Professor Maurice Anthony Biot (1905 – 1985)

(The following write-up is from Wikipedia)

Born May 25, 1905, Antwerp, Belgium
Died September 12, 1985 (aged 80), New York City, New York, U.S.
Fields Physics
Institutions Harvard University
Catholic University of Leuven
Columbia University
Brown University
Alma mater Catholic University of Leuven
California Institute of Technology
Known for Poroelasticity
Notable awards Timoshenko Medal (1962)

Maurice Anthony Biot (May 25, 1905 – September 12, 1985) was a Belgian-American physicist and the founder of the theory of poroelasticity.

Born in Antwerp, Belgium, Biot studied at Catholic University of Leuven in Belgium where he received a bachelor's degrees in philosophy (1927), mining engineering (1929) and electrical engineering (1930), and Doctor of Science in 1931. He obtained his Ph.D. in Aeronautical Science from the California Institute of Technology in 1932.

In 1930s and 1940s Biot worked at Harvard University, the Catholic University of Leuven, Columbia University and Brown University, and later for a number of companies and government agencies. During the period between 1932 and 1942, he conceived and then fully developed the response spectrum method (RSM) for earthquake engineering which was further promoted by George W Housner.

In the period between 1935 and 1962 Biot published a number of scientific papers that lay the foundations of the theory of poroelasticity (now known as Biot theory), which describes the mechanical behaviour of fluid-saturated porous media. He also made a number of important contributions in areas of aerodynamics, irreversible thermodynamics and heat transfer, viscoelasticity and thermoelasticity, among others.

Biot is a recipient of the Timoshenko Medal (1962) and was elected a Fellow of the American Academy of Arts and Sciences the same year.
--------end of write-up from Wikipedia

Biot was awarded Honorary Fellowship in the Acoustical Society of America in 1983. Here follows a citation written for that occasion:

CITATION TO MAURICE ANTHONY BIOT

... for fifty-five years of extensive and widely diversified research, which includes acoustics, aeronautics, applied mathematics, chemistry, geophysics, thermodynamics, vibrations, and viscoelasticity.

SAN DIEGO, CALIFORNIA, 9 NOVEMBER 1983

MAURICE ANTHONY BIOT was born on 25 May 1905, in Antwerp, Belgium. He received from Louvain University a bachelor's degree in philosophy (1927), as well as degrees in mining engineering (1929) and electrical engineering (1930). In 1931 he was awarded a D.Sc. He was granted a Ph.D. in Aeronautical Science from the California Institute of Technology in 1932, by which time he had produced his first three invention patents, and about a dozen publications. There followed successive faculty appointments: at Harvard (1934-35), Louvain (1935-37), Columbia (1937-46), and Brown (1946-52). In these years he published about 40 papers and produced 20 or more consultant reports.

After 1952 Professor Biot worked, largely alone, as a consultant for various government agencies and industrial laboratories. A long series of consultant reports was one result. Another has been the continuing appearance of published papers; the present total is around 170.

A listing of Biot's professional output and of awards made to him, through 1979, can be found in the Journal of Mathematical and Physical Sciences for February 1980. (That entire issue was dedicated to Professor Biot in the year of his seventy-fifth birthday.) Listed for both the United States and Belgium are memberships or fellowships in learned societies (including the National Academy of Engineering), as well as medals and awards. Among the latter are the Timoshenko Medal of the American Society of Mechanical Engineers and the Th. von Karman Medal of the American Society of Civil Engineers. There are also six invention patents, about two dozen technical reports not published in the general literature, over 160 papers (mainly research but some of tutorial nature), and three books. The first book was a text, Mathematical Methods in Engineering (co-author, Th. von Karman), McGraw-Hill, 1940; it was later translated into nine foreign languages. Next came a treatise, Mechanics of Incremental Deformations, Wiley, 1965, followed by a monograph, Variational Principles in Heat Transfer, Oxford U.P., 1970.

Biot's research topics and fields range very widely. Listed in alphabetical order, they include acoustics, aerodynamics and aeronautics, applied mathematics, chemistry, electromagnetism, engineering, geophysics, nonlinear systems, physics, thermodynamics (including irreversible aspects), vibrations, and viscoelasticity. He has published articles in many journals, but nearly a third of the total are found in only four journals: Journal of Applied Physics (16 entries in 25 years), Journal of Aeronautical Sciences/Aerospace Sciences (15 entries in 23 years), Annales de la Societe' Scientifque de Bruxelles (12 entries in 9 years-during his first years of publication, before he moved to the United States); Journal of the Acoustical Society of America (9 entries in 35 years).

Professor Biot is being awarded Honorary Fellowship in the Acoustical Society of America. Therefore, we shall devote more specific attention to acoustics.

Biot has had nine research articles (three with co-authors) in the Journal of the Acoustical Society of America, over a time span of 35 years. All are good solid research efforts; probably four of them have had especially great influence on the acoustical work of other people. It would be easy to select twenty more articles by him which could be described as sound, shock, and vibration. Most if not all of these papers could equally well have fitted our Journal. Another ten articles, or more, would be found quite useful toward the solution of acoustic problems. Certainly he has contributed greatly to the field of acoustics.

Biot, however, has never for long restricted himself to any single topic. For example, in the 1930's he studied wave propagation in prestressed solids, formulated for them an elegant general system of linear field equations, applied these in geophysics, seismology, and engineering, and ultimately found a method for dealing with the early stages of folding in geological structures. -----by A. O. WILLIAMS, JR.


Biot in his apartment at 300 Central Park West, New York, September 1964

In 2003 the American Society of Civil Engineers established the Biot Medal, shown here:

On the other side is inscribed the following:
"PRESENTED TO/ _____________/ AWARD ESTABLISHED/ BY THE/ ENGINEERING MECHANICS/ DIVISION FOR/ OUTSTANIDNG ACHIEVEMENTS/ IN THE/ FIELD OF MECHANICS OF/ POROUS MATERIALS/ <year>/American Society/ of Civil Engineers"

1962 ASME Timoshenko Medal Acceptance Speech by Maurice A. Biot

Timoshenko Lecture: Science and the Engineer

As everybody knows, there are two sides to a Medal. The bright side in this case is obviously the encouragement to the recipient. The darker aspect of the other side is something you will have to bear with me. I refer, of course, to the after dinner speech.

First of all, it is a great honor to be associated with the name of Timoshenko, the Teacher, the Scholar, the great Engineer and Scientist. It is widely agreed that the high level of instruction and application of solid-state mechanics in this country is due to his influence and his teaching.

However, to me the name symbolizes much more than the award and the honor. It evokes a brilliant phase and tradition in the practice of science and engineering which unfortunately seems to be on the decline. This is the tradition of clarity, simplicity, intuitive understanding, unpretentious depth, and a shunning of the irrelevant.

There is, of course, no merit in sophistication for its own sake. In the understanding of the physical world, and particularly in the area of technological applications, it is important to perceive what is irrelevant. The level of irrelevance involves a value judgment which usually requires rather subtle habits of thought related to natural endowment and previous experience.

We should not overlook the importance of simplicity combined with depth of understanding, not only for its cultural value, but as a technological tool. It leads to quantitative predictions without laborious and costly calculations; it suggests new inventions and simple solutions of engineering problems. Aside from obvious economic advantages, it also provides an important quality in engineering design, namely reliability. In this respect one cannot help reflect on our dismal record of staggering cost and repeated failures in the field of rocketry.

Deeper physical insight combined with theoretical simplicity provides the short-cuts leading immediately to the core of extremely complex problems and to straightforward solutions. This cannot be achieved by methods which are sophisticated and ponderous even in simple cases. The process of thought which is involved here may be described as "cutting through the scientific red tape" and bypassing the slow grinding mills of formal scientific knowledge. Of course, formal knowledge is essential but, as for everything in life, the truth involves a matter of balance. The instinctive embodiment of this truth is to be found more often in the politician than in the scientist. However, it is essential to the make-up of a competent engineer.

Doubt about the engineer's function in our increasingly complex technological culture has been expressed by the blunt question "Is the engineer obsolete? Should he be replaced by the scientist"? Although such a question is the product of ignorance, the situation is such that, in this country at least, it finds a respectable echo.

What about the physicist? Speaking in general and with due respect for exceptional personalities endowed with outstanding natural ability, I think the physicist has turned away from his own tradition and has tended to become a victim of narrow specialization. Nuclear and particle physics, solid state, spectroscopy, plasma physics, all claim their victims. Many are almost totally ignorant of classical mechanics and are not able to understand the formulation of even simple problems unless it can be reduced to the solution of a Schroedinger equation.

As for the mathematician, a situation has developed which is a complete reversal of what existed in the past. Many of the great names in the history of mathematics of the nineteenth century have been those of distinguished engineers. An outstanding example is Cauchy who graduated as a civil engineer and was engaged in the practice of engineering for many years. These men were of a different breed. They had a deeper grasp of scientific knowledge, a much broader outlook than the professional mathematician of today.

Whatever the cause of this reversal we must face the fact that mathematical science has become dominated by abstract formalism. It is increasingly dehumanized and cut off from its roots in the rich and nourishing soil of physics and engineering, and the other natural sciences. What should be referred to as applied mathematics does not exist on its own, but describes essentially a function and a craft by which the science of mathematics finds its nourishment.

Much of the so-called applied mathematics which is practiced today is almost diametrically opposite to this function. It is permeated with legalistic hair-splitting, shrouded in pretentious language, as if the purpose were to obscure and surround with an aura of mystery and profundity what is very often a simple and even trivial subject.

This trend toward a formalism devoid of humanistic content, this emphasis on form at the expense of substance is found not only in science. It also prevails in our contemporary art and literature and obviously results from deeper, and perhaps self-destructive, undercurrents in our culture.

It constitutes a retrogression toward the abuses of medieval scholasticism and away from that intimate union of craftsmanship and science so characteristic of the Renaissance period. In this connection I recall a quotation from Ortega y Gasset. "Life is not to be lived for the sake of intelligence, science, culture, but the reverse; intelligence, science, culture, have no other reality than that which accrues to them as tools for life. To believe the former is to fall into the intellectualistic folly which, several times in history, has brought about the downfall of intelligence."

Generally speaking, the professional mathematician of today is a specialist in logical systems and rigor. His lack of flexibility makes him unable to exercise one of the very essential functions of mathematics in the natural sciences and engineering, which is to separate the relevant from the irrelevant, to simplify the formulation of complex phenomena, to synthesize and to unify the substance rather than the form. There is not time here to dwell on the details. For contrast let me cite only the brilliant treatment of the Navier-Stokes equations by Prandtl in his famous theory of the boundary layer.

There is, however, a more ominous aspect of this situation which brings up the matter of education of scientists and engineers. We should remember that intuitive ability closely resembles artistic talent. It may be developed or it may be smothered depending on the environment and the training. Rigor and abstract formalism are technical aspects of mathematics which may actually impede invention. They are for the specialist. The engineering student should be exposed to them only as an experience. They should not pervade his thinking nor exceed the point at which the intuitive faculties become inhibited.

In many schools the hard core of mathematical and physical knowledge is submerged in a flood of special courses characterized by abstract-formalistic overtones. There is an emphasis on formal knowledge rather than understanding and the climate is not favorable to creative talent. It should be remembered that one of the important functions of a school is to discover, encourage and develop talent and not only to transmit knowledge. To make the situation worse, we are now witnessing the introduction of the abstract axiomatic approach in high-school mathematics. Such a development involves great dangers to our future scientific and technological standing. It has been said that "Learning is the kind of ignorance distinguishing the studious." I don't want to downgrade studiousness, but I don't think knowledge should be an obstacle to understanding.

While I have dwelt on the more gloomy aspects of this situation, I would like to conclude these few remarks with a more optimistic note.

Let us hope for a revival of humanism and a spirit of synthesis in science. Let us also put new emphasis on engineering as a professional craft, requiring high skill, natural talent, deserving social recognition, and distinctly different from the scientific professions as such. New stirring are appearing in this direction. I am inclined to believe that engineers and engineering schools will play an important part in restoring the unity and central viewpoint in the natural sciences. This is because modern engineering by its very nature must be synthetic. Specialization carried to extremes is a form of death and decay.

One could formulate a principle of degradation of knowledge entirely analogous to the second principle of thermodynamics. It represents a powerful force which can be defeated only by a hard and difficult struggle. The burden of it must be carried, not by teams and organizations, but by a few individuals. In this connection there is much to be said for the smaller schools. They should provide a better environment for unhurried maturing of thought and for the nucleation process by a very small number of qualified people.

It has been customary for the recipient of an award to avail himself of the opportunity to reflect on current problems of professional interest. While I do not pretend to have brought to light any really new ideas, it seems to me that the occasion was most appropriate for their reemphasis in the framework of the Timoshenko tradition.

In this future synthesis and the revival of technological craftsmanship, I think we all agree that in the practice as well as in the teaching, engineers are called upon to play a very fruitful and essential part.