Philip O. Gravelle and the Origins of Macrophotography in American Scientific Consulting and Corporate Advertising 1920-1935

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An often overlooked but important site for the production of new meanings of photographs of material phenomena below the threshold of human vision during the twentieth century is commercial industry. During the early decades of the twentieth century, scores of U.S. manufacturing corporations began turning to consulting scientists and engineers for help detecting flaws in materials and for gaining knowledge about their behavior. One consulting industrial microscopist, Philip O. Gravelle, an internationally known authority on microscopic photography, who became especially instrumental in the transformation of the photography of extremely small objects into a manufacturing concern, is particularly interesting in this regard. A pioneer in the use of magnification, dyes in negatives and polarized light to make photographs of microscopic phenomena, he was also a prominent nature photographer and the first non-English scientist to win, in 1923, the prestigious Barnard medal, awarded by the London Photographic Society, the highest achievable honor in photomicrography. Although virtually overlooked in today's scholarship on the history of photography, he was a popular scientific celebrity during the 1920s and 1930s, when his photographs of subvisual phenomena graced hundreds of glossy corporate print advertisements and his photography was widely covered by the press. Gravelle's life and photographic productions serve as a reminder of the range of photography and its hybridity during the early decades of the twentieth century. This essay briefly describes the nature of Gravelle's work with photography of the invisible, discusses the nature of its public appeal, and presents specimens of his work, including color photographs that have never before been reproduced. It is argued that Gravelle's photomicrographs offer a valuable and hitherto unutilized lens through which to reconstruct the historical and cultural contexts that engendered new public meanings of "snapshots of the invisible" in the early twentieth century, an era of protean creativity and innovations with the scientific camera.[1]

"Industry's New Eye That Sees and Solves"[2]

"Have you ever examined the tongue of a fly"? Or "that the spines on strawberries are like big carpet tacks"? So wrote the popular writer Fritz Blocki in the opening lines of an article about Gravelle in *Popular Science Monthly* in October 1927.[3] Like similar articles that appeared in the illustrated popular press around this time, Blocki stressed several things about Gravelle: his interest in photography, dating back to his childhood; his success as a pioneer free-lance microscopist in industry; his practical contributions to society through his work for industry and crime laboratories; and his remarkable photographic revelations through the microscope. The article contained reproductions of several examples of his photographs of phenomena magnified up to two thousand times under the microscope: a spectacle that

1. On the history of the scientific camera and photography of the unseen there is a large literature including Lorraine Daston and Peter Galison, *Objectivity*, Cambridge: MIT Press 2007); Peter Geimer (ed.), *Ordnungen der Sichtharkeit: Fotographie in Wissenschaft, Kunst and Technologie,* Frankfurt am Main: Suhrkamp 2002; Corey Keller (ed.), *Brought to Light: Photography and the Invisible, 1840-1900*, New Haven: Yale University Press 2008; Helga Nowotny and Martina Weiss (eds.), *Shifting Boundaries of the Real: Making the Invisible Visible,* Zurich: Hochschulverlag 2000; Jennifer Tucker, *Nature Exposed: Photography as Eyewitness in Victorian Science,* Baltimore: Johns Hopkins Univ. Press 2006, among others. For the history of the "snapshot," see Douglas Nickel, *Snapshots: The Photography of Everyday Life*, San Francisco: San Francisco Museum of Modern Art 1998.
2. Henry Propper, 'Industry's New Eye That Sees and Solves', in: *The New York Herald Tribune* (May 25, 1924): 10-11.
3. Fritz Blocki, 'He Photographs the Invisible', in: *Popular Science Monthly* (Oct. 1927): 47-48.

Figure 1
'Philip Gravelle's home laboratory, with photographic and microscopic apparatus', c. 1935, gelatin black-and-white print, 12.1 x 17.8 cm, in: *Symmetry and Structural Design in Nature*, unpublished manuscript, c. 1940. The Gravelle-Foster Collection, Staten Island Museum History Archives and Library, New York.
To achieve standardized lighting, Gravelle worked with engineers at General Electric to produce a new kind of lamp made of ribbon filament tungsten.

revealed an "astonishing new world of tiny wonders" in the tiny foot of a spider; a group of microscopic pond organisms; the lateral grooves on a phonograph record; the edge of a shaving razor and beard fragments. Many of these were familiar to American consumers; a popular press account of his work reminded readers that, "Many of the pictures of magnified objects you have seen in the advertising sections of leading magazines have come from Gravelle's home laboratory."[4]

Gravelle's life and interests provide a window into the surprising and hitherto unexplored links that connected microscopic optics, photography, amateur nature study and the world of commercial advertisement and manufacturing interests in the 1920s and 1930s. Philip Octavious Gravelle was born in San Francisco, California, in 1877. A textile designer by profession, his interest in the chemical processes of textile manufacturer, together with his interest in photographic chemicals, led him to study chemistry at Pratt Institute and Columbia University. Around 1900, he moved to South Orange, New Jersey, where he resided for the rest of his life and where, like many inventors and amateur hobbyists of his time, he set up a home laboratory for his professional and amateur pursuits with microscope and camera. (Fig. 1) There, as free-lance industrial microscopist, he applied the microscope to industrial problems, to the solving of crimes. Early in this career he invented a technique that became widely adopted in the forensic investigation and identification of firearms used in crimes, using a comparison

4. Edwin Teale, 'Wins World-Wide Fame with Microscope Hobby', in: *Popular Science Monthly* (Dec. 1934): 24-26.

microscope which makes side by side comparisons of bullets: a technique he later adapted to the observation of three-dimensional specimens (a critical innovation that allowed for viewing a whole specimen, rather than individual cells, in the years prior to the invention of the scanning electron microscope in 1952).[5] In addition to his work for industry and crime labs, he quickly became established as a popular science writer and a nationally recognized nature photographer who wrote and gave talks for popular audiences locally. His photographs of marine creatures, minerals, and plants seen through the microscope and camera were borrowed and reproduced widely by other naturalists and popular science writers in places ranging from the Museum of Natural History in New York to the new glossy popular interest mass circulation magazines, *LOOK* and *Life*.[6]

Gravelle began working as a free-lance industrial microscopist at a time when photomicrography was being widely hailed as a boon to industrial manufacture. *The New York Herald Tribune* published an article on the value of photomicrography to industry in a 1924 article, "Industry's New Eye that Sees and Solves", in which it noted that "Industry has been given a new eye with which to look into itself." Since the beginning of the 'big business' era", the article continued, there had been a "marked tendency toward industrial introspection," with industry increasingly seeking "the aid of science in uncovering unknown and disturbing factors which impede its progress. "Industry was looking for a 'physician'," one who could diagnose causes. "Some idea of the variety of industrial problems presented to the photomicroscopist" could be gathered from the aid given by Gravelle, the microscope and photography to the phonograph industry and to the plaster of Paris manufacturer.[7] (Fig. 2) Microscopic photographs began to be used in industrial manufacture for the purpose of detecting and diagnosing flaws in materials and for learning knowledge about the behavior of materials that would provide a competitive advantage. From 1920 through the 1940s, Gravelle worked on a variety of different projects for over one hundred corporate brands, supplying photomicrographs to manufacturers of razor blades, textiles, phonographic records, paints, cosmetics, and newspapers, to name just a few.

Public perceptions of the importance of photomicrography for industry reflected the expansion of corporate-sponsored scientific research. Fritz Blocki for *Popular Science Monthly* wrote, "The science of photographing under the microscope has been practiced for some time in such fields as pathology, biology and botany; but now, largely through the efforts of Mr. Gravelle, its usefulness has extended to another purpose, that of furnishing an additional link between science and industry by solving mysteries and difficulties of manufacturing which could be solved in no other way."[8] Another journalist wrote that his "snapshots of the invisible" pro-

5. 'Life and Death Hinge Upon His Photos as South Orange Scientist Aids Police', blazed one headline from 1931. Press clippings, The Foster-Gravelle Collection. Staten Island Museum History Archives and Library (SIMHA).

6. A few of the slides he prepared for *Life* and *Look* may be found in The Foster-Gravelle Collection (SIMHA).

7. Propper 1924 (reference 2), 10-11.

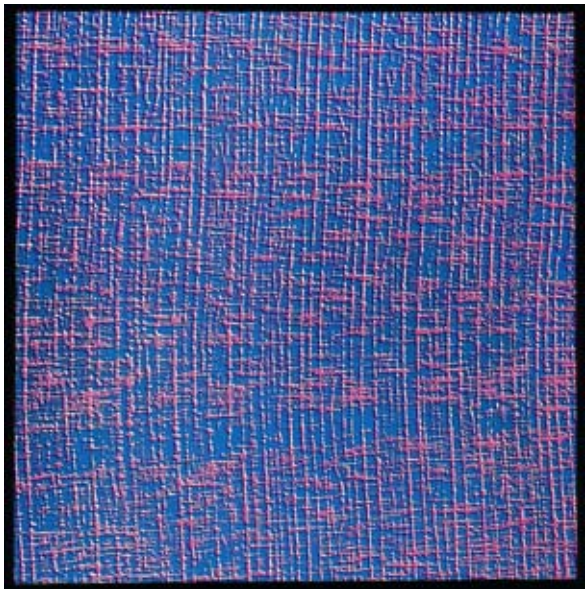

Figure 2
Woven textile pattern, c. 1920-1935, lantern slide negative obtained with a microscope and use of dyes on the negative, 8.3 x 10.2 cm, magnification 140. The Gravelle-Foster Collection, Staten Island Museum History Archives and Library, New York.

vided industry "with a new eye." [9] The role of illustrated newspaper and print media was important, both in bringing him into the public eye, and in promoting commercial products. In his laboratory, a Waterman's ad is shown hanging on the wall beside other scientific photographs. Over the course of his career, Gravelle produced magnified pictures of silk, tobacco, soap, yeast, coal, milk, metals, pencils, pens, razor blades, mayonnaise, cod liver oil, ink, cocoa, shoe polish, runs in stockings, women's facial creams, and a host of other commodities.

To show potential clients the range of his products, Gravelle produced a pamphlet, *Photomicrographs for Advertising and Industrial Use*, containing "Greatly reduced illustrations of Nationally Advertised Products showing the use of Gravelle Photomicrographs."[10] (Fig. 3) A list of users of "Gravelle Photomicrographs" in the pamphlet included not only the major New York City advertising agencies (George Batten Company, Frank Presbrey Company, and Lord and Thomas and Logan), but over forty laboratories and industrial organizations. Photomicrographs were placed in the ads in order to provide empirical support of the corporation's claims that the product was scientifically better than its competitors, and why the product was superior. American industry was producing thousands of consumer goods in the 1920s, and mass-appeal advertising (from radio to magazine print advertising) paralleled the mass production of goods.[11] While advertising generated modern anxieties about its ethical and social implications, it nevertheless became newly central in the 1920s, by one estimate rising from a total volume of $200 million in 1880 to nearly $3 billion in 1920.[12] Advertising agencies, who formerly bought advertising space in local newspapers and a few magazines, began working for the new national advertisers, placing advertisements in places most likely to attract buyer's attention, especially in the scores of new mass circulation magazines.

American commercial photography before about 1915, Elspeth Brown reminds us, was a medium whose faithful reporting of material fact and enthusiasm for endless detail failed to meet advertisers' growing demand for the abstraction or idealization necessary for "capitalist realism": "it provided realism but not art, rationality but not emotion." Brown shows how the change in this outlook can be dated from the work of Lejaren à Hiller, who, borrowing fine art aesthetics and techniques from pictorialist photography, "established the medium

8. Blocki 1927 (reference 3), 47.
9. Edwin Teale 1934 (reference 4), 24.
10. Gravelle's dossier included print ads for Colgate's shaving cream; Waterman's pens and pencils and inks; Peter's "DK" Cocoa; Tastyeast; Facial cream; Faber pencils; D and G. Sutures; lustrous white paint by Barreled Sunlight.
11. On American advertising and mass consumer society, see esp. Elspeth Brown, *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-1929,* Baltimore: Johns Hopkins Univ. Press 2005; T.J. Jackson Lears, *Fables of Abundance: A Cultural History of Advertising in America*, New York: Basic Books 1995; David E. Nye, *Image Worlds; Corporate Identity at General Electric*, Cambridge: MIT Press 1985; Susan Strasser, *Satisfaction Guaranteed: The Making of the American Mass Market,* Smithsonian Books 2004.
12. On the modernization of American advertising to 1920, see esp. Pamela Walker Laird, *Advertising Progress: American Business and the Rise of Consumer Marketing,* Baltimore: Johns Hopkins Univ. Press 2001.

Greatly reduced illustrations of Nationally Advertised Products showing the use of Gravelle Photomicrographs.

Figure 3
"Greatly reduced illustrations of Nationally Advertised Products showing the use of Gravelle Photomicrographs,"
printed promotional pamphlet, c. 1935.
The Foster-Gravelle Collection,
Staten Island Museum History Archives
and Library, New York.

as suitable for the complex visual and narrative strategies required by the social tableaux advertising of the period."[13] What Gravelle's work for commercial advertisements during the 1920s and 1930s adds is yet another dimension, showing how photography's value as a medium of efficient rationality and revealer of visual truths hidden beneath the surface became, no less than pictorialism, a symbolic language associated with the cultured aesthetic connoted by the feature illustration. A typical magazine ad using Gravelle's photographs directed the viewer's eye to a photomicrograph of a commodity (e.g. the point of a lead pencil or night cream). One of the most famous was his photograph of shaved beard trimmings made with the use of polarized light. The text around the images characteristically stressed the connection between scientific investigation and product superiority that the advertiser encouraged. The mechanical recording of visual facts, rather than being replaced by pictorial or artistic photography, became joined with the new advertising appeals to the subjective realms of emotion and psychology.

Gravelle's status as a scientist helped legitimize his use of photography in commercial illustration from 1920 to 1940. In commercial advertisements using Gravelle's photographs, scientific photographs became advertising currency. An ad for Faber lead pencils boasted, for example, that THESE AMAZING PHOTOGRAPHS TELL THEIR OWN STORY. The advertising text frequently encouraged viewers to place their trust in a commodity because of what the photomicrograph showed and to draw their own conclusions, after viewing the microscopic evidence for themselves, about the product's efficacy and manner of working: as one ad put it, "The Microscope Shows *Why* Peter's gives better results." The convention of the "before and after" photograph, with origins in nineteenth-century philanthropy and medicine, became central to commercial advertising: a photograph of the point of an "ordinary" surgical needle was juxtaposed with that of an improved "atraumatic" one. In other ad, a photomicrograph of yeast in an "ordinary" yeast cake was shown next to a brand name ("Tastyeast") yeast case "For purpose of comparison." Advertising appeals in these ads stressed not the heightening subjective powers and artistry of the photographs but their "unretouched" quality and lack of artistry adduced their power as visual proof. In many of these, a photograph of Gravelle himself appeared, peering through a microscope in a white laboratory coat. Perhaps to ward off any impression prospective that buyers might form as to the coldness of material recording scientific fact, advertisers emphasized the brand's personal connection to prospective buyers by means of a direct address to viewers: an ad for Waterman's pens reads, for example, "Waterman's *made this MICROSCOPE TEST for you.*"

13. Elspeth H. Brown, 'Rationalizing Consumption: Lejaren à Hiller and the Origins of American Advertising Photography, 1913-1924', in: *Enterprise and Society* 1, December 2000. 715-738; 718, 715.

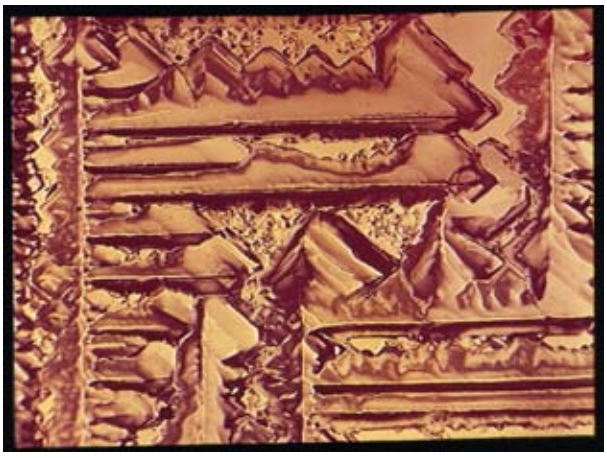

Figure 4
Oriental, c. 1920-1935, lantern slide negative of Potassium Chlorate obtained with microscope, polarized light, and dyes on negative, 8.3 x 10.2 cm, magnification 85. The Foster-Gravelle Collection, Staten Island Museum History Archives and Library, New York.

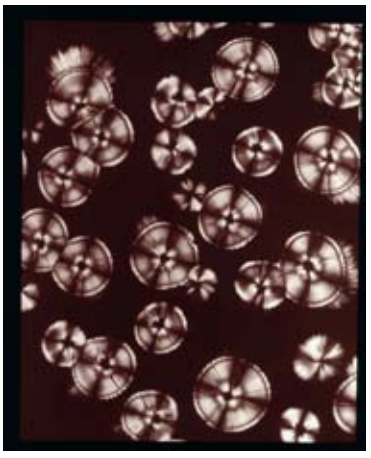

Figure 5
Quinate of Quinine, c. 1920-1935, lantern slide negative obtained with microscope, dyes on negative and cover acid of fuchsine, 8.9 x 10.2 cm, magnification 125. The Foster-Gravelle Collection, Staten Island Museum History Archives and Library, New York.

"Symmetry and Structural Design in Nature"

Central to Gravelle's ability to act in the role of a "boundary agent" were his photomicrographic knowledge and skill and his access to means of producing so-called "snapshots of the invisible" using technical processes that included his new techniques of magnification and color photography, including his pioneering use of dyes on the negative. In their influential 1989 sociological essay, Susan Star and James Griesemer note the important and often overlooked role of individuals who facilitate communication across a cultural divide or boundary, translating information and mediating between different domains.[14] Their concept of "boundary objects" (and, by extension, what we could call "boundary agents") is a helpful theoretical frame for interpreting the work of a photomicrographer like Gravelle, who actively took up various roles in relation to different participants in the process of bringing nature photography, industry and commercial advertisers together, negotiating differing perspectives and concerns in the process.[15]

Surviving lantern slides of his photographs of crystals, viewed under a microscope and polarized light, and reproduced here for the first time in color, in appearance resembling fractal and Polaroid art that developed in later decades. (Figs. 4 and 5). He also made hundreds of slides of organic compounds such as adipic acid, which rarely occurs in nature but which from an industrial perspective was (and remains) the most important dicarboxylic acid, used mainly as a precursor for the production of nylon. (Fig. 6)

A surviving manuscript in the Gravelle Collection at Staten Island Historical Institute that Gravelle intended for publication, which he titled *Symmetry and Structural Design in Nature*, contains over three hundred photographs and accompanying text with captions which, in

14. Susan Star and James Griesemer, 'Institutional Ecology, "Translations", and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939', in: *Social Studies of Science*, vol. 19 (Aug. 1989): 387-42.

15. "Trading zones" is a metaphor produced by Peter Galison that is often applied to describe collaborations between science and industry, when representatives of different cultures (e.g. physicists and engineers) are able to exchange goods, despite differences in language and culture. See Peter Galison, *Image & Logic: A Material Culture of Microphysics*, Chicago: Univ. of Chicago Press 1997.

Figure 6
K4416 Salicylaldoxime-Adipic Acid, 1920-1935, lantern slide negative obtained with microscope and submitted to *Life* magazine, 12.7 x 17.8 cm, magnification 75. The Foster-Gravelle Collection, Staten Island Museum History Archives and Library, New York.

combination with hundreds of his surviving slides, is the most complete surviving record of the range and unity of his life's work. Completed around 1954, it was never published, though Gravelle's friend Gordon Foster mailed it to Macmillan by registered mail in 1956, after Gravelle's death in 1955. It was around this same time, during the early to mid-1950s, that photographic expertise in scientific reporting was becoming increasingly popular due in large part to the well-known work of Hungarian émigré, Fritz Goro, the talented photographic expert in science reporting for *Life* magazine for twenty-seven years, whose *Life* magazine series, "The World We Live In," 1952-1954, in association with the science writer Lincoln Garret, tops the list of best-known popular science writing of the twentieth century.[16] Today, Gravelle's unpublished manuscript stands as a rare and forgotten example of what people then described as "Ultra-Microphotography" under scientifically exacting conditions in the years prior to the electron-scanning microscope. Gravelle provisionally titled his manuscript *Symmetry and Structural Design in Nature (Animal, Vegetable, Mineral)*. It contained one hundred fifty pages of text and over three hundred photographic illustrations of objects selected from a "diminutive world of great diversity and form, living at the present time and from the past."

Written for a popular lay audience, Gravelle emphasized the general nature of the work and what he called its "esthetic approach," which he characterized, in language that evoked discourses of 1950's architectural modernism, as the visual display of the patterns of "Symmetry and Structural design" that Nature "devised."[17] Gravelle's clear passion for making photographical illustrations of subvisual phenomena through various arrangements of microscopes and cameras had roots in his hobby of nature photography. Alongside his consulting work he was a popular lecturer who gave hundreds of illustrated popular slide lectures about "nature viewed under the micro-

16. Stephen Jay Gould called Goro "the most influential photographer that science journalism (and science in general) has ever known." In: *On the Nature of Things: The Scientific Photography of Fritz Goro*, introduced by Stephen Jay Gould, New York: Aperture 1993, 7.

17. *Symmetry and Structural Design in Nature*, unpublished manuscript by Philip Gravelle. The Foster-Gravelle Collection 23: G-F Box 3/6 (SIMHA).

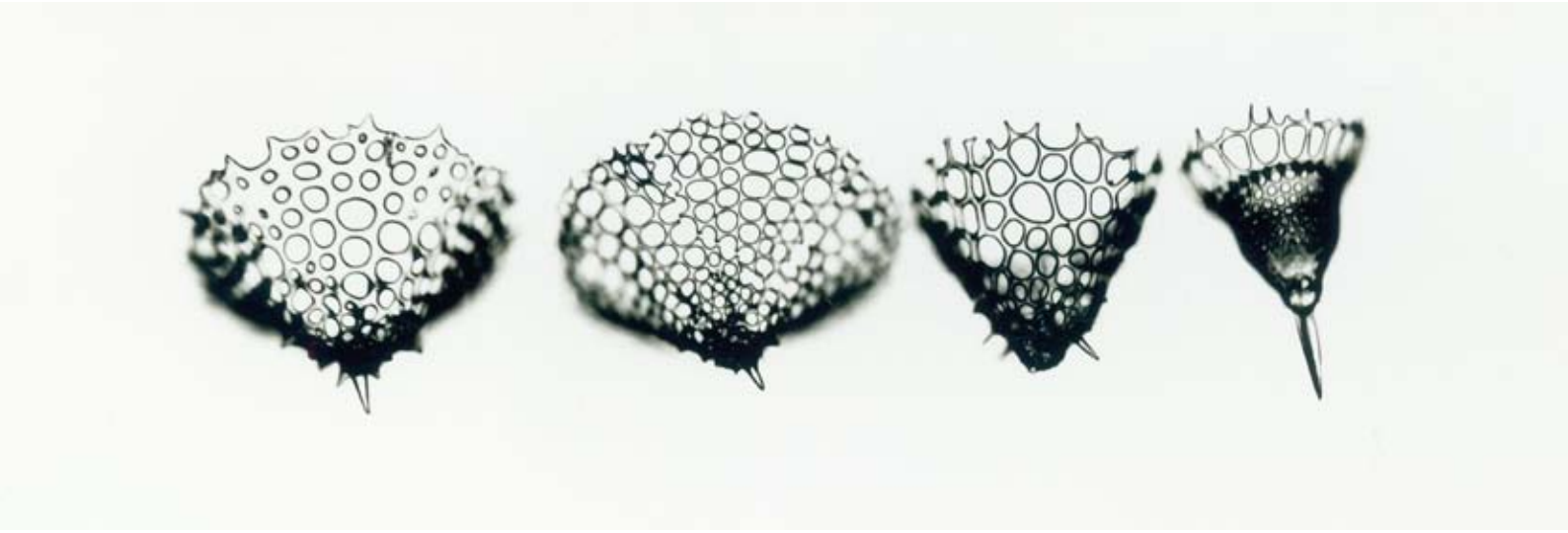

Figure 8
Radiolaria from Barbados, 1920-1935, black-and-white gelatin print using transmitted light and microscope, 4.4 x 12.1 cm, magnification 116, in *Symmetry and Structural Design in Nature*, unpublished manuscript, c. 1940. The Gravelle-Foster Collection, Staten Island Museum History Archives and Library, New York.

scope" to civic organizations, local microscopical societies, photography clubs, and gardening groups. In addition to his still photographs he also made teaching films about nature on subjects ranging from the life cycle of the rotifer to the circulation of the blood to the behavior of the amoeba and other microorganisms, culled from a pool in his garden. Called "physiological" films, one was made for the manufacturer of surgical sutures and depicted the "thrilling drama" enacted within the human body when the blood corpuscles battle to the death with germs of infection.[18]

The manuscript begins with a short historical introduction titled "The Need for Magnification." Then follow three illustrated parts: "Animal Life," "Vegetable Life," and "Mineral Life." Every illustration in the text was accompanied by a legend and text with the magnification and method of illumination given in the margins. The images Gravelle chose for the manuscript manifest the range of a diverse subject unified through a common focus on the simple terms of geometrical symmetry and the construction of both animal and vegetable structures. His photographs of marine invertebrate specimens using illumination by transmitted light, staining, and magnifications from twenty-five to two hundred fifty, displayed symmetry, bilaterism, and geometric forms. (Fig. 7) In Part II ("Vegetable Life") Gravelle included photographs of diatoms as found in nature and as arranged to "form pleasing designs," as in the following figures. (Fig. 8) Part III ("Minerals") contained photographic specimens of microscopic objects observed by incident light and different illumination techniques.

18. Described in Teale 1934 (reference 4), 25-26.

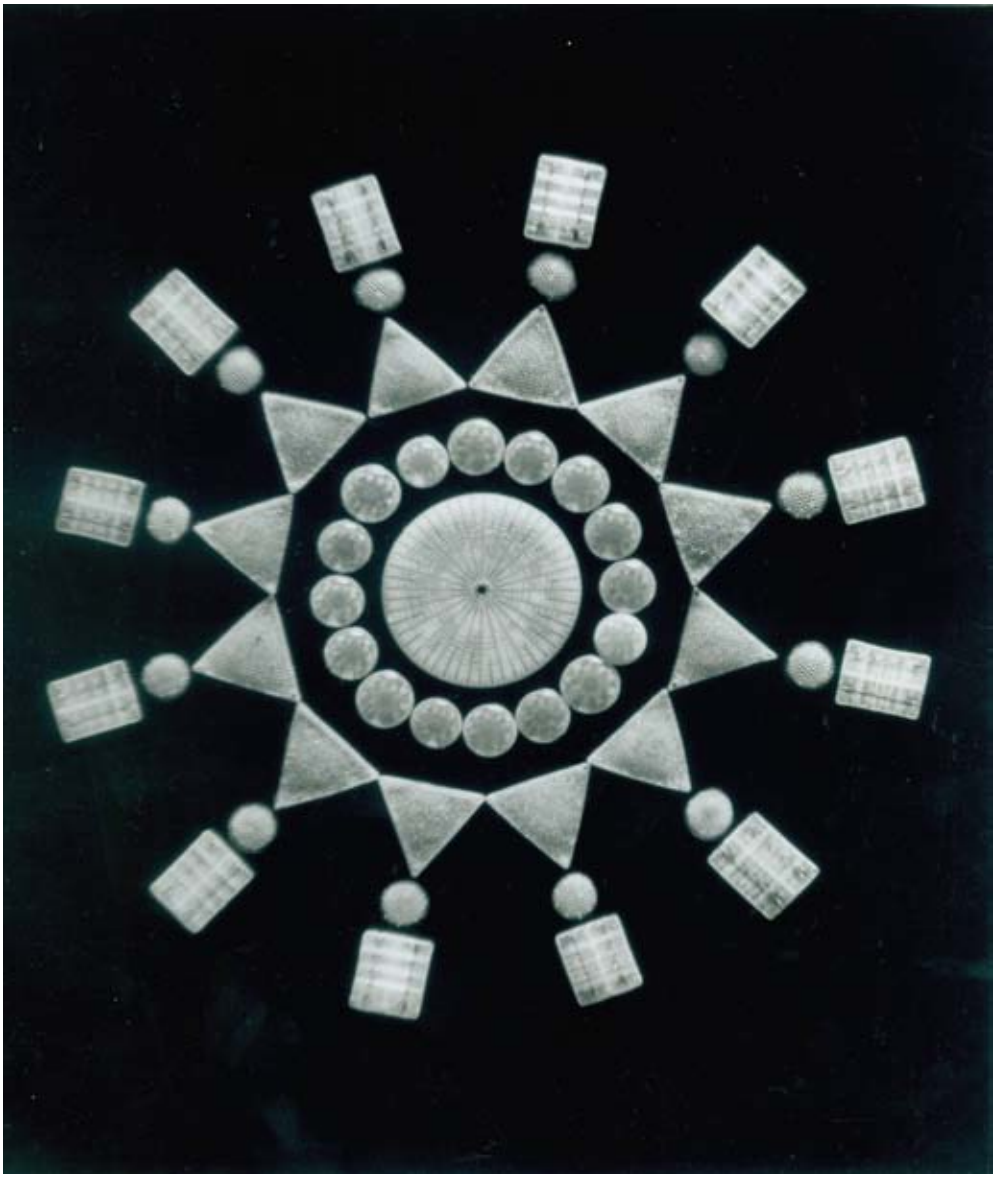

Figure 7
'An arrangement of Recent Marine diatoms and a Recent Fresh-water form, Terpisinöe musica around the outer edge of the preparation (c. 1891) by J.D. Möller', obtained with incident light, 19.2 x 22.2 cm, magnification 120, in *Symmetry and Structural Design in Nature*, unpublished manuscript, c. 1940. The Gravelle-Foster Collection, Staten Island Museum History Archives and Library, New York.

Preliminary historical assessment of this work suggests that in both his industrial work and his amateur nature studies, Gravelle had a core interest in the underlying symmetry and structural design in nature, areas that clearly carried over to his advertising work. A mass reproduced advertisement for Proctor and Gamble from the 1940s is especially interesting

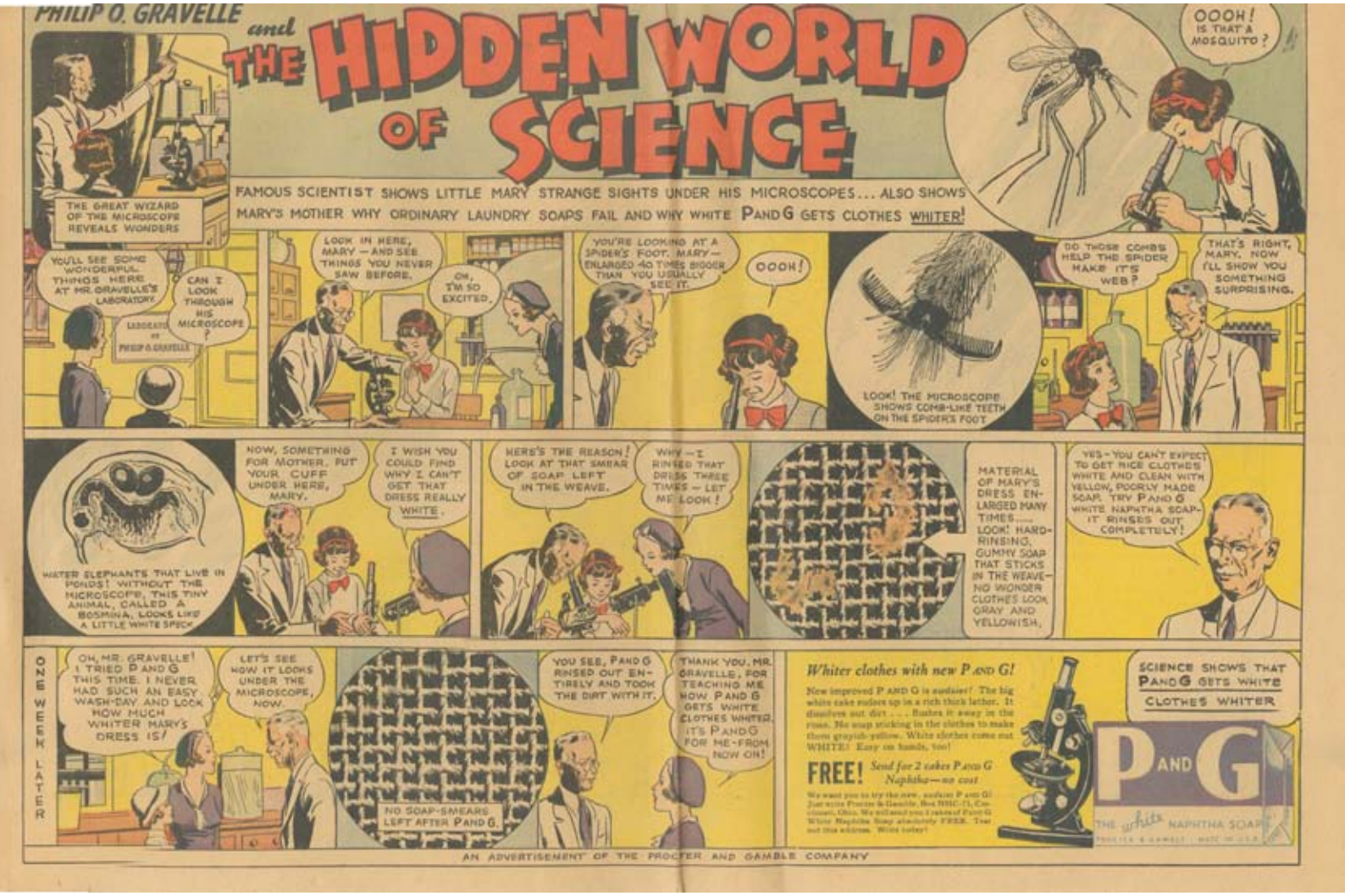

Figure 9
Hidden World of Science, c. 1945,
color cartoon advertisement
for Proctor and Gamble, 26 x 39.4 cm.
The Gravelle-Foster Collection,
Staten Island Museum History Archives
and Library, New York.

for the way it linked his photographs, his public image as a professional modern scientist and his celebrity within the amateur world of nature study in the service of promoting a mass consumer good. Titled *Philip O. Gravelle and The Hidden World of Science* (subheaded "Famous Scientist shows Little Mary Strange Sights under his Microscopes"), the color cartoon strip presented a series of vignettes in which what begins as a child's induction into the world of natural marvels seen through a microscope concludes in Mary's mother being shown by Gravelle how the microscope discloses new facts about how "ordinary Laundry Soaps fail and why white Proctor and Gamble gets clothes whiter." The ad includes drawings based on photographs representing magnified appearances of fabric, both before and after being washed with Proctor and Gamble soap. (Fig. 9)

As this essay has suggested, Gravelle's celebrated "photographs of the unseen" were produced not in contexts of "pure" science, but in the spaces of applied science and industry: domains of "photography of the invisible" and discourses of discovery that warrant much more historical attention. Laboratory observation was changing and new markets for scientific images opened with the dramatic rise in the early twentieth century of mass circulated illustrated picture magazines. While Gravelle fits into a longer historical tradition of photomicrography and scientific visuality that dates back to the 19th century, therefore, his work also must be seen as representing novel practices in mid-twentieth century commercial science and art.

Moreover, although Gravelle was internationally known as a skilled photomicrographer, I have suggested here that it was his eye for modern forms of design, in structures of both living and non-living matter, that informed his photographic aesthetic, from his popular scientific writing and illustrated lectures on nature photography to his astute grasp of the demands of the new age in advertising. His life and work illustrate, among other things, how visual objects are able to bridge the boundaries erected between different scientific fields because they satisfy the needs of different social groups, despite that they frequently have been treated within academic disciplines as belonging to different "genres." It is hoped that this essay contributes not only to a reappraisal of Gravelle's importance in the history of macrophotography but also to new understandings of "photography of the invisible" in the advertising age.