# NOBEL PRIZES IN . . .

## Chemistry

World Wide Photos

*Dr. Derek H. R. Barton*

Aftenpeften

*Dr. Odd Hassel*

To non-chemists, just as a rose is a rose, butane is butane and glucose is glucose.

But the practitioners of the branch of chemistry called stereochemistry see substances differently. They recognize significant differences in a single compound, depending on the orientation of its atoms in space. Thus, although a compound has only one chemical formula, it can have several structural formations depending on the arrangement of its molecular components.

Two men who devoted their scientific careers to describing and examining the different shapes of otherwise undifferentiated compounds, and explaining the effects of what they saw on chemical behavior, were rewarded for their research labors last week. The Swedish Academy of Sciences named Dr. Derek H. R. Barton, professor of chemistry at the Imperial College of Science and Technology in London, and Dr. Odd Hassel, formerly of the University of Oslo, as the winners of the 1969 Nobel Prize in Chemistry.

Dr. Barton, a 51-year-old organic chemist, and Dr. Hassel, a 72-year-old retired physical chemist, carried out their major work in the early 1950's. But the road leading to their awards started back in 1885 when Adolf von Baeyer proposed his theory that ring-shaped molecules, if they were packed with six carbon atoms or more, would be severely strained. Baeyer's theory rested on the assumption that the atoms would all lie in the same plane. In 1926, evidence was presented that showed that carbon atoms could be puckered into different planes to relieve the strain.

But even before the evidence was in, chemists had theorized that a six-membered ring could exist in the shape of a lounge chair or tub-shaped boat, that is, by drawing in the bond angles between the carbons, convoluted convex outlines resembling chairs and boats emerged.

Dr. Hassel's chief contribution lay in proving, through electron diffraction studies of cyclohexane, a six-membered ring compound, that the chair form was the dominant one, and so required less energy to maintain. He also distinguished between the two types of carbon-to-hydrogen bonds in cyclohexane: those perpendicular to the plane of the ring and those parallel to the plane.

The import of Dr. Hassel's work was that it offered an insight to Dr. Barton, who had the vision to apply it to a whole world of other organic compounds. Dr. Barton is particularly noted for developing conformational analysis: the explanation of chemical and physical properties of a compound based on its molecular shape. There are many substances, such as steroids (cholesterol, bile acids and sex hormones) and terpenes (menthol, camphor and cedar oil), the chemistry of which is now better understood because of knowledge of their molecular shape.

One of the puzzles that was finally solved by applying conformational analysis

## Physics

Nickerson Photo

*Dr. Murray Gell-Mann*

In the late 50's the world of particle physics began to come apart with a rush. Until then the number of subatomic particles had seemed manageable, and the three that make up stable atoms, the proton, the neutron and the electron, dominated the field.

Then came the strange particles, dozens of entities with unusual properties whose existence seemed random and whose connection with the particles of the atom seemed remote or nonexistent.

After studying the strange particles for some time, however, Dr. Murray Gell-Mann of the California Institute of Technology supplied the connection. For doing so he has been awarded the 1969 Nobel Prize in Physics.

Dr. Gell-Mann found that nearly all the known particles, including the strange particles and protons and neutrons, could be grouped into families or multiplets. These multiplets had particular geometrical patterns corresponding to the so-called Lie groups, patterns that had been studied by the Norwegian mathematician Sophus Lie. The rules of geometry that Lie had developed for these patterns could be applied to particle physics, and when this was done, a physical theory emerged to explain the properties of the particles in the multiplets and to predict the existence of new ones. The predictions and explanations have been successfully and repeatedly confirmed.

The patterns of the Lie groups can be built up by combining three basic

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elements, and when this principle was translated into particle physics, it came out as a statement that the subatomic particles were built out of various combinations of three ultra-elementary particles to which Dr. Gell-Mann gave the whimsical name of quarks. Among non-physicists, he is better known for that than for the multiplet groupings.

A search for quarks began, with each of the world's largest laboratories taking its turn. After seven fruitless years an Australian team has entered a claim to the discovery of a quark (SN: 9/13, p. 198), but the claim is regarded with skepticism pending the submission of more evidence. □

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was the inconsistency of cyclohexane. Sometimes one form was more stable than another form; at other times it was less stable. Conformational analysis resolved the problem, giving organic chemists a way of telling which conformation of a given structural arrangement would be more stable and which more reactive.

Conformational analysis thus became important in planning the synthesis of complex substances and in analyzing exactly what happens in a chemical reaction.

But its consequences are not limited to chemistry alone. It is significant in understanding biological processes, such as how substrates fit on enzyme surfaces. And perhaps the outstanding discovery of the last decade—the double-helical shape of the DNA molecule—ultimately rests on conformational analysis.

Dr. Barton carried his studies into the plant world, where he unraveled a number of sequences of the steps a plant goes through to make alkaloids, nitrogenous compounds of vegetable origin which in small quantities have profound biological effects. Another of his achievements, which earned him the American Chemical Society's 1957 Fritzsche Award, was the determination of the structure of caryophyllene, the chief chemical constituent of oil of cloves.

In the field of photochemistry, he discovered certain photolytic reactions, specifically the breakdown of nitrides of alcohol by light. The discovery eventually led to the synthesis of difficult and complex molecules.

Of Dr. Barton's winning the Nobel Prize, Dr. Gilbert Stork, professor of chemistry at Columbia University and at one time a colleague of his, says, "It was exceedingly reasonable that he would get it. Everyone knew he would get it, the question was when." □

## IMMUNE RESPONSE AND CANCER THERAPY

In the fight to bring rampaging cancer cells under control, the idea of stimulating the body's defense to combat what is in fact a foreign substance is simple and appealing. It is the principle behind the development of vaccines against many of man's afflictions, from smallpox to polio to German measles. It has even been tried by some Russian immunologists against leukemia (SN: 8/30, p. 161).

The dream of a cancer vaccine is still just that—a dream. But experimenters at Emory University in Atlanta have shown that the basic mechanism—stimulation of an immune response—can take place.

"Man," says Dr. Loren Humphrey of Emory, "can react against cancer."

Dr. Humphrey's team injected an experimental substance, made of killed cancer cells from other patients' tumors, into 70 incurable cancer patients. About 20 percent of the patients have had some response, and in cases where the patients were estimated to have at least a year to live, the response rose to 50 percent. The reactions ranged from stopping the growth of the tumor to causing it to shrink, and in some cases to disappear altogether. Improvements have lasted from 4.3 months up to two years.

The theory behind the procedure assumes that cancer patients build an immune factor which is contained somewhere in the blood. "We don't know whether the factor is in plasma or white blood cells, so both are used," Dr. Humphrey told a meeting of the American College of Chest Physicians in Chicago.

To make the preparation, a part of a tumor is excised from one patient, and the tissue, including plasma and white cells, minced and frozen to render it acellular. The homogenate is then injected into another patient with the same blood type.

In one patient with inoperable cancer of the colon, the tumor disappeared. "She has been free of the disease for two years now," Dr. Humphrey says. Another, a man suffering from a malignant melanoma, a vicious cancer that affects the skin, has been free of the tumor for 14 months after treatment with the vaccine. The prognosis for the others, however, is not nearly so promising. The majority of the cases are terminal, having failed to respond to either surgery or X-rays. And even in those in whom there was some remission, it has not been enough to make a difference.

But the overall result justifies further work.

"The fact that an occasional excellent response is obtained in some patients justified the effort of developing the vaccine," says Dr. Charles R. Hatcher Jr., also of Emory University, and who is working with Dr. Humphrey on the vaccine. "We hope to see if it's a safe vaccine—then use it in patients earlier in the course of the disease."

FORECAST AND SOLUTION

## To fill the world's belly

FAO

*Famine: More to come in 20 years.*

For years agronomists and population experts have predicted that the world's supply of people will outrun its supply of food sometime before the end of the century (SN: 2/12/66, p. 102). The experts agree that the result will be massive starvation in the underdeveloped nations of Asia, Africa and Latin America, but agricultural and population statistics have been too vague to predict just when the crisis will occur.

The United States has exported vast amounts of surplus food to obviously desperate countries like India and supplied underdeveloped countries with birth control information and technical assistance in devising better agricultural techniques. American agronomists have helped develop new varieties of cereals that yield two and three times