar' to stop sweat from dripping into the one's eyes and rest easy on the wearer's face, have curved arms that wrap around the ears to hold the glasses securely in place, and large, rounded lenses to encompass the wearer's full field of view. AN6531 Type II sunglasses, introduced later in 1944, can further be distinguished by their darker, rose smoke lenses. With the introduction of the United States to the war and the increasing expansion of the American armed forces, production of AN6531 glasses skyrocketed to meet wartime demand, introducing the design to hundreds of thousands of enlisted airmen and sailors.

A Boeing B-17 Gunner posing for a photo with AN6531 Sunglasses, Will Rogers Field, Oklahoma City, 1943.

In 1944, the cultural associations between the American military and aviator sunglasses would become utterly cemented as a cornerstone of aviator iconography. The driving force to this end was the American public's introduction to sensational images of the popular and very media-conscious general Douglas MacArthur triumphantly wading ashore in the Philippines, all while

sporting his iconic corncob pipe and Ray-Ban sunglasses. After being defeated by Japanese forces and pushed out of the Philippines in 1942, MacArthur, then, just having arrived in Australia following his arduous escape, had made a public declaration before a crowd of reporters that one day he would return. That day, October 20, 1944, naturally became a media phenomenon, not least because of the dramatic considerations of its architect, general MacArthur who ensured that his arrival, famously featuring himself, his general staff, and Philippine president Sergio Oseña Sr. marching through Leyte's

One of a number of photos taken of General Douglas MacArthur on the day of his return to the Philippines, October 20, 1944.

surf was well photographed. MacArthur's flair for crafting an iconic public persona simultaneously grafted his defining icons into his wartime celebrity status. His hat, his pipe, and his aviator sunglasses transformed into enduring symbols of victory and wartime heroism. With accompanying newsreel footage and wartime photography of American servicemen wearing their comfort cable glasses, the aviator-style sat prominently in the public consciousness. Following the war, 'Comfort Cable' sunglasses entered the surplus market in the millions, allowing those who didn't already have them to buy them virtually at discounted prices. Far from being the medical devices of Fieuzal's day, the protective equipment of Crookes', or even the tool of well-to-do hobbyists, aviator sunglasses truly entered the mainstream of American consumer culture.

"With his flamboyant headgear, his sunglasses and corn cob pipe, he looked like an actor playing the role of a great general. He also had the sort of press an actor likes; he arranged that, in part, by keeping his subordinates as anonymous as possible."

- Journalist C.L. Sulzberger writing on Douglas MacArthur, 1963

Aviators' initial popularity being a product of strong associations with both Hollywood and the American military, it is meaningful to highlight how these linkages have only been reinforced over time, sometimes even simultaneously. The preeminent example, of course, being the 1986 hit, *Top Gun*, featuring a prominently aviator-sunglasses toting Tom Cruise as its lead. Regardless, aviator sunglasses continue their military legacy, depicted in film or not, as they have since 1958 under the HGU-4/P standard. All in, behind their decades of influence on

An ad from the June 1948 issue of Popular Science for surplus AN6531 sunglasses.

American culture, aviator sunglasses underscore a deep history of scientific exploration seeking to resolve the essential problem of dealing with harmful amounts of light. Thereupon, aviators represent but one branch of optical science culiminating in the answer to a very specific concern, and the path towards their development and eventual popularity, may offer some insight into the process of how such solutions are found and become widely accepted.

Notes

1 Quote from translated Scientific American article "Shooting Spectacles", original text from *Die Umschau*.

2 Macready's daughter recalled a humorous demonstration of Macready's contribution to the field of aviation whereby, following his reenlistment to serve during World War II, Macready had been inspecting a selection of Boeing B-17 bombers and a young lieutenant, remarking about the aircraft's superchargers that enabled its high altitude ceiling, asked, "Know anything about these, sir?" to which Macready simply responded, "Yes, Lieutenant, I believe I do."

3 This point is relevant given that the final shape of the D-1s is reminiscent of certain earlier 20th century driving goggles and hence, not necessarily an entirely novel design, though they are the first "aviator sunglasses" to bear the distinctive overall shape and be purpose-built for pilots. It should also be noted that the D-1s could be designed as they are, that is, as conventional sunglasses instead of more cumbersome goggles, because of then-modern innovations in aeronautic design such as a closed cabin.

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