Hamamatsu Photonics: Scientists in Business

By Frederick S. Harriman

When was the first Japanese television made? Sometime in the early 1950s? Wasn't it an imitation of an English or American device? Actually, the first Japanese television was successfully tested by Kenjiro Takayanagi, in 1925, in the city of Hamamatsu in Shizuoka Prefecture. Takayanagi's experiments are argued to be the first successful attempt at the development of television. It was a group of Takayanagi's students who in 1948 formed the company that is now called Hamamatsu or Hamamatsu Photonics K.K.

Other companies of the Hamamatsu area—Honda, Yamaha, Suzuki—are perhaps better known than Hamamatsu Photonics K.K. These companies manufacture products that are in the public eye, and also fit in with the image of the Japanese company that "improved on someone else's product" (motorcycles, musical instruments, etc.). Hamamatsu Photonics is not like them. From its study-group days under Kenjiro Takayanagi, it has made products that no one else attempted to manufacture, much less market.

Hamamatsu is not the type of company one expects to find in the nuts-and-bolts Tokai region of Japan's industrial heartland. The alma mater of its management, the Shizuoka University's Faculty of Engineering (located in the city of Hamamatsu), has turned out legions of technicians for Japan's manufacturing industry. But the managers of Hamamatsu Photonics are not exactly technicians. They are better understood as scientists who have used a corporate structure to provide themselves with a place to pursue scientific goals. At Hamamatsu, research is performed to develop products, as it is in any other company. But in the hearts of those involved, those products are merely the material culmination of research. Hamamatsu Photonics is a company of scientists in business.

Photonics as a business

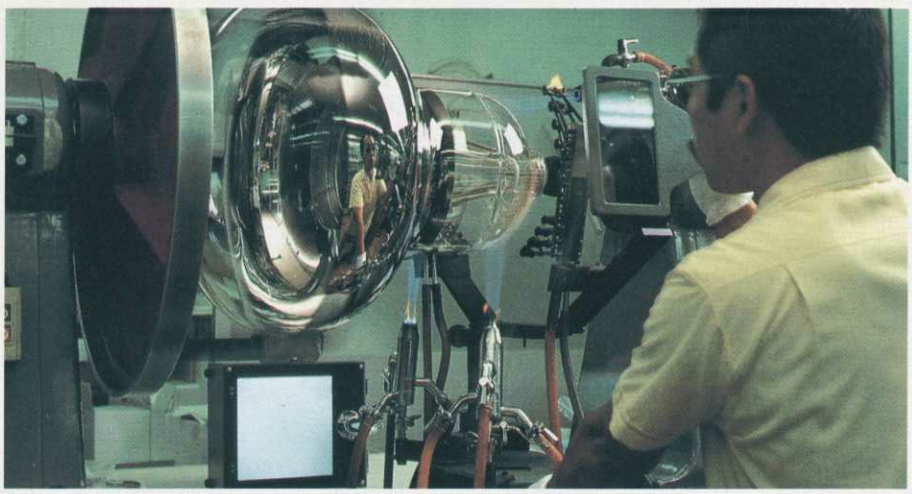
The photon is a stable elementary particle of zero mass, zero charge, and spin 1 traveling at the velocity of light. In other words, photons are to light what atomic particles are to matter. Photonics is the study of these particles, which also turn out to behave like waves. This is referred to as the "duality" of light. Understanding and probing this duality is one of Hamamatsu's main research activities. Among other capabilities, it has given the company the technology with which to count single photons, and measure ultra-high-speed phenomena.

What this means in practical terms is that Hamamatsu can manufacture devices that are extremely sensitive to light. Such devices that may immediately come to mind are television cameras or devices which can see in the dark. Hamamatsu does manufacture these. But the light involved with such devices is the light that we commonly perceive in our everyday activities. It is the light that is emitted from the sun. There are many other sources of light.

For example, there is light from a fire. A fire is a chemical reaction that gives off light—all chemical reactions do, we just may not be able to perceive it. When molecules break up and form, photons are emitted—these photons are the "fire" that we see, or don't see. If they can be detected and classified, then it is possible to "watch" reactions happen—as opposed to having to wait until they finish and analyze their products in order to deduce what happened. For every photon, there is a molecule that emits it. So single photon counting can mean the capability to observe single molecules and their reactions on a real-time basis.

The device that is capable of such observation is the photomultiplier tube (PMT), and it is basic to many Hamamatsu devices—as well as to the devices of many other companies that have asked Hamamatsu to develop special versions of it for specific uses. These uses include everything from detecting cosmic rays in order to find proof of the existence of black holes in the universe, to using light to verify the supply of oxygen to the brain in premature infants.

But light sensitivity is not the only technology that Hamamatsu has. It also produces devices that can emit specific wavelengths of light—for example, lasers. The surgical capabilities of lasers are already well-known. Use of lasers is also



The manufacturing process of a 20-inch diameter electron photomultiplier tube.

possible on a micro scale. A new Hamamatsu system is capable of burning down specific areas of chromosomes for genetic engineering and research.

The list of clinical uses and applications in research of photonic devices is endless. There are industrial uses as well. Using and detecting light is a non-invasive, non-destructive technology. Semiconductor signal testing is being performed with photonics, as well as the measurement of extremely high temperatures that would melt any type of probe used.

Teruo Hiruma, Hamamatsu's president, is known by his co-workers to be a demanding person. Researchers are made well aware that new projects are to generate income for the company. Efforts must not be wasted on unrealistic goals. But at the same time, Hiruma is known to scold young, new employees for shunning unproven methods or scientific theories. Hiruma complains that young people who have done well in school do not have enough curiosity and confidence to challenge the unknown. They did not get good grades by taking chances. But it is by challenging the unknown that Hamamatsu has gained a unique place in the world of research and high technology.

While neighboring auto part suppliers and other companies in Japan are known for their achievement of "zero defects," Hamamatsu has applied its production zeal to products that other manufacturers would not touch due to their high rate of defects. Hiruma remembers that in earlier days, an order for high sensitivity vidicon tubes might have been met while suffering a defect rate of 200:1, bad tubes to good.

This is perhaps the most interesting aspect of the company: Hamamatsu is capable of mass-producing devices that normally would be constructed only in the research laboratory, for a specific experiment. Hiruma recognizes that the company owes a great debt to the people on the factory floor who enjoy the challenges that come from pursuing extraordinarily demanding specifications.

But the good-natured attitude of those who work at Hamamatsu comes from something deeper than good management-labor relations. There is a healthy sense of humility among those who are treading on untested ground. This feeling runs through all levels of the organization and makes for a healthy working environment.

Research and profit, conflicting goals?

Research cannot guarantee that its results will be profitable. Can a corporate structure, with the demands placed on it to produce profit, provide the proper environment for research? Does not research require the room to make mistakes and follow unforeseen paths? And science itself is an altruistic pursuit that cannot remain the possession of any one group if it is to progress. To many companies, research is an expense that is tolerated so as to improve products in order to compete, or to stimulate a saturated market. But to Hamamatsu, research capability is itself a product.

Hamamatsu does have a very successful line of products and components, such as photodiodes and photocouplers, that find their way into a wide range of products from office to medical equipment. Its main divisions for product development and manufacture are: the Electron Tube Center (high sensitivity TV cameras, components, PMTs, light sources, etc.); the Solid State Division (photodiodes, photocouplers, photo ICs, etc.); the System Division (streak cameras for ultra-high-speed phenomena observation, photon-counting image acquisition system, television-computer imaging systems for microscopy, etc.); and the research centers.

The research centers—one in the Tsukuba Science City, two in the city of Hamamatsu: the Central Research Laboratory and the Positron Emission Tomography (PET) Center—do feed back research results to the other divisions in order to improve the components, devices and systems that are manufactured and marketed. However, it is the company's goal to attract more joint research projects with other corporations, hospitals and institutes. Photonics has a lot to offer to both the public and the private sector—and just how much has yet to be understood. Considering that Hamamatsu has no *keiretsu* ties, and it does not manufacture consumer goods (its TV cameras are for research use), it may be an attractive source of Japanese technology for many non-Japanese firms.

Teruo Hiruma, president of Hamamatsu Photonics, with Emperor Akihito—then the crown prince—during a tour of the Hamamatsu factory in 1988.

Hamamatsu also holds annual conferences in the city of Hamamatsu on such topics as "Mind/Brain Science," gathering together the top researchers in fields that phtonics can make a contribution to. These conferences are effective in spreading the knowledge of what can be done with non-invasive research methods that use light.

Being aware of the capabilities of photonics in the 1990s puts Hamamatsu in a similar position to those who experimented with electromagnetic waves at the end of the last century. Photonics will play a critical role in humanity's future development and Hamamatsu is aware of its social responsibilities to further the use of light technology. It will be interesting to see what joint research projects at Hamamatsu laboratories will yield, and how they will contribute to technology in the 21st century.

Frederick S. Harriman is an American consultant specializing in corporate communications, based in Hamamatsu City.