SCIENCE NEWS

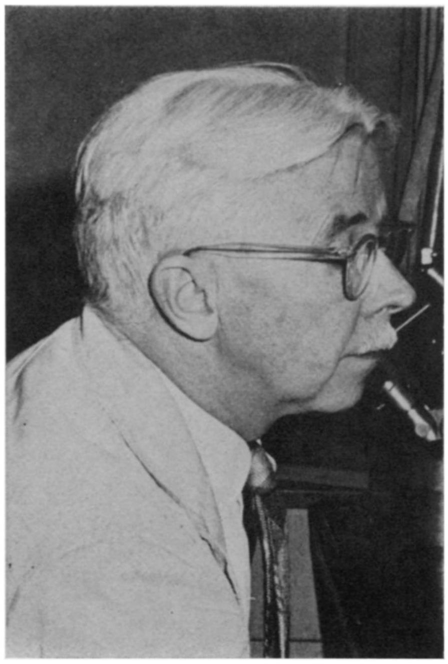
OF THE WEEK

Nobel Prize Winners

Discoveries concerning primary chemical and physiological properties of vision earned three scientists this year's Physiology/Medicine award

Harvard University

Dr. George Wald



Rockefeller University

Dr. Haldan Hartline

Wide World Photos

Dr. Ragnar Granit

George Wald has worked in the midst of the revolution that has changed biology from a cellular to a molecular science—and has himself contributed much to that revolution. A pioneer in biochemistry, he never took a course in that subject; instead he learned by teaching it. He receives the Nobel Prize at the age of 60, after 40 years' work on the biochemistry of vision.

Prof. Wald entered the field that was to win him the Prize in 1927, immediately after graduating from the Washington Square College of New York University. For his doctorate, he moved to Columbia University, where Selig Hecht asked him to work on the vision of the fruit fly.

On receiving his doctorate in 1932, Wald realized that he "wanted to get his hands on the molecules involved in vision." Since Hecht's department

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When Prof. Haldan Keffer Hartline sails on Long Island Sound or Chesapeake Bay with his boss, President Detlev W. Bronk of New York's Rockefeller University, they can take unusual pleasure in the maritime view. For both have made important contributions to the understanding of how the roughly one million fibers in each of our two optic nerves convey the glitter of sun on a sharp chop or the green of distant headlands from eye to brain in such a way that, while seeing an entire view, we are still most aware of what interests us most.

While his fellow 1967 Nobel laureates concentrated on the chemistry of retinal cells struck by light and the response to different light wavelengths that create color vision, Dr. Hartline kept trying to tune in on the nerve fibers of horseshoe crabs and scallops

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Finnish-born Ragnar Granit takes such delight in studying the brain's control of sense organs that he spends little time on anything else.

His homeland was a Russian province when he was born in 1900, the son of a forester, but was free by the time he finished his education.

At 19 he graduated from the Normallyceum in Helsinki and received his Doctorate of Medicine from the University there eight years later in 1927.

During the next eight years, Dr. Granit took two years off from his teaching post at the University of Helsinki to study at the Johnson Research Foundation at the University of Pennsylvania and later traveled to Stockholm where he joined the famed Karolinska Institute.

Currently a visiting professor at Oxford's St. Catherine's College—a pre-

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. . . Wald

was not then working at the molecular level, Wald moved to the laboratory of Otto Warburg, in Berlin-Dahlem. It was here that he first identified Vitamin A in the retina of the eye, in studies of pig, sheep and frog eyes. At that time, Prof. Paul Karrer had just isolated Vitamin A, and Wald went to his laboratory in Zurich to continue his work.

Following studies at the Kaiser Wilhelm Institute in Heidelberg and the University of Chicago, Wald became a tutor in biochemical sciences at Harvard, where he has remained ever since, for the last 19 years as professor of biology. Here he has continued to "narrow in on what light does in vision."

Vitamin A, Dr. Wald discovered, is essential to vision. A normally straight molecule, in the eye it is bent and twisted. When light hits the retina it straightens out this twisted molecule so that it can react chemically with various eye proteins called opsins. This chemical reaction then triggers electrical impulses that travel through nerve fibers to the brain.

Further experiments on the eye revealed that cones contain pigments for the three essential colors—red, blue and green—thus accounting for color vision. When light hits one of these pigments it bleaches it by splitting it into two parts—vitamin A and protein. The ensuing reaction carries a message to the brain which then reads out color. If the diet lacks vitamin A, starved cells cannot form normal amounts of pigment and the necessary reactions cannot occur when light strikes. The result is color blindness, Dr. Wald explains.

In addition to his reputation as a researcher, Prof. Wald has won many plaudits as a teacher. Six years ago, during a minor teaching crisis in Harvard's biology department, he volunteered to teach the basic biology course to freshmen, whom he finds very sophisticated in science. Finding the laboratory facilities in a primitive condition, he immediately persuaded the National Science Foundation to grant $120,000 to renovate them.

Prof. Wald's courses emphasize the unity of science. As a lecturer he is fervent and excitable. Following criticism on this point by a campus rating system (which otherwise gave him excellent marks), he told his students that he is not putting on an act to gain their interest; he genuinely feels "a deep sense of involvement and commitment" in his teaching.

Word that he'd won the Nobel Prize came by way of a call from the Harvard News Office in the early morning of October 18. "Now I'm going to get to meet the king, his six-year-old daughter rejoiced. A few hours later Dr. Wald celebrated by dispensing champagne to his students.

An easy conversationalist, Prof. Wald's speech contains an occasional teenage cliche that clearly appeals to his undergraduates. As a new Nobelist, he found himself asked to express an opinion on every subject from the Venus soft landing to the state of the world. After two days he balked, insisting that he "wants to avoid the pitfall of becoming an oracle." He does not expect that the Nobel Prize will change his fundamental attitudes or make him stop expressing them, he says. In fact, he will "be happy if it gives them a little more weight." ◈

. . . Hartline

to find out how the myriad electrical 'beeps' from the retina are differentiated to produce a coherent motion picture. Scientists all over the world are now following his lead and, in the process, putting together the final pieces in the puzzle of how we see.

Born in Bloomsburg, Pa., on Dec. 22, 1903, Dr. Hartline attended Lafayette College in his home state, then went to Baltimore for his M.D. from Johns Hopkins, where he stayed on for two more years (1927-29) as a research fellow learning more about the physics of his profession. He pursued the subject still further as an Eldredge Reeves Johnson traveling research scholar at the Universities of Leipzig and Munich, returning to work with Dr. Bronk at the University of Pennsylvania in 1931.

From studies on the metabolism of nerve cells, he had gone on to demonstrate in medical school that events seen by the eye show up as changes in the electrical potential of the retina, the layer of special cells on which the lens focuses incoming light. But what happened to the electricity? Dr. Bronk had shown that it was possible to record voltage from a single nerve fiber leading from a cell in the retina to the brain.

Other scientists had measured the big electric changes along the main cables of the optic nerves, but Dr. Hartline wanted to find out what was happening in the individual fibers. Because the thousand optic fibers leading from the many-faceted eye of the big, ugly crab were slightly larger than those of any other animal, Dr. Hartline decided on it as a subject.

In 1934, Dr. Hartline found that the more intense the light in the crab's eye, the more rapidly the electric impulses traveled along any given nerve on whose receptor cell that light was focused. He also found that, as in a camera, the nerve would respond to very faint light if exposed to the stimulus for a long time. The scientist could tell the sensitivity of the receptor by reading the nerve impulses coming from it.

By 1938, having moved to the Cornell Medical School in New York, Dr. Hartline switched briefly to vertebrate animals and discovered that some nerve fibers pulsed when a light was suddenly turned on, others while the light kept shining and still others briefly when the light was turned off. He later found a still more important phenomenon: that the eye's receptor cells are connected by nerve conduits so that when one is strongly stimulated, its immediate neighbors were tuned down.

Thus his painstaking work had solved the problem of how we see the contrasts of edges and motion, an ability that a simple on-off arrangement would make impossible.

For these last and most important findings, Dr. Hartline had returned to his favorite crab and, in 1953, had joined the Rockefeller University (then Institute) as full professor.

Still picking at the crab's optic fibers, Dr. Hartline now knows that the nerve cells and fibers of the eye react with one another in ways almost as complicated as the cells in the brain itself.

Diminutive in height and small of frame, the white-haired scientist lives from Monday to Friday within two blocks of the University campus in New York's posh and medical East Sixties. Now that his three sons are grown and in college, Elizabeth, his wife, more frequently visits the New York flat from the Hartlines' farm outside Baltimore.

The biophysicist keeps no telephone in New York and admits no unexpected visitors. He spent the day after the award announcement filling his customary lecture schedule. ◈

. . . Granit

vious visiting professorship took him, in the 1950s, to New York's Rockefeller University—Dr. Granit's next trip will take him back to his adopted country to receive the Nobel Prize for his work in illuminating the electrical properties of vision.

He doesn't know, he says, what inspired him to start his experiments on vision, but "it gave me great delight from the beginning." In 1945 he completed the 18 years of work on wavelength discrimination in the eye for which he is now being honored. Dr. Granit was the first man to demonstrate that single nerve fibers in the retina are able to distinguish different wavelengths of light. By inserting electrodes into single cells in the eyes of experimental animals and measuring electrical response, he proved that variations in cell response occur. He went on to show that different units in the retina therefore distinguish color by their varying reactions to different parts of the spectrum. Retinal activity, Dr. Granit discovered, is controlled ultimately by the brain stem.

From his studies of light and what it does when it hits the eye, he also learned that light waves both excite and inhibit the discharge of electrical impulses—a phenomenon known as on-and-off activity in the eye. When you turn a light on, there is a brief period during which electrical activity in the optic nerve slows down before the expected burst of nerve cell activity takes place. When a light is turned off, Dr. Granit found, the flow of electricity then slows down as diminished light inhibits nerve cell behavior.

At Oxford, where he is in the department of neurophysiology, Dr. Granit's continuing research on nerve impulses has branched out to include electrical control of nerves in muscle tissue, ways nerve impulses convey senses of pain and touch, and further work on electrical activity in the retina. Writing a book describing his past studies of the eye also occupies much of his time.

During what little time is left over, Dr. Granit, who is married to Baroness Daisy Brunn, sails and enjoys his most recent avocation—gardening. His one son, Michael, is an architect in Stockholm. ◈

VENUS OBSERVED

Double probe sketches planet's portrait

If there were such an organization as an International Venus Committee, it could hardly have distributed the labor more evenly. On Oct. 17, Russia's Venus 4 began collecting data some 15 miles above the surface of earth's sister planet and continued all the way down to the surface. Two days later, the U.S. Mariner 5 flew by and made measurements that reached down to just about where the Soviet probe had started.

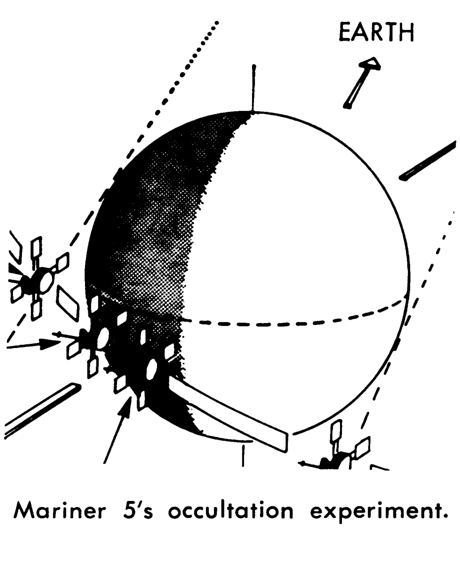
Although scientists from each country are reluctant to formulate theories that depend on the accuracy of the other country's results, they have been able to extract enough information from the reams of data bits transmitted by the two vehicles to fill in a little of Venus's sketchy portrait.

Prof. James A. Van Allen of the State University of Iowa, who discovered the belts of radiation that circle the earth, was unable to detect any such belt around Venus even with the aid of an elaborate instrument that was actually four detectors in one. Either there is no belt at all, he said last week, or it is a million times weaker than earth's and thus virtually undetectable.

One previous Mariner flight, which visited Mars in 1965, found no radiation belt there either. In fact, says Dr. Van Allen, earth's belt is rather extraordinary, since except for the giant planet Jupiter, there is no other object in the solar system known to have one.

The magnetic field of Venus is also either very weak—perhaps a three-hundredth as strong as earth's—or nonexistent, according to Mariner 5. Soviet scientists announced a similar finding, gleefully declaring that their probe had "corrected considerably" the data of America's first Venus probe, Mariner 2, which passed by the planet in 1962. Mariner 2, however, went no nearer than 21,594 miles, compared to Mariner 5, which came within 2,550 miles of the planet.

U.S. scientists would not be pinned down to a temperature for the surface of Venus, but they seemed to go along with the Russian finding of 536 degrees F. The previously accepted figure was about 800 degrees F., measured by Mariner 2. Before that estimates had



Mariner 5's occultation experiment.

ranged widely, even down to 40 degrees below zero. U.S. scientists will probably accept the Russian figure until Congress agrees to finance an American Venus lander, at which time the question will be opened all over again.

Early this year, the National Aeronautics and Space Administration published an attempted summary of research into Venus' atmosphere. They could scarcely have been further wrong. More than 60 percent of the atmosphere could be nitrogen, the report said at the time, and most of the rest is neon.

Instead, Venus seems to have an atmospheric makeup much more like that of Mars, although immensely thicker. The Russians first announced that Venus was almost entirely blanketed with carbon dioxide, with only 1.5 percent of the atmosphere made up of anything else. Taking another look at their data, they changed the CO_2 figure to between 90 and 95 percent. The U.S. probe indicated that the amount of CO_2 is somewhere between 72 and 87 percent, if the remainder is mostly nitrogen, though the amount might be as high as the Russian estimate if lighter gases such as hydrogen and helium are also present.

A glowing hydrogen halo, or corona, was detected about 1,800 miles above Venus by Mariner 5, though the Soviet probe found only a weak halo. The reason for the apparent difference, said U.S. experimenter C. A. Barth of the University of Colorado, could be that while Mariner swung around the planet, covering both its dark and light sides, the Russian probe landed directly in the Venusian night, where indeed the hydrogen corona could be as much as 100 times weaker.

Another glowing effect, visible only through ultraviolet filters, was also found unexpectedly surrounding the planet. Possibly, says Barth, it is due to chemical reactions in the atmosphere or bombardment by charged particles freed by electrical discharges from the planet's surface.

The Soviet craft indicated that the pressure at the surface of Venus is about 22 times that on earth, or 323.4 pounds per square inch. Previous estimates had ranged from two or three times earth normal to a crushing 300 times, equivalent to more than 4,400 pounds per square inch. But the pressure would need to be only eight times earth's in order to produce an almost psychedelic phenomenon that prompted Stanford's Prof. Von R. Eshleman to describe the planet as a "hell hole."

The hell, he said, is from the high temperatures. The hole, however, is an amazing effect that would be visible only to an observer whose eyes, unlike an earthman's, could see light in long, millimeter wavelengths. The dense atmosphere would bend such light so much that it would travel all around the planet instead of reflecting back out into space. The result would be that instead of setting, the sun would seem to dissolve a few degrees above the horizon, then "reassemble itself" above the opposite horizon the next morning. During the night the glow from the opposite side of the planet would keep the planet alight with a faint radiance.