

# Arie Jan Haagen-Smit

1900-1977

## A Tribute by James Bonner

**A**RIE JAN HAAGEN-SMIT was a very special person. He did so many things so well that it is a privilege to celebrate his life on this occasion.

Arie — or Haagy, as we all knew him at the laboratory — was born in 1900 in the city of Utrecht in Holland. His father was the chief chemist of the Royal Mint of the kingdom of the Netherlands, and Arie's first chemistry lesson consisted of playing hide-and-seek among the piles of gold and silver bricks. He also watched his father dissolve coins and analyze them for their gold, silver, or copper content, a process that did not arouse Arie's interest in chemistry.

In high school Arie became enthusiastic about mathematics. He learned calculus by self-study and found physics fascinating. Arie also found languages fascinating and rewarding. In addition to English he studied French, German, Latin, and Greek. According to him his only poor grade in high school was in his native Dutch.

During his high school days his athletic skills developed too. As soon as the canal ice melted in the spring, he would begin rowing up and down the canals. He also sailed on Holland's lakes, and he was a champion boxer. Thanks to that rowing and boxing, his biceps were the largest to be found in the entire division of biology faculty — at least, up to about 1960. From that time on, Arie, having joined the establishment because of his work on air pollution, always wore a coat, so I couldn't check on the status of his biceps any more.

In 1918 Arie entered the University of Utrecht and chose chemistry as his major. He might have become a mathematician or physicist except that he was counseled by the university officials that there were no positions in Holland in these fields.

When it came time for graduate school, Arie again chose Utrecht and organic chemistry. The Professor of Chemistry at that time was P. Van Romburgh, a natural products chemist, who soon had Arie isolating a dermatitis-inducing agent from the outer layers of the fruit of the cashew nut.

Van Romburgh retired in 1926 and was succeeded by the young Leopold Ruzicka, who came fresh from Zurich. Ruzicka, the young giant of European organic chemistry, was interested at that time in the isoprenoids and in particular in the isolation, structure, and synthesis of the sesquiterpenes. His work with Ruzicka conferred on Arie a lifelong interest in the chemistry of the terpenes.

Arie received his PhD in 1929 and stayed on at Utrecht as a Chief Assistant in organic chemistry. In this position he was able to do his own individual research on natural products, but he also was obliged to supervise undergraduate laboratory courses.

In 1933 Ruzicka was succeeded at Utrecht by the German, Fritz Kogl, and Arie stayed on as his Chief Assistant. Utrecht, at that time, was the world center of the invention of a plant hormone, the so-called growth substance. Having one and subsequently two students from Utrecht, Caltech was basically a substation in plant growth hormone studies, the only such center in the U.S. A biological assay for the plant growth substance had been developed by Frits Went during the time that he was a graduate student at Utrecht and before he came to Caltech. Arie (and perhaps Kogl) set out to isolate the active principle, the plant growth substance. He isolated the material called heteroauxin, now called auxin, in 1934. The substance was indole 3 acetic acid. Its isolation laid the cor-

nerstone of our knowledge of plant growth regulation.

It has always impressed me that Arie claimed no special credit for such a great discovery. Neither did he claim credit for another even larger discovery made in the summer of 1935. Frits Went, who was then a faculty member at Caltech, spent that summer in Utrecht, where he worked with Arie. They found that substances chemically similar to indole 3 acetic acid, such as  $\alpha$ -naphthalene acetic acid — substances never found in nature — can completely mimic the action of indole acetic acid in the control of plant growth. From this discovery (not patented by the discoverers, of course) grew the whole field of chemical control of plant growth, the invention of 2,4-D as a weed killer, the idea of selective herbicides, the whole field of agricultural chemicals.

The Caltech plant hormone center included Kenneth Thimann and Frits Went. Thimann left Caltech in 1935 to establish a competing center at Harvard, and he persuaded Arie to come there for the 1936-37 academic year. This was the period when the Harvard chemistry faculty could not decide whether or not there was really such a thing as biochemistry. Thimann had a PhD in biochemistry himself, but I am sure there was some doubt about appointing more biochemists. In any case, it was relatively easy for Frits Went and Thomas Hunt Morgan, the chairman of the division of biology at Caltech, to persuade the Haagen-Smits to come to Caltech in 1937. Haagy was appointed an associate professor of bio-organic chemistry. The family rapidly took root in Pasadena, and here Arie and Zus raised their children: Jan, Maria, Margaret, and Johanna (Maria Van Pelt, Margaret Scott, and Johanna Demens).

Arie quickly established a research program; he and I collaborated on the isolation and structure determination of the plant wound hormone, which we named traumatic acid. Haagy investigated the terpenes of the turpentines of most species of pine. He also investigated the nature of the oils of desert plants, thus giving him an excuse for desert camping trips. And he worked on the flavoring materials of natural products. Haagy's complete microchemical analytical laboratory in Kerckhoff served not only Arie and his group at Caltech, but to a considerable degree it became a national facility for microanalytical chemistry, particularly during World War II when Americans were cut off from previously used resources in Germany.

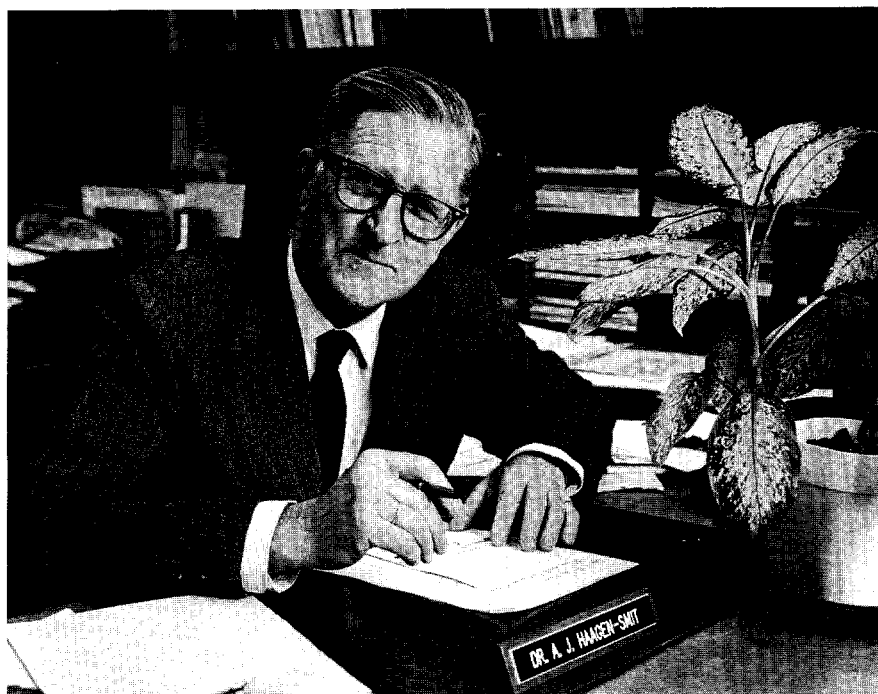
Haagy was good with students; one of them told me several years after he left Caltech that his notes on the course, Chemistry of Natural Products, contained more meat than those of any other class he had taken here.

Arie's students produced papers, and these papers produce an anecdote. My brother David got his PhD with Haagen-Smit and subsequently became a professor at Yale University. He once told me, "As a graduate student I used to be so annoyed when Haagy automatically put his name on my papers. Now, in the light of my greater experience, I realize the wisdom of his policy."

Arie shared completely the academic burdens of his colleagues. In addition he served for six years as the first executive officer for the division of biology, and I remember he had so much work to do that each evening, instead of a briefcase, he took home a suitcase full of papers, which he brought back in the morning full of resolved work.

Smog was born in 1943 at the Shell Butadiene Plant in South Los Angeles, and soon Arie and his colleague, Dr. C. Bradley, retired chemical director of Uniroyal, became completely occupied with the study of the chemical nature of smog and its source. I want to recall just three vignettes from these years.

The first is from perhaps 1946, when Haagy and Bradley were measuring oxidant levels in the ambient air. To do



this they sucked air through short pieces of bent rubber tubing. The shorter the time it takes for the rubber tubing under tension to crack, the higher the air oxidant level. This turned out to be a measure of the ozone concentration in air. With such simple tools Arie established the nature and sources of smog. It was one man against an establishment that at first insisted that petroleum and automobiles could not possibly be the source of smog — but as we all know, Haagy won and won totally.

Another memory comes from quite a few years ago when I saw Haagen-Smit in the hall smiling to himself, and I asked him what was so funny. He said, "Today I had three Ford vice presidents in my office. Last year I would have had to go to Detroit to see them."

Still later, when he was chairman of the Air Resources Board, he was responsible for certifying that each car manufacturer had filed a compliance with the California Regulations Certificate. Volkswagen failed to get their compliance certificate in on time. Haagy was exultant! "I'm sorry it wasn't General Motors," he said, "but it was Volkswagen, and I shut down all their sales in California for one week until they complied. That's real power."

Once we discussed all of the facets of smog research and control that he had worked on, and he concluded that he had covered the field pretty well — scientific, legal, political, the works. "But," he said, "I might have done more in city planning."

Friendliness and friendship, good humor and a sense of humor, characterized every action of Arie Jan Haagen-Smit. They made him the ideal colleague and friend. We all rejoice that his work became so publicly appreciated during his lifetime, that so many honors were bestowed upon him in recent years. He deserved those honors, and I think he really liked them. Arie is the example, very rare, of the true scientist, who takes a problem and solves it not only scientifically but also societally. Whatever he did he did superbly. Sad as we all are that Arie is now gone, we can rejoice in his long and productive life — a life that I believe was happy and satisfying to him.

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*Arie Haagen-Smit died on March 18 of lung cancer, and a memorial service for him was held on campus on May 5. This tribute is adapted from the remarks made on that occasion by James Bonner, professor of biology.*