James Wyant: East to West, Industry to Academia, A career of impact and innovation

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ABSTRACT

As a PhD graduate of The Institute of Optics in 1968, Jim Wyant made important technical contributions to the field in academia and industry. His thesis on topics in holography would augur decades of work in interferometric techniques that have been essential in applications from astronomy to computer technology. His journey from a farm in Ohio, to Case Institute of Technology to the University of Rochester, to the Itek Corporation in Boston and of course to the University of Arizona spanned the country and left an indelible print on the history of optics and The Institute itself. Throughout many years, even as he committed time to the University of Arizona, the OSA and the companies he founded, he continued to support The Institute of Optics through our summer short course program, through advice, and through generous support of professorships and programs at the University of Rochester.

Keywords: Wyant Tribute, Aspheric Optical Testing, Holography, Computer Generated Holograms

1. PHD STUDIES AT ROCHESTER: THE MYSTERIES OF HOLOGRAPHY

Jim joined the Institute of Optics while it was still quite a small department. Based above the UR Physics department in the top floor of Bausch and Lomb Hall, Lewis Hyde was then director of the Institute, with faculty that included Rudolf Kingslake, Robert Hopkins, Robert Boynton, and M. Parker Givens. Arriving at the Institute, Jim brought along a fascination with holography, something that had only been demonstrated a few years before [1,2] and would be recognized by the Nobel committee with the 1971 prize in Physics going to Dennis Gabor. The use of lasers at the Institute was still relatively new [3] and Jim found a perfect fit with Parker Givens as a thesis supervisor. The theme of both his MS and PhD work was to understand, both theoretically and experimentally, the brightness of a holographically reconstructed object as a function of the number of reconstructed object points and, especially, as a function of the photographic gamma on the resultant image. While Parker Givens officially retired only a few years later, he continued teaching and writing for another 25 years, passing on his love of optics to many generations of students. It warmed the entire Institute community many years later when Jim was able to endow a professorship in honor of Parker Givens.

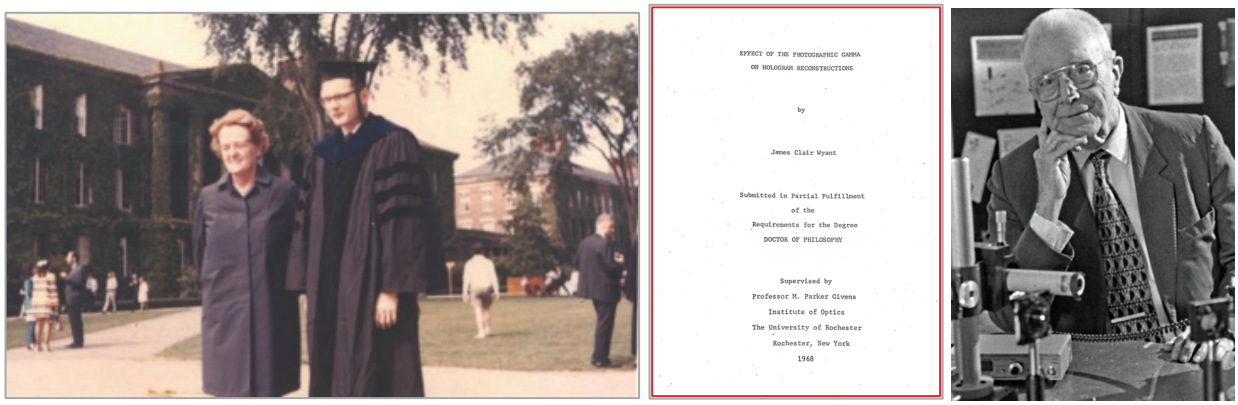

Figure 1. Left: Dr. James C. Wyant on commencement day 1968; Middle: Cover page of his dissertation; Right: Iconic photograph of Professor M. Parker Givens.

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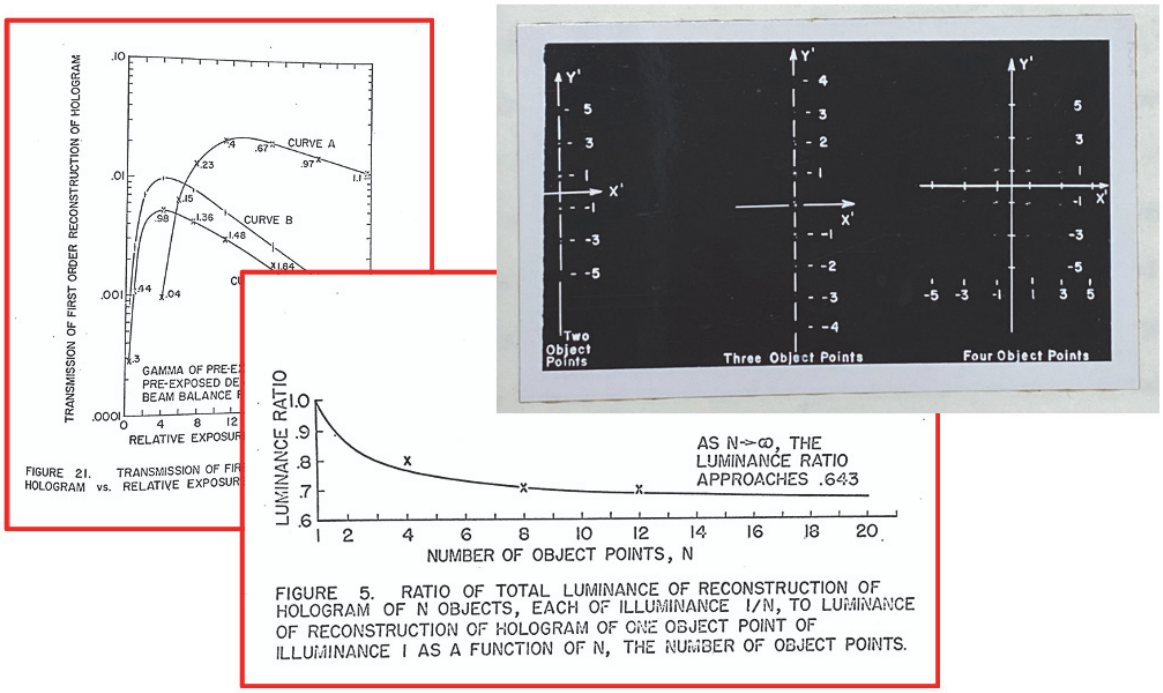

Figure 2. Figures from Jim's dissertation, entitled "Effect of the photographic gamma on hologram reconstruction". An original print of the upper right figure is in a bound copy of the dissertation in the Institute of Optics' collection.

2. A TALE OF TWO CLIMATES

The snowy winters of Western New York (along with the rest of the Northeast) are legendary. While the general climate was nothing new (Jim had grown up in Ohio and attended Case Institute for his undergraduate studies), the snowfall in December of 1968 and 1969 were two of the top three heaviest on record. Jim seemed to have a sixth sense about these things: By December of 1968 he had moved on to Itek Corporation in Boston. But February of 1969 brought what was, at that time, the heaviest recorded snowfall in the history of Boston.

Figure 2. Contrasting climates of Rocheter and Tucson

Even during graduate school, according to Jim's own account, he'd been intrigued by pictures of the Southwest brought back to Rochester by Robert E. Fischer, a fellow graduate student. Another colleague, Roy Frieden, interviewed for a

faculty position at the recently established Optical Sciences Center in Tucson. Initially uncertain whether to accept the offer, Roy was caught in a snowstorm trying to return to Rochester and promptly accepted the offer.

It was Robert Shannon who initially recruited Jim to come to Itek. (Bob's recollections of this are recorded elsewhere in this symposium). However, just months after Jim's arrival in Boston, Shannon accepted a position at OSC, leaving Jim devastated. Whether it was the snowstorm of 1969 that nudged Bob to Arizona remains uncertain. Six years later, in 1974, Jim would once again be recruited by Bob, this time to join the faculty at OSC in Tucson. From a weather perspective, he did so just in time; Groundhog day of 1974 brought 28 inches of snow to the Boston area, but a few years later the Blizzard of '78 hit Boston, during rush hour, stranding thousands of cars. By this time, Jim was safely in warm Tucson. Snow aside, Jim had six very productive years at Itek and laid the technical groundwork for both his scholarly work at the University of Arizona and and his entrepreneurial activities.

Jim was not the only Rochester graduate to migrate to a warmer climate and join the OSC faculty. In addition to Frieden and Shannon, others included Chris Koliopoulos (who later teamed with Jim in founding Wyko), Kathy Creath, Jim Eyre, Jim Schwiegerling, John Koshel, and Laura Weller-Brophy. In reflecting on the Rochester influence on Tucson, Jim later wrote in 2004 "Two of the graduates of the Optical Sciences Center have had faculty positions at the Institute ... however they have both left Rochester. I think the Rochester winters were too much for them." [3] A few years later, Rochester would finally land an Arizona graduate tough enough for the Rochester winters, when Jannick Rolland joined the Institute faculty as the inaugural Brian Thompson Professor of Optics. Teaming with Kevin Thompson, another OSC Alum, Jannick would found the Center for Freeform Optics (CeFO). It is no accident that many of the metrology activities important to modern freeform optics have been built on the foundational work done by Jim Wyant and colleagues.

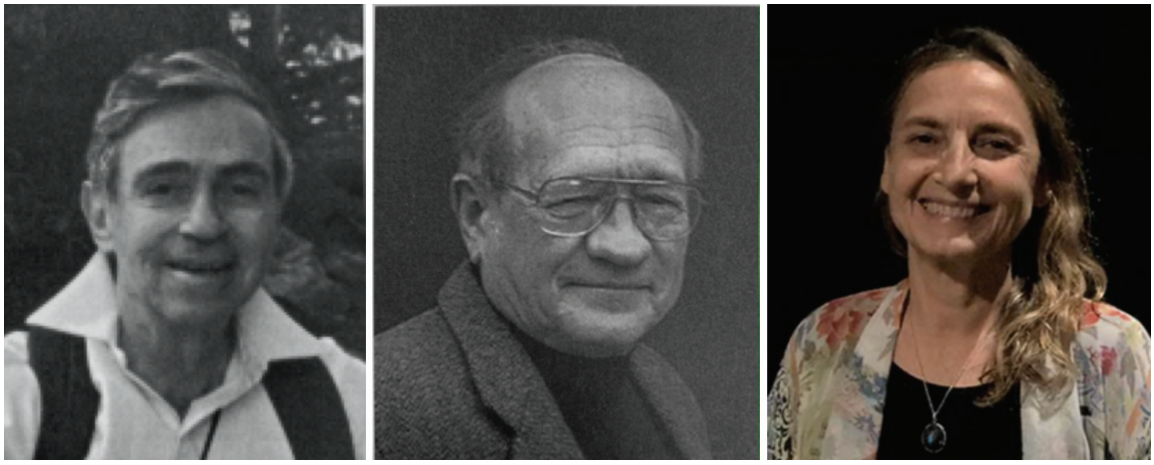

Figure 3. Roy Frieden (left) was the first Institute graduate to migrate to Arizona. Bob Shannon (center) was a Rochester Alum who worked at Itek, moved to Arizona, and directed the Optical Sciences Center for many years. Jannick Rolland (Right) is the lone Arizona Alum who has been tough enough to manage the Rochester winters.

3. LAYING THE GROUNDWORK AT ITEK

Jim's interest and deep understanding of holography continued for many years after his PhD; one of his earliest contributions to solving the problem of aspheric optical testing, carried out at Itek, was the use of a hologram to solve the nulling problem in aspheric testing. However, Jim realized that, while exposing and developing a photographic hologram could do the job, it was also possible to create synthetic (computer generated) holograms (CGHs) using some of the emerging photoreduction methods becoming popular in semiconductor lithography. The paper published with A. J. MacGovern in 1971 [4] remains one of the earliest successful demonstrations and analyses of aspheric metrology using a CGH. While at Itek, Jim also recognized that interferometry using conventional laser sources tended to have an intrinsically low dynamic range due to the problem of phase unwrapping, a problem that led to ambiguities for steep surface slopes and abrupt edges. In a September 1971 Applied Optics paper he introduced the concept of two-wavelength holography as one approach to extending the 'effective wavelength' of the measurement and solve the phase ambiguity

problem [5]. Thirteen years later, while at OSC, Jim was able to combine holography and two-wavelength interferometry with the emerging field of phase-shifting interferometry enabled by the use of digital image sensors. [6]

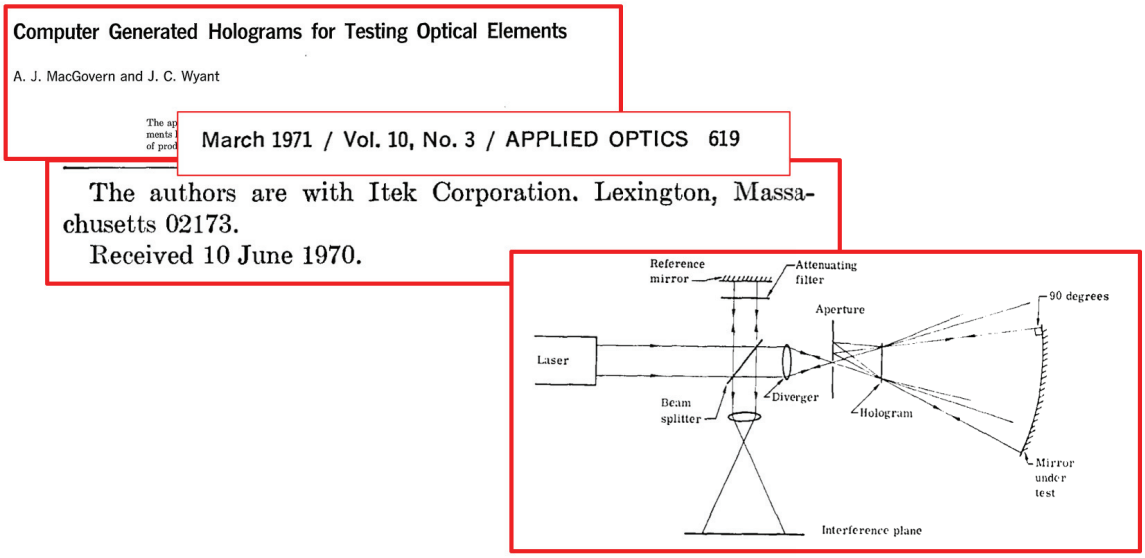

Figure 4. While at Itek, Jim applied his understanding of holograms to pioneer the use of computer generated holograms for use in aspheric testing. [4]

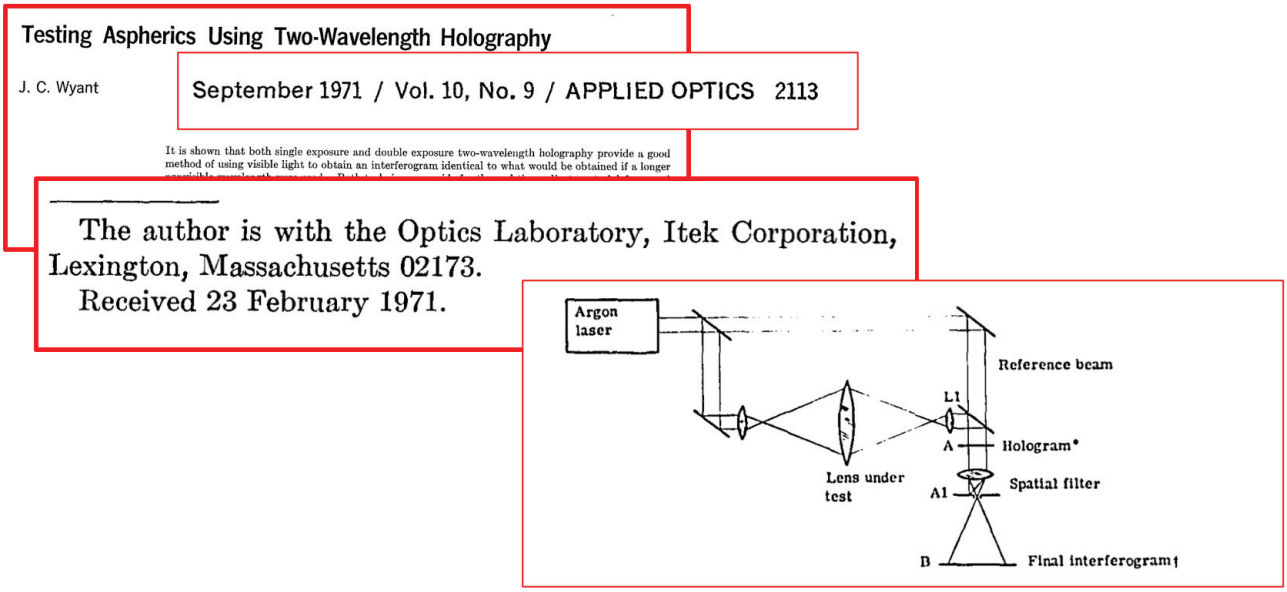

Figure 5. The combination of multiple wavelengths with a holographic optical element helped solve the problem of phase ambiguity for steep and discontinuous surfaces. [5]

4. EXTENDING THE TECHNOLOGY

Others in this symposium will elaborate on Jim's many fundamental and commercial contributions to metrology during his Arizona years. With Katherine Creath (another Rochester Alum) he was able to extend the wavelength range, develop increasingly sophisticated white light techniques and refine the use of CGHs in aspheric metrology.[6] With his many other students and business colleagues he was able to move the use of micropolarizer array-based phase shifting into practical and commercial success, thus unchaining the world of interferometric metrology from vibration isolated optical tables.

5. GIVING BACK TO ROCHESTER

Jim has served in a valuable role as both trustee of the University of Rochester and advisor/cheerleader for our faculty, staff and students. He has endowed two chairs, providing valuable extra resources to bolster our faculty ranks. But long before his business successes, Jim was giving back to his alma mater in ways that have positively impacted generations of our faculty, staff, graduate students and Industrial Associates members. For more than 25 years he was an instructor in our annual summer school. He served on an advisory committee that led to the establishment of our optical engineering degree program and has made his wisdom and experience available to several generations of Institute Directors. And the science and technology he pioneered have been of equal importance and influence in the life of our students. Last year Margaret Flaum (Institute undergraduate, class of 2022) won a campus wide research award for investigating the use of photopolymer holograms as reference spheres in a non-null Fizeau interferometer. The project includes the use of a multi-wavelength source (in this case an inexpensive green laser) to expose a reflection hologram of a freeform surface. The coarse coherence fringes in the hologram are due to the temporal coherence function of the multi-wavelength source; they reveal the absolute surface shape using a very long effective wavelength while the interference fringes provide a fine measurement with the accuracy of a conventional Fizeau. It is interesting that this experiment involves elements of Jim's thesis work (optimizing hologram exposure), his early work at Itek and OSC (use of holograms for aspheric measurements), and his later work on multiple wavelength and phase-shifting interferometry.

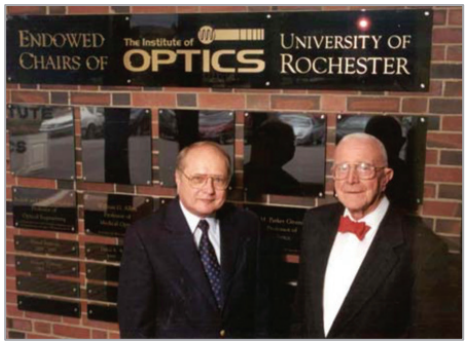

Figure 6. The M. Parker Givens chair was the first of two endowed chairs established by Jim at the Institute of Optics.

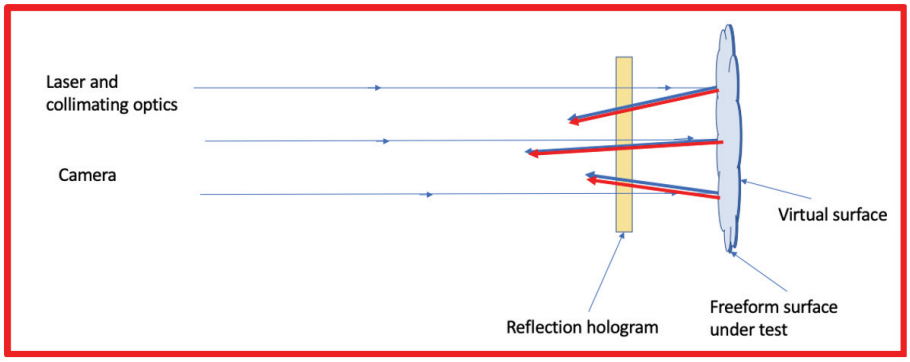

Figure 7. The technical legacy of Jim Wyant implemented in an award-winning undergraduate research project. A multimode laser exposes a high quality photopolymer hologram that acts as a nulling reference sphere in a Fizeau.

6. CONCLUSION

As we survey the modern field of interferometry and optical testing, it is remarkable how many of the methods and instruments we depend on in the laboratory and in the optics shop were built on foundations laid by Jim, his colleagues, and his students. But more remarkable still is the human legacy, witnessed in this symposium, produced by Jim in his mentoring, teaching, entrepreneurship and generosity. Technology eventually gathers dust, but the ideas and skills live on in the people. Thank you, Jim Wyant, for investing in people.

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