Contemplating an invention? Frederic Ives would say "Go for it!"

By Elaine Carol Main

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Got a new idea? Think of Frederic Ives. He would caution four things: Be persistent. Diversify. Promote your ideas. And, for goodness sake, patent what you invent.

Ives (1856–1937) followed his own advice so successfully that the Optical Society of America recognizes distinction in optics with the Frederic Ives Medal, its highest award. The award, which has been given for 58 years, commemorates Ives' pioneering contributions in color photography, photoengraving, three-color process printing, and other branches of applied optics.

A picture isn't worth a thousand words if it looks fuzzy, and Ives used optics to attack that printing problem. His invention, exactly a century ago, was the halftone screen that printers still use today.

"A number of people were trying to develop the halftone process," said Elizabeth Harris, curator of graphic arts for the Smithsonian's National Museum of American History in Washington, D.C. "But it was Ives' work that was published in journals. Other experimenters hadn't gotten that far."

The problem Ives tackled had stumped the ingenuity of printers for years. They had become adept at printing pictures from wood blocks or plates that had to be hand made by skillful woodcutters or engravers. Sometimes the craftsmen reproduced photographs by this hand method. Reproducing photographs directly would save time and money.

Shades of grey

The dilemma was that ink is black. Black and white photographs are not really black and white but rather shades of grey. Printers must reproduce these shades with their solid black ink. To do this, grey must be broken into minute dots of black—some large and some small. Lots of black dots close together appear dark grey; small dots farther apart appear light grey.

A number of inventors worked on the problem and Ives experimented with the best technique developed thus far. That technique was to make a negative of a photograph through a ruled glass screen. Halfway into processing the negative, the screen was rotated 90°. The resulting image was a sea of dots, ranging from large-sized dots where the photograph had dark areas to tiny dots where the photograph image was light.

But the process didn't satisfy Ives. Stopping the negative while it was developing was imprecise, and rotating the screen invited errors. He wanted sharper printing of photographs. Why not seal two lined screens together with their lines at right angles to each other? The idea worked: the photograph became a sea of precise dots. Ives' biogra-

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pher, Louis Walton Sipley, documents that Ives was the first to use the double-pane screen with right-angled scoring. That technique is still the best for printing black-and-white or color halftones.

Today's screens are very finely lined. Readers are unaware that newspaper photographs are composed of dots until they examine one under a magnifying glass. Then each grey area becomes black dots.

Persistence paid off

As Ives' experiments failed and succeeded, his mood swung from the pits to the heights. However, he persisted. "My sleeping place was the laboratory," Ives wrote, "partly for the convenience of being able to get up in the night and try experiments which occurred to me."

He'd go to sleep "in a fog over a problem" and wake up the next morning with the solution projected on the ceiling, completely worked out. When experiments demanded it, he worked without sleep—once for three days and nights without stopping. The fourth day, a family friend who was a doctor stayed with him to inject "morphia" to keep him going.

Today, Ives' persistence would be labeled job stress. A hundred years ago, he didn't dwell on the amount of work he was putting in. He was simply glad he had a place where he could work and try all those ideas that were simmering in his mind.

Ives applied for a position in Cornell University's photographic laboratory in Ithaca, N.Y., but Cornell declared him too young and inexperienced and turned down his application. Was 19 years old too young? Ives had already worked for an Ithaca printer and a photographer in Greene, N.Y., and he'd apprenticed in a newspaper office. Ives persisted, and convinced the university to hire him on a trial basis. That trial appointment became a four-year stretch of employment (1875–78). When he left, it was to develop commercially the processes that he invented during his stay there, according to his autobiography.

After Cornell, persistence remained his watchword. His

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Frederic Ives shown at work in his photographic laboratory. Photo courtesy of the International Museum of Photography.

first move was to a Baltimore plant that made stereotype plates from plaster molds. He had only been on that job three weeks when his boss "went on a drunk." Ives found himself making his first stereotype plates. To deliver the plates to the pressroom on time, he worked uninterruptedly from an early Thursday morning through the next Saturday afternoon. "Then I slept for 24 hours on a table in the pressroom," Ives reports.

Wooed by Cornell; investigated by the Secret Service

Cornell wanted Ives back, and its president, Andrew D. White, wrote Ives offering an instructorship, a fixed salary, and the carrot of retaining additional money he might earn from his photographic work.

However, in 1878 Ives chose to join Crosscup and West in Philadelphia as a photoengraver. He installed his camera and equipment in a loft and within a year improved his halftone process and applied for two patents. His persistent mind also invented an ether saturator, which increased the intensity of projection lanterns. The Franklin Institute in Philadelphia used Ives' saturator and awarded him a medal for the invention.

Ives also had a workshop and printing office on the third floor of his home, and his constant work attracted attention and suspicion.

"The fact that I spent so much time alone in this room

made my next door neighbors suspicious about my occupation. They reported to government Secret Service agents that they thought I might be a counterfeiter. Agents visited me, but they could find no money of any kind in my place or on my person—all my extra money went promptly into new experiments," Ives said in his autobiography.

On to microscopes and tintometers

When Ives was nine years old, his father gave up farming and bought out a small country store. That opened a new world for Ives, because the store held a treasure. He found a lens, a double convex lens with a 1½ inch focus. Ives remembered experimenting with that lens, but he did not suspect then that one day it might lead to his short-tube single-objective binocular microscope.

"The remarkable feature of Ives' intellect was his versatility," said Phil Condax, photographic expert and curator of technology at the International Museum of Photography at the George Eastman House in Rochester, N.Y.

When Condax talks about Ives, he speaks from the heart, because Ives was the first man to hire Condax's father. At the time, his father was 16 years old. Ives was 59 and worshipped by the young man. "According to my father, Ives could do no wrong. Partly that was because he was doing so much in so many areas," Condax notes.

His contributions, in addition to the halftone screen and the binocular microscope, include:

- The tintometer, an early form of the colorimeter that checks the quality of filters
- The photochromoscope, which optically reproduced objects in full modeling and perfect color when viewed through a special kromscope.
- The concept of the "optical V," describing the photographic process that replaced hand-produced wood engraved printing plates.
- The parallax stereograph, a three-dimensional photograph that required no stereoscope or viewer.
- The enamel process using copper plates to create cross-line screens.
- The dye-inhibition method of producing color photography, using three projection lanterns, one for each color.

His special camera also had one opening for each of three colors. However, his work of producing color by subtraction was not successful. An exposure could take up to two minutes, a long time for a portrait sitting.

"Ives' system was limited," admitted Condax, "and it was outside the mainstream of color development. He missed the boat. Additive color became the basis for color photography."

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Ives also developed a Hicrocolor camera that used a special film pack. It had a beam splitter that produced three images. The equipment worked, but it was clumsy and expensive.

From inventing to public relations

Ives knew that it was not enough just to invent. Inventors must get their ideas to the people who will use them and show how the ideas work. An inventor must be an entrepreneur, and Ives became his own public relations expert.

"Ives pushed very hard to get his methods across," said the wife of his biographer. "People divided into two classes—those who liked Ives and those who didn't."

He pushed despite the scoffing that greeted some of his new ideas. For example, he reported how the Royal Society in London reacted to his trichromatic photography process.

"Sir William Abney refused to be introduced to me until he had seen my results. There was only one photochromoscope on exhibition, surrounded by an excited crowd. After a long wait, Abney got a look, straightened up as if galvanized, blinked his eyes for a minute, then took another look—this time a long one. He then pushed his way to me and invited me to be a dinner guest at the Camera Club, of which he was President.

"A number of writers continued to scoff, declaring that it was not color photography, but merely the exhibition of ordinary photographs through bits of colored glass, etc., and I was denounced as a false pretender in letters to the newspapers. Even when the U.S. Patent Office included the photochromoscope in an exhibit at the Pan-American Exposition at Buffalo, a prominent physician of that city protested to the Government official in charge, making the same declaration. And when I showed trichromatic process color prints in London, Professor Vidal, then an accredited authority in France, wrote to the President of the

Camera Club warning him against being made the victim of a hoax."

Ives demonstrated his ideas to the people that could use them. Often those people were dubious, and he reports winning a five dollar bet from a French printing expert. The Frenchman bet that Ives couldn't mix colored inks to create "a decent grey or black." Ives chose a transparent yellow, a milori blue, and a crimson lake, and the expert couldn't tell the result from carbon black ink.

The same skeptical reaction greeted Ives' halftone process. "Wood engravers were frightened by the competition, and printers were resentful because the halftone plates . . . required the use of hard-surfaced paper, fine ink, and a hard-faced tympan. . . . It took years to convert the printers.

"When I made plates too large to prove on my small press, I took them to a professional proof printer, who, after I told him what kind of paper, ink, and tympan to use, asked me if I imagined that the ancient and honorable art of printing would ever be modified on account of anything a little snip like me could do, and refused to pull proofs on anything but soft plate paper, with a soft tympan and elaborate cut-out overlays.

"At every step I met with this kind of opposition."

Ives' experience proves that an inventor needs thick skin and the courage to face slamming doors. Yet he contonued to put himself in the right places where he would meet the right people. For example, in 1885, he participated in the Industries Inventions Exhibition in London and the Novelties Exhibition of the Franklin Institute in Philadelphia.

Such promotions resulted in 23 medals, including the Franklin Institute's Elliot Cresson Medal for color photography and its Edward Longstreth Medal for his photomicrographic process. Other medals came from the Photographic Society of Philadelphia (1892) and the Poor Richard Club (1926). He was honored by the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Royal Photographic Society, and he was bestowed honorary membership in Sigma Xi, the scientific fraternity.

The importance of patents

Ives had to be careful that the ideas he promoted were protected. Many photographers dabbled with inventions similar to his, and it would be easy to "borrow" ideas and then quickly patent them.

A letter Ives wrote to the "American Amateur Photographer" shows him responding to others' false claims. He objected to the credit a man named Gray was claiming in the field of color camera work.

"It is not true that there is one single new idea or improvement shown in Gray's demonstration. His claims are fraudulent, and he appears to be infringing my patent rights while trying to discredit my work by misrepresentation," Ives wrote.

Of course, the solution was to patent, and Ives' list numbers over 70 patents between 1880 and 1924, most for optical devices. He claimed that he could have taken out three times that many patents, and he took pride in the fact that the patents were for objects that were still relevant.

Later, some of these objects were "reinvented and exploited abroad after periods averaging about 10 years. Only a month ago (October 1928) I was asked to sell a patent which I applied for in 1914, for a device which within the last year has been announced abroad as something new and valuable, and to which half a page of the last issue of the *Journal of the Society of Motion Picture Engineers* was devoted. The other
half of the same page describes as the accepted best modern practice in trichromatic process negative making a system I used more than 30 years ago, and took out one patent on."

Sometimes he pointedly did not patent an invention. One example was his polychrome process of making a two-color print. He refrained from patenting it so that others would experiment with the method and develop new techniques from it. He thought it was a good idea, but he was disappointed when there was little response from other inventors.

Ives was also disappointed when others claimed credit for what he considered his halftone process, and because of the large number of inventors working with similar processes, experts are still not definitive.

"It is unclear who developed the halftones," according to Fred Spira of Flushing, N.Y., a photo historian. "Inventors had to work hard to be accepted. They faced accusations and law suits and poverty. They had to sell themselves."

Ives disagrees about the halftone invention.

"I do not disclaim the title 'father of halftone'," he wrote. "I was the first to deliver the goods acceptably."

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