G. SARTON MEMORIAL CHAIR LAUDATIO
for Prof. Sir E.P.Abraham, Oxford University, U.K.

THE PENICILLIN STORY : SAGA AND SCIENCE

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Prof. Sir E.P. Abraham, you belong to the great personalities, who played a major role in the penicillin saga. The full story of this monumental discovery is glorious, even fantastic and also fraught with human passion and-above-all scientific drive.

Names of the Nobel-laureates Alexander Fleming and of Howard Florey, Ernest Chain a.o., with whom you collaborated from the very early stages in the 1940's — and whose work and ideas you extended brilliantly at Oxford University up to now — sound familiar to layman.

No film scriptwriter could ever have invented such an exciting tale cast for larger-than-life actors and you are one of them.

At the centre of the stage was Alexander Fleming, working at St. Mary's hospital in London U.K., deputy to the legendary Almroth Wright, one of the fathers of vaccination who believed that the body can mobilise its own defences against disease. A. Fleming was one of the first to realise the value of lysozyme found in mucosa and saliva,

as an antibacterial. This sparked off Fleming's interest in other antibacterials of natural origins. In the late 1920's he discovered *accidentally* that a *Penicillium* mould secreted a natural product which inhibited staphylococci. The isolation of the active ingredient, which he named penicillin, from the culture proved difficult. In vain he sought assistance from others including Raistrick and Clutterbuck, but by 1936 he gave up after having published all his findings.

In the late 1930's Florey, at the Sir William Dunn School of Pathology of Oxford University, gathered a team including Chain, Abraham, Heatley... to discover antibacterials for infective diseases. Very soon they renewed their attempts to extract, isolate and characterise penicillin. Step by step the Oxford group succeeded in this, until they reached the last hurdle, how to produce this antibiotic on a large scale.

Only surface culture had been used to produce penicillin but not enough could be made by this technique. In desperation, the U.K. government sent Florey to Northern Regional Research Laboratory of the U.S. Dept. of Agriculture in Peoria, Illinois, who had experience in growing *Aspergillus* moulds under submerged aerated fermentation. Peoria developed a medium based on cheap agricultural byproducts such as starch hydrolysate, lactose and corn steep liquor suitable for producing penicillin by submerged fermentation.

Eventually large scale manufacture of penicillin was made possible by the Americans and then spread worldwide. This development set standards for a worldwide search and interest in useful microorganisms and their products.

Those who still decry the profusion of antibiotics available to the medical or biological profession should reflect for one moment where we would have been if those pioneers — to whom you belong — had not persevered against all odds in unravelling these scientific and technical difficulties.

Thanks to you, most infectious diseases are today under control, although for some people : 'A medical drug is a shortcut to change disease'. Also, we all agree with the statement of the famous philosopher Schopenhauer :

'Health is not everything, but without health everything is nothing'. Indeed, the discovery and development of penicillin has not only served humans and improved their health directly or indirectly, it has also launched a frenetic search among microorganisms for other useful microbial products, which are now invaluable in human society to combat human, animal and plantdiseases. It has surely started interest in industrial microbiology, which is in fact the use of microbes to synthesize complex molecules (it is a subdiscipline of what is now called biotechnology).

Dr. E.C. Stakman has stated that 'microorganisms are among man's best friends (making antibiotics, vitamins, enzymes,...) but also his worst enemies (causing, disease, spoilage of food, materials, water,...) but that it took him a million years to find out'.

Prof. Abraham, your work and discoveries, including that on penicillin, cephalosporins, bacitracin,... have shortened this time-span considerably.

It goes beyond saying that the penicillin story is a historical milestone on the road of science development. In this respect, the life and work of Prof. Abraham fits completely within the scope and aims of the SARTON-committee. Indeed we are pleased that the present holder of the SARTON-chair is in the same way as George SARTON was — a person of richly faceted intellect and achievement, reaching from the lab bench to large biological industries.

You have set standards for those who followed : a long line of brilliant scientists and true humanist with interdisciplinary motivation and believing in symbiosis of sciences.

Sir Edward, you are convinced that knowledge, science and wisdom stand central to the individual's and to man's endeavours towards progress, although a bit of luck has often to be present (as illustrated by Dr. Fleming's *'accidental'* observation).

This is now often cited as a school-example of serendipity (which is, and I quote from the Oxford English Dictionary : 'The faculty of making happy and unexpected discoveries by accident', or easier to remember : 'Searching for a needle in a haystack, and finding a nice girl'.

Here, we should recall the words of Louis Pasteur — the first biotechnologist avant la lettre — : 'Chance only favours the prepared mind' (le hazard ne favorise que l'esprit preparé).

You were crucial in the development of fermentation industries, pharmaceutical and biotechnological companies all over the world, thereby applying *micro*biology to solve *macro*problems.

You played a key role in directing worldwide fundamental antibiotic research to meet practical challenges in biology, agriculture, medicine, fermentation, biochemistry and recombinant DNA research. Indeed your fundamental contributions — reflected in your numerous publications, books and lectures — on microbiology, biochemistry, enzymology, genetics and organic chemistry of now extremely useful or model microbial products — penicillin, bacitracin, cephalosporins, nisin, bacilysin... have set standards for other disciplines and products. Although several of these and similar compounds are made industrially in large quantities by fermentation, details about their biosynthesis, genetics remain to be solved and this is where fundamental research is essential. In this respect, a very famous scientist once said (I hope rather ironically) : 'Fundamental research is what I do when I do not know anymore what I am doing'; however he was a pure physicist rather than a biologist.

Sir Edward Abraham's eminent scientific career has been recognized and awarded with a series of worldwide honours, prices, patents, fellowships, medals,... and is now completed with the G. Sarton Memorial Chair (see c.v. below).

The endowment of a Knighthood in 1980 by the Queen of England deserves special mention.

Patents derived from the Oxford work on cephalosporins earned substantial royalties, since the worldsales of these antibiotics climbed in 25 years to more than 4 billion U.S. dollars per year. Charitable trust funds were set up with these royalties for support of medical, chemical, pharmaceutical and agrobiological research in several parts of the world.

Your wife Lady Asbjörg, which was a most charming host, when I stayed with my family in Oxford at the University and in your home, has been a fervent supporter and moral power behind the scenes of your scientific work and deserves our honours as well.

In overviewing the history and current state of industrial microbiology, we are struck by an underlying theme : mutually beneficial relations between what we use to call basic research and applied research. A century ago the largely practical investigations of L. Pasteur led to the establishment of microbiology, immunology and biochemistry as basic sciences. Much later the discovery and productions of antibiotics — in which you were very instrumental — by applied microbiologists provided tools crucial to the development of molecular biology. And now basic research in microbial genetics has returned the favour by supplying an array of new techniques useful to construct 'tailor made' microorganisms for industrial applications. This synergy between science and technology is the key to further progress in industrial microbiology, fermentation and biotechnology. Indeed, L. Pasteur's saying of exactly 100 years ago remains true : 'There are no applied sciences; there is only the application of sciences'. (il n'y a pas des sciences appliqués; il n'y a que des applications des sciences).

Prof. Sir E. P. Abraham's curriculum vitae is condensed here below :

ABRAHAM, Sir Edward (Penley), Kt1980; CBE 1973; FRS 1958; MA, DPhil (Oxon);
Fellow of Lincoln College, Oxford, 1948-80, Honorary fellow, since 1980; Professor of Chemical Pathology, Oxford, 1964-80, now Emeritus Professor; b 10 June 1913; s of Albert Penley Abraham and Mary Abraham (nee Hearn); m 1939, Asbjörg Harung, Bergen, Norway; one, s. Educ : King Edward VI School, Southampton; The Queen's College Oxford (1st cl. Hons sch. of Natural Science), Hon. Fellow 1973, Rockefeller Foundation Travelling Fellow at Universities of Stockholm (1939) and California (1948).
Ciba lecturer at Rutgers University, NJ, 1957; Guest lecturer, Univ. of Sydney, 1960; Reader in Chemical Pathology, Oxford, 1960-64. Lectures : Rennebohm, Univ. of Wisconsin, 1966-67; Squibb, Rutgers Univ., 72; Perlman, Univ. of Wisconsin, 1985; A.L.P. Garrod, RCP, 1986. Hon. Fellow : Linacre Coll., Oxford, 1976; Lady Margaret Hall, Oxford 1978; Wolfson Coll., Oxford, 1982; St. Peter's Coll., Oxford 1983. For. Hon. Mem., Amer. Acad. of Arts and Scis, 1983. Honn. DSc : Exeter, 1980; Oxon, 1984, Royal Medal, Royal Soc., 1973; Mullard Prize and Medal, Royal Soc., 1980; Scheele Medal, Swedisch Academy of Pharmaceut. Sciences, 1975; Chemical Soc Award in Medicinal Chemistry, 1975 Internat. Soc. Chemotherapy Award, 1983. Publications : Biochemistry of Some Peptide and Steroid Antibiotics 1957; Biosynthesis and Enzymic of Penicillins and Cephalosporins, 1974, contribs to : Antibiotics, 1949; The Chemistry of Penicillin, 1949; General Pathology, 1957, 4th edn 1970; Cephalosporins and Penicillins, Chemistry and Biology, 1972; scientific papers on the biochemistry of natural products, incl. penicillins end cephalosporins. Recreations : walking, ski-ing. Adress : Badger's Wood, Bedwells Heath, Boars Hill, Oxford T : Oxford 735395; Sir William Dunn School of Pathology, South Parks Road, Oxford OX1 3RE. R : Oxford 275571. Club : Atheneum.