MECHANICS

Bringer of Light

Sweden's Gustaf Dalén invented the sun-valve beacon, which guides ships and planes, and incidentally devised safe method of bottling aceylene gas.

By ERIK WÄSTBERG

➤ EVERY ship captain feeling his way through perilous channels, every air pilot who flies commercial lanes by night, every welder wielding his blazing torch on Liberty ship or warplane owes a debt of gratitude for his safety to Gustaf Dalén, a man of whom he doubtless never heard.

Dalén was a Swedish peasant whose passion for things mechanical led him through all obstacles into the immortal company of Nobel Prize winners. He was one of the world's great inventors, and all of his major inventions were designed to save lives.

When Thomas Edison first heard of Dalén's most ingenious device, the sun-valve—which, without cogs, wheels, electricity or clockwork, automatically lights beacons when darkness falls and puts them out at sunrise—he said, "It won't work." The German Patent Office snorted that his device was "impossible."

But it does work. Dalén's automatic beacons dot the coasts and harbors of the world—the U. S. Lighthouse Service alone uses 5,000 of them. Thousands more are used on airways and airfields. As part of his work on beacons, Dalén invented the safe method of bottling the highly explosive acetylene gas, essential not only for beacons but for welding.

His Eyes Destroyed

By a bitter twist of fate, the man whose lights fringe the Seven Seas never got to see them. Just when world recognition and wealth began to reach him, an explosion during one of his experiments destroyed his eyes. He walked in darkness for the last 25 years of his life, but dauntlessly pressed forward with his research and inventions.

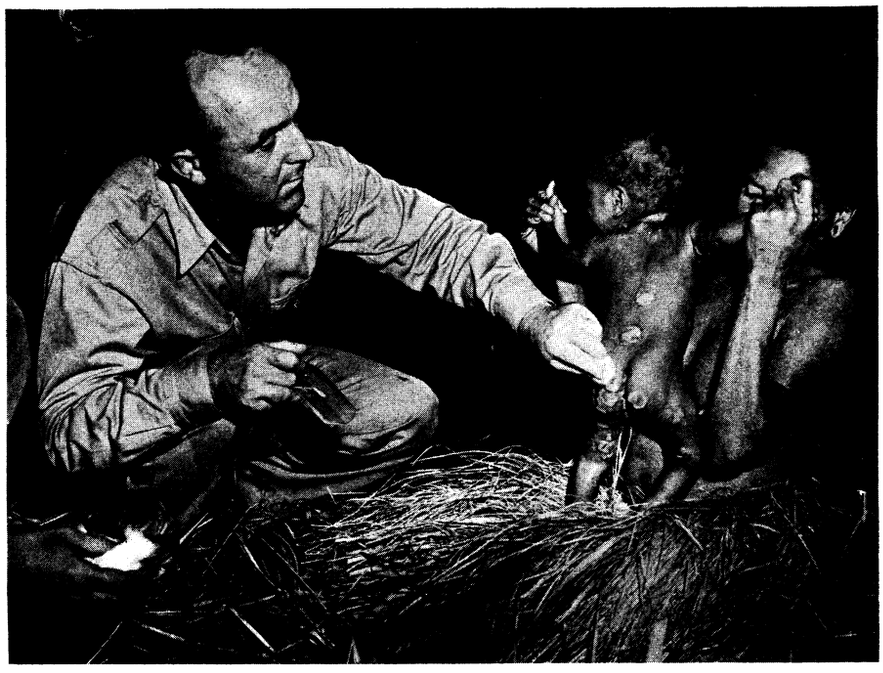
Gustaf Dalén was born November 30, 1869, on a tiny farm in southern Sweden—one of several children in a peasant family. Their life was rigorous, and the children had tasks for every waking hour. As a boy, Dalén detested farm chores, and his first invention was a threshing machine to shorten the hated job of shelling the winter's supply of dried beans. The thresher was powered by an old spinning wheel, and the crowning touch was that Gustaf persuaded his little brother it was fun to pump the treadles.

All his life, Gustaf Dalén hated to get up in the morning; to the end of his days he averaged nine hours' sleep a night. His second boyish invention was a fantastic sleep-prolonger. He got hold of an old wall clock and rigged it to rotate a spool at a set time. The spool rubbed against a match and ignited it. An elaborate arrangement of cords and levers swung the match over the wick of an oil lamp and lighted it. A coffee pot hung over the lamp flame. In 15 minutes the clock started a hammer beating against an iron plate. Thus Gustaf was awakened in a lighted room, with hot coffee ready.

While still in his 'teens, Gustaf designed a milk tester. It worked so well that he took his model to Stockholm to show it to De Laval, the famous inventor of the cream separator. "What an extraordinary coincidence!" exclaimed De Laval and showed the lad blueprints of a device on which he had already applied for patent. It was an almost identical tester. Young Dalén promptly asked for a job in De Laval's laboratory. "Not yet," the older man replied. "Get sound theoretical training first."

Young Gustaf's excitement over the master's approbation was overcast by a serious problem. His older brothers had already gone out into the world. They counted on him to maintain the farm which had been the family property for hundreds of years. But more than anything in the world, Gustaf Dalén wanted to use his talent for invention. He was a gentle, conscientious person; how could he leave his family? Reluctantly, he made his decision. He returned home. Later he wrote one brother: "Nine-tenths of my thoughts are occupied with mechanics. How will it all turn out?"

Gustaf fell in love with a pretty, 15-



FRIENDLY AID—The help of the natives of the South and Southwest Pacific islands has been of tremendous assistance to the U. S. armed forces in those areas. This official U. S. Army Signal Corps photograph shows an Army Medical Corps officer treating a New Guinea baby for ringworm.

year-old girl from a nearby village and talked to her of marriage. She told him she would not be a farmer's wife. Her attitude reinforced Dalén's strong desire for an engineering career, and he resolved to leave the farm.

It was not until he was 23, however, that he was able to break away. In 1892, he left before the crops were harvested, to enter the Technical Institute in Göteborg and hurled himself happily into the wonderful world of mechanics. He theorized, he experimented, he reveled in his work. He was too busy to eat and sleep, too happy to care that he had almost nothing to live on. After graduating with honors, he went on to advanced studies in Zurich, Switzerland.

Finally, after five arduous years, Gustaf knew he was ready for that job in the De Laval works. Finally he was able to marry the girl who had waited so devotedly for him. They moved into a tiny Stockholm flat, which promptly became more laboratory than home, because Dalén spent every free moment on his experiments. "Ideas, ideas!" a colleague of his remarked. "Dalén had 20 ideas a second! Many were hopeless, but the good ones showed real genius."

The young man also became an agent for an acetylene company, the beginning of a business connection which later developed into the now world-famous AGA (Aktiebolaget Gas Accumulator) company.

For years, Sweden had spent far more money than it could well afford on the men and equipment needed to maintain the great number of lighthouses its rugged coast and archipelagoes required. Every lighthouse had to have a keeper, living quarters for him and his family, a boat quay where supplies could be landed, and there even had to be special school facilities for lighthouse keepers' children. The government was eager to lighten this burden, and by the late '90s had developed a beacon that required attention only once in ten days.

Kept Working

Dalén thought that was not good enough, and kept working on the problem. One May day in 1905, he was ready to test a new device he had invented. He drew the curtains in his flat and attached the mysterious gadget to the gas pipe. Dalén struck a match, held it to the outlet. Tensely he watched. Soon, with a slight pop came the first, brilliant flash of light. It died, was followed by another flash, then another, and another. He had invented the automatic flasher, a rather simple affair of levers and magnets. The first model was so well-designed that no changes except insignificant modifications have ever been made.

Now Sweden could have its automatic beacon. The device would look after itself, could be set for the different flashes and signals desired, and would reduce gas consumption by 90%. Since the acetylene gas containers would last ten times as long as before, one boat could look after numerous lights, recharging them once in several months. Beacons could be placed in dangerous locations that could be reached only at rare intervals.

What does an inventor say when he sees his theories triumphant, and when he knows his work will help his nation, and the world, and save countless lives? Dalén turned to his young wife, who was looking on admiringly, and said, "You know, dear, we shall certainly make money out of this."

Beacon Successful

They did. The Dalén beacon was immediately successful. But its inventor was not satisfied. The beacon still wasted gas, because it blinked both night and day. After only one month of concentration, Dalén found the answer—the sun valve, that device which neither Edison nor the German Patent Office believed possible. Dalén merely followed the law of nature which people follow when they wear white in the summer. On the principle that a white or highly-polished surface reflects heat while a black, unpolished surface absorbs heat, he devised a valve comprising three brightly polished metal rods and a fourth black rod. When the sun rises and its rays hit the valve, the black rod absorbs more heat than do the white rods. The resultant uneven expansion actuates a lever which closes the hole through which the gas flows to the light. Thus the valve extinguishes the beacon when full daylight comes. With darkness, the metal rods shrink to the same length, opening the gas jet again.

The beacon had reached full efficiency. Beacons to run a year without attention were fully practical. But Dalén and his assistants were not finished. They now turned their attention to the acetylene gas. Engineers had developed methods of accumulating and storing the gas under pressure in steel cylinders. But acetylene—92.3 parts carbon and 7.7 parts hydrogen—is highly explosive, and it had caused frequent horrible accidents. Using a liquid solvent or packing the cylinder with such materials as charcoal and asbestos had not proved satisfactory. Dalén and his men began experimenting with new ideas.

It was dangerous work.

"I remember," reminisced Gustav V. Karlson, now in the American AGA plant, "one day in Sweden when Dalén and I were working with the gas. One small cylinder exploded and when I crawled out from under the table I saw it had blown Dr. Dalén clear across the room."

Hit Upon Something

Finally the indefatigable researchers hit upon something——a porous mass somewhat like cement (asbestos and diatomaceous earth among its ingredients)—which acts as a sponge. Gas saturates this sponge and the gas is therefore distributed through the cylinder so evenly and in such small particles that it cannot explode. This new porous mass had amazing effects on an industry quite unrelated to beacons.

For the first time, the use of acetylene gas for welding became safe. Many other factors, of course, have contributed to the tremendous growth of welding, but Dalén's contribution of safety was the foundation.

Dalén's company, AGA, sprang into

world prominence, and expanded from a group of 15 men to hundreds of employes, and branch offices in many countries. Dalén further perfected his beacon system by inventing an automatic changer for the incandescent mantles used in large lighthouses, and by experimenting until he developed a mixer of gas and oxygen which yielded the utmost efficiency in lighting.

By 1912 Dalén had achieved world recognition. His inventions were accepted everywhere. He had won the contract for lighting the Panama Canal, of which he was very proud. He and his wife and children were for the first time able to enjoy the better comforts of living—fine food, the theater, social life with their friends. They moved into a new village outside Stockholm, and were just settled when two American engineers came to see the master Swedish inventor.

Problems of Safety

While discussing problems of safety, the three engineers decided to find out how the acetylene accumulators would behave in case of fire. "It's not at all dangerous," Dalén assured them. "The safety devices are perfect." So the men lit a huge fire in a cleft of rocks and hung the gas-filled cylinders over the fire. Back in the laboratory's observation room assistants checked the valves and pressures.

At first the safety devices functioned to perfection. On the fifth repetition of the experiment observers noticed that the gas pressure was falling. (Later they found a defective valve.) Dalén and two of his assistants waited half an hour, then approached the fading fire. Suddenly, as they neared it, a steel cylinder exploded with a report which was heard for miles.

Jagged pieces of steel whizzed through the air. By a miracle the two chemists escaped with only minor injuries, but Dalén's body was covered with the scalding mass that spurted from the shattered cylinder, his face was black and bleeding, one eye was almost torn from its socket, his clothes were flaming. Rescuers beat out the fire with their bare hands. As Dalén lay by the roadside waiting for the ambulance, he asked if anyone else were hurt. Not seriously, he was told. "I am glad," he said. "It is only right that I, who am responsible for all this, should suffer most." Hospital physicians and Dalén himself thought he would die. To his wife he gasped, "Our happy story is at an end. I would have liked to see our children grow up."

But Dalén did not die. His strong peasant body and his magnificent will combined to win in his fight to live. His sight, however, was gone forever. His brother, Albin, who had become Sweden's outstanding eye specialist, tried his best to save the one eye whose optic nerve was still intact. He made a trip to the United States, and for months he and Dr. Alexis Carrel experimented with transplanting corneas. All over the world people heard of their labors, and Gustaf Dalén was much moved to learn that many people had offered one of their corneas that the great inventor might go on with his work. The two doctors finally decided that it couldn't be done. Gustaf Dalén would never see again.

Received Nobel Prize

While the inventor lay helpless and in pain, he learned that the Swedish Royal Academy of Science had bestowed upon him the 1912 Nobel Prize in physics. Dalén was grateful, but he was also saddened by this honor. "What do they expect of me who can no longer do anything," he asked, and lay with tears streaming from his sightless eyes while admiring students serenaded under his window.

Soon, however, Dalén determined that he would learn to do things, and to enjoy life again. When his strength returned he went back to his job as president of AGA. He returned to his first love, designs, and assistants working with him found that, so amazing was Dalén's memory, they could describe drawings to him and he would immediately hit upon any detail that needed correction. Much of his business he conducted from his desk, talking over a battery of telephones, keeping innumerable details in his memory.

He also returned to social life—the theater, parties, ice skating. Always dapper and well-groomed, Dalén would turn up, walking alone, a fresh boutonniere in his coat lapel, the gayest member of the party.

Became Statesman

The inventor's blindness, of course, forced him to give up many phases of engineering. This gave him time to turn to other fields. He made long trips abroad. He became one of Sweden's elder statesmen, consulted by the government on many problems, particularly on monetary affairs. Soon he was a familiar sight at all state functions, a beaming, lively companion whose dark glasses were the only indication that this was a man who could not see.

He encouraged his company to branch out into new production. The tremendous growth of automobile traffic after the first world war made AGA blinkers of tremendous value on the highway. Railroad engineers had already found them invaluable. Then came aviation. When transcontinental mail, complete with night flying, was first established, AGA beacons and landing field markers did much to make it practicable.

Dalén himself devised the AGA stove—a masterpiece of efficiency and economy which maintains cooking heat 24 hours a day with a consumption of only 8 pounds of coal. In the United States the AGA stove is of particular value in places where electricity or gas is unavailable or to which it is difficult to transport coal. At present our Coast Guard buys the entire output of these stoves for their remote stations.

In 1936 the 67-year-old president of AGA called a meeting of his board of directors. "I must tell you," he began quietly, "that my doctor tells me I have a cancer which cannot be cured. I shall go on as long as I can." He calmly consulted the notes in his hand, went on with the next item of business.

He steadily grew worse. One of his experiments had cost him his eyes. Now in a kind of poetic compensation, one of his inventions eased his otherwise in-

tolerable pain. The flasher cut-off valve he had contrived for lighthouses had been adapted for the administration of partial anesthesia, and it was used to keep him in a kind of twilight sleep.

On December 9, 1937, Gustaf Dalén died in his lovely villa overlooking Stockholm harbor. As Swedish and foreign ships made their way through the icy harbor, that dark December day, each ship reduced speed, each flag was lowered, in mourning for the man who had lighted their way home.

Science News Letter, January 15, 1944

RADIO

Color Television Produced By Subtractive Method

➤ AS EXPERTS debate whether post-war television must be restricted to black-and-white reproduction or whether color pictures can be brought to American homes at once, color reception has been advanced still another step.

Adapting the "subtractive method" of ordinary color photography to television, instead of using the "additive method" often proposed, Adolph H. Rosenthal of New York has produced pictures of equal brilliance with only a fraction of the illuminating light necessary in the latter method.

White light is passed through successive transparent image screens which "subtract" the unwanted color wavelengths of the light. A patent is pending on the ionic crystal type of screens used.

Science News Letter, January 15, 1944

ORDNANCE

Time Fuse Uses Gas Instead of Powder Train

➤ A NOVEL type of time fuse for artillery shell is the subject of patent No. 2,334,182, obtained by Stanley Farrow of Denville, N. J. For the customary powder train, whose slow burning determines the moment of explosion, a container of gas under pressure is substituted. This is punctured when the gun is fired, and its rate of escape is regulated by a pre-set mechanism. When enough of the gas has passed through a pellet of a chemical catalyst to heat it to ignition temperature, it sets off a booster charge of powder, which in turn explodes the main charge.

Mr. Farrow has assigned to the U. S. Government the right to manufacture and use his fuse without payment of royalties.

Science News Letter, January 15, 1944

METEOROLOGY

Your Coal Bin Should Now Be More Than Half Full

➤ DOES the top of your coal pile, or the gauge on your oil tank, still stand a bit above the half-way-down mark?

If so, OK. If not, get set for chills, warns the U. S. Weather Bureau.

The middle of winter, measured in practical terms of days of really cold weather, normally comes about Jan. 15 in the South, Jan. 17 or 18 in the central and northern Plains, and Jan. 22 to 24 in the Great Lakes region and the Northwest. So the farther north-northwest you are, the higher that coal-pile top or oil gauge should be.

There's a joker in this, though—as there always is in the weather deck. The Bureau hedges: "As these dates are normals, or long-time averages, the mid-season for individual years frequently differs considerably from them, depending on whether the first half or last half of the winter is the colder."

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