a course in environmental physics in which he taught business majors to think quantitatively about energy sources, pollution, rapid transit and ecology. He also created a course in the "physics of seeing." He felt it a moral obligation of the university to interact with the surrounding community, and established a weekend program whereby black high-school students learned the physics of radios while building them. A true humanitarian and active anti-militarist, he terminated his Department of Defense grants a year ago.

JENSEN

Tony Jensen had the gift of making science a human and exciting experience. He will be easy to remember.

A. J. Heeger, J. A. Cohen,
P. M. Chaikin
University of Pennsylvania

James E. McDonald

A senior physicist at the University of Arizona's Institute of Atmospheric Physics, James E. McDonald, died on 13 June.

McDonald, who was 51 years old and held degrees in chemistry and meteorology as well as in physics, was a specialist in cloud physics and had also contributed to weather-modification research. A member of the National Academy of Sciences, he was a proponent of the possibility that unidentified flying objects might be controlled from beyond the earth. In July 1968 McDonald tried to convince the House Committee on Space and Astronautics that a serious study of "flying saucers" should be conducted. He accused the Air Force, which had commissioned a study of UFO's, of being "blissfully unaware" of the seriousness of the situation, and he later challenged the Air Force's Condon Report, in which most UFO sightings were linked to satellites, weather balloons, clouds, birds and other explainable phenomena.

At a private hearing of the Department of Transportation last year and again this year at a House Appropriations Committee hearing, he testified that a full fleet of supersonic transport planes would reduce the protective layer of ozone in the atmosphere that screens out some of the harmful ultraviolet rays of the sun. Although some members of the House Committee doubted his report, a National Cancer Institute specialist later concurred with McDonald, saying that McDonald's estimate of the impact of supersonic planes on skin cancer was, if anything, too modest.

Igor Tamm

Igor Tamm, head of the theoretical department of the P. N. Lebedev Physical Institute in Moscow, USSR and winner of the 1958 Nobel Prize for Physics, died on 12 April at the age of 75.

Among Tamm's many important contributions to theoretical physics was the theory of light scattering in crystals, which first demonstrated the fruitfulness of the conception of sound quanta (or "phonons," a term suggested by Tamm's friend and colleague Jacob Frenkel). In 1930 Tamm also proposed the theory of light scattering by free electrons in which he was the first to obtain rigorously the Klein-Nishina formula. He further showed that the scattering of even very soft quanta cannot be calculated correctly if Dirac's negative-energy states of the electron are neglected. And Tamm's work on the photoeffect of metals, formulated with Shubin in 1931, remains a basic theory even today.

Another of Tamm's important contributions was the theory of "Tamm's levels" of electrons in solid-state physics. He found that the particles in the Tamm levels are bound to the surface of the body and can move only along the surface. Explanation of various surface and contact properties of solid bodies is impossible without taking the Tamm states into account.

In the late 1950's Tamm performed what is perhaps considered to be his most important work when, together with Ilya Frank, he formulated a theory of the Cerenkov effect, discovered by Pavel Cerenkov in 1934.

Tamm made further advancements in physics with his prediction of the existence of the magnetic moment of neutrons and the correct prediction of its sign and his theory of controlled thermonuclear reactions, formulated with Andrei Sakharov.

In many cases Tamm's work led others to further important theoretical developments. The best example is his beta-theory of nuclear forces (1934)

in which the forces inducing beta-decay (that is, interaction through the electron-neutrino field) were assumed to be the forces of nucleon-nucleon interaction. These forces were shown to be very small in comparison with nuclear forces. Several years later Hidekl Yukawa developing Tamm's ideas made the next important step and showed that nuclear forces are due to mesons, not to electrons and neutrinos. However all the later theories of nuclear forces were developing according to the same scheme as Tamm's theory. Tamm himself thought this theory to be one of his greatest achievements. For, as he said about his theory of the Cerenkov effect, "This is not the work for which I would like to get the Nobel Prize."

In his later years Tamm worked on the formulation of the quantum field theory in curved momentum space.

TAMM

His aim was to develop a consistent theory of elementary particles free of divergencies and of other difficulties.

This list of Tamm's achievements, though short and incomplete, indicates the range of Tamm's contributions to theoretical physics. But his scientific accomplishments alone do not fully explain his authority in physics and the love that all his friends and numerous disciples felt toward him. Tamm always met any new idea in physics with enthusiasm and he was unselfishly joyful at every success. His teaching was always inspiring, the discussion of any physical problem with him was fruitful and the use of it went far beyond the framework of the particular problem. He was always kind and friendly and his most critical remarks were taken without offense and stimulated a desire to work.

He hated injustice, and if he ran into any examples of undeserved praise or undeserved blame he fought actively for the restoration of the truth. He devoted much of his time and efforts to the fight against a dogmatic approach to biology, and he was enthusiastic about the success in molecular biology (particularly about the deciphering of the genetic code).

During his last years Tamm paid much attention to the problem of peaceful coexistence. He was a member of the Pugwash movement in defense of peace. This activity helped to increase confidence and mutual understanding among scientists from different countries. Tamm had many friends both in the USSR and beyond its borders. In 1928 Tamm visited Paul Ehrenfest in Leyden. Ehrenfest later wrote in a letter to Abram F. Joffe, "I cannot think of anyone better than Igor Tamm as a successor in Leyden when it is time for me to pass away." This phrase expresses the feeling of love and respect felt for Tamm by all who knew him.

B. Bolotovsky
P. N. Lebedev Physical Institute

Arthur Bramley

Arthur Bramley, theoretical and experimental physicist, died 3 June of cancer. He was 70.

Born in the UK, he came to the US in 1919, attended the University of Oregon and received the PhD degree from Princeton in 1924. He held the Jacobus Fellowship there, which is accorded to the highest standing graduate student in the university. For eleven years he then did research in problems of pure physics at the Bartol Research Foundation at Swarthmore.

After a period of collaboration with the Fixed Nitrogen Laboratory and the war department, he worked consecutively at the National Union Radio Corp, Du Mont Laboratories and Republic Aviation. In consulting and other work he subsequently headed his own firm in Falls Church, Va.

Bramley's research, as reported in over 60 papers and demonstrated by 15 patents, dealt with relativity theory, electrodynamics, beta particles, optical characteristics of water, radioactive tracers, thermal diffusion, photoconductive response, electro-luminescent displays and interaction of light with nonlinear media. Certain of his papers were written in collaboration with others, including his physicist wife, the former Jenny E. Rosenthal.

Although he did not engage in formal teaching, a large number of fellow students, colleagues, laboratory associates and others will testify to the invaluable clarification, guidance and stimulation he gave them in understanding and overcoming the physical and technological problems they faced in their own careers.

Henry A. Barton
Greensboro, Vermont□