the world. Others discovered plant poisons capable of paralysing mammals or birds if applied to the tips of hunting arrowheads. It is well within living memory that man has put plant 'poisons' like curare to medical use.

Some of the major influences on pharmacy have stemmed from the development of trade, especially that of spices which were brought to Europe along the silk route and later by sea from India and beyond, and from the emergence of trade guilds in medieval times leading to the professional organizations of today. The later introduction of rudimentary standards to regulate the quality of products and to control deliberate or accidental adulteration eventually led to the control of harmful impurities, and to increased safety and efficacy of drugs and medicines.

In the twentieth century, the 'therapeutic revolution' has seen the transition from drugs of natural origin (which in most cases were capable only of relieving symptoms such as pain, indigestion or constipation) to today's mostly synthetic organic compounds with specific effects and the capacity to combat infection and interfere with the progress of the disease process.

In order to assess the future and continuing development of pharmacy, an awareness of the past is invaluable. As Sir Winston Churchill once said, 'The longer you can look back, the further you can look forward.'

1.1.1 Historical beginnings

The 'cradle of pharmacy' is considered to be the Mesopotamia of about five thousand years ago, or 3000 B.C. Clay tablets dating from this period refer to medical treatments involving incantation and the use of vegetable drugs including almond oil, cannabis, poppy and henbane, as well as substances of animal origin such as fats, animal secretions and parts, honey and beeswax. Many drugs were brought and distributed along the caravan routes from India and Arabia and compounded with gums and resins such as acacia and myrrh by the Babylonian priest-pharmacist-physician. The separation of science from religion is a relatively recent phenomenon although it is worth noting that today's rapid spread of the hospice movement for the more dignified treatment of the terminally ill places great emphasis on the support and treatment of the whole person.

Meanwhile in China, many records indicate the foundations of Chinese herbal medicine, which dates from at least 2000 B.C. Ephedra, cinnamon and rhubarb are believed to have been tested, used and included in the Chinese pharmacopoeia, which has a history stretching back over three thousand years. In modern times, the importance of ephedra as a bronchodilator was recognized in Europe only after the isolation of the alkaloid ephedrine in Peking earlier this century.

The durable papyrus records that survive from ancient Egypt include the Papyrus Ebers, which is believed to have been written about 1500 B.C. It consists of over eight hundred prescriptions recording seven hundred drugs in formulations varying from snuffs and inhalations to ointments, plasters and suppositories. The later contribution and influence of Graeco-Roman and Arabic pharmacy, which dominated the Western world until the seventeenth and eighteenth centuries, has been well documented. Theophrastus, around 300 B.C., was a close associate of

Aristotle and has been called 'the father of botany' and 'the father of pharmacognosy' because of the completeness of his writings and his systematic and orderly methods of observation when describing the preparation and uses of drugs obtained from plant sources in his history of plants. He is believed to be the first to have recorded the action and effect of male fern (*Dryopteris filix-mas*), which was used as an anthelmintic until recent times.

Dioscorides (first century A.D.) is considered to have introduced the scientific method to the study of drugs. From his place of origin in Asia Minor, part of the Roman Empire, he travelled with the Roman legions examining and systematically recording his observations of herbs and drugs of mineral and animal origin. Even in the sixteenth century his writings were still regarded as authoritative for the identification of medicinal plants.

The term 'galenical', which for centuries was used to describe pharmaceutical preparations such as ointments and extracts which were compounded by mechanical means, was derived from the name of Galen, who lived in the latter half of the second century. Galen taught and practised pharmacy in Rome and influenced pharmacy for 1,500 years by the methods he developed for extracting, refining and compounding drugs.

By the middle of the eighth century pharmacy could be separately identified from medicine, at least in the Middle East, where in Baghdad the establishment of a pharmacy preparing and dealing in drugs had occurred. The availability of sugar from the sugar cane enabled Arabian pharmacists to develop drug formulations in the form of syrups and confections. Aromatic waters prepared by distillation were also developed at this time.

It was not until the twelfth century that pharmacy and medicine gradually became distinct from one another in Europe. Prior to this time in Europe the term 'leech' had been in general use to describe the medicine man. However, as the medieval craft guilds developed, among them were guilds for those described as mercers (general import merchants of spices, etc.), pepperers and spicers. The importance of trade in spices from the East and their use both to preserve food and mask the unpleasant tastes and smells around had resulted in the increasing wealth, power and influence of those involved.

History records that pharmacy and medicine were legally separated in Europe in A.D. 1240 during the reign of Frederick II, Emperor of Germany and King of the Two Sicilies. At the interface between the Muslim, Jewish and Christian worlds, he encouraged scientists of every faith and gave pharmacists their professional independence while establishing regulations controlling their code of practice.

The medieval apothecaries, relatively few in number, were often associated with other trades and professions in town guilds. In England they were members of the Grocers Company, but by the early seventeenth century the apothecaries had achieved their independence and were granted their own charter in 1617. In the English speaking world the apothecary steadily consolidated and widened his role by providing free advice with the medicine he compounded and supplied. In many places he effectively became the poor man's physician. In England the Great

plague of 1664–66, which had swept through Europe devastating the population and leaving too few physicians, resulted in the further consolidation of the apothecaries' position as medical advisers. Gradually, the right of the apothecary to practise medicine was established. The passing of legislation in England in the early nineteenth century (Apothecaries Act 1815) confirmed the development of the British general medical practitioner who, from his apothecary origins, retained the right to dispense medicines. This development in the role of the apothecary has influenced pharmacy and medicine throughout the English-speaking world, in North America as well as Australasia and other parts of the Commonwealth.

Not all apothecaries modified their role, and this transition did not happen in Western Europe. However, where a gap was left, there emerged a new group of specialist suppliers, with an interest in the newly discovered and isolated inorganic chemicals, who became increasingly identifiable as chemists and druggists. In the eighteenth and nineteenth centuries many significant discoveries and developments were made by pharmacists, often in a laboratory within their pharmacy. The Swede, Carl Scheele, made many discoveries, including that of the fruit acids, while two French pharmacists, Joseph Caventou and Pierre Pelletier, successfully investigated alkaloids following the discovery of morphine by Friedrich Sertuner, a German. Other pharmacists of this period included Parmentier (French), who introduced and popularized potatoes in France, Pettenkofer (German), the father of modern hygiene, Henry Wellcome and Silas Burroughs, the American pharmacists who founded one of the world's leading pharmaceutical manufacturers and philanthropic foundations, and Buchner (German), who isolated the alkaloids of potato and tobacco. The British pharmacists Benger and Bird contributed to the development of invalid foods, while Bowie and Weddell formulated free-flowing 'dry' table salt. Joseph Swan, who invented the carbon filament lamp, was a British pharmacist; he was later knighted and made a Fellow of the Royal Society.

The experimental work with dyes by Paul Ehrlich (1854–1915) marks the origin of the chemotherapeutic revolution. After screening more than six hundred substances he discovered arsphenamine, which attacked the spirochaete of syphilis within the body without harming the host. Organic arsenicals were only superseded in 1945 by penicillin.

Until the discovery of prontosil, announced early in 1935 by Domagk in Germany and by Horlein at a meeting of the Royal Society of Medicine in London, there existed very few drugs capable of attacking the causes of disease. Those that there were included insulin, quinine for malaria, emetine (from ipecacuanha) for amoebic dysentery, digitalis for certain heart conditions, vitamin C for scurvy and vitamin D for rickets. In the British Pharmacopoeia of 1932 there were just thirty-six synthetic drugs, including aspirin, phenacetin and barbitone, all of which had been developed in Germany before 1900. Later in 1935, French scientists demonstrated that the chemotherapeutic effect of prontosil was due to its breakdown to sulphanilamide in the body. The race was on, and a succession of

sulphonamide products with increased potency, lower toxicity and a wider spectrum of action resulted.

1.1.2 The development of formularies and pharmacopoeias

The political turmoil that ravaged Europe for centuries following the collapse of the Roman Empire resulted in a serious decline in public health, which had been one of Rome's main contributions to civilization. Methods of construction of aqueducts, baths, sewers and hospitals, and their importance, were neglected and forgotten. During the Middle Ages, monasteries throughout Europe not only preserved the writings of Hippocrates, Dioscorides, Galen and others, but also served the community as hospitals while medicines were prepared from herbs grown in the monastic herb gardens.

The gradual accumulation of knowledge helped to bring about the establishment of educational institutions primarily concerned with higher learning. The medical school at Salerno dates from 848, the university there from 1180, the universities of Paris from 1110, Oxford 1167, Cambridge 1209, Prague 1347, Vienna 1365 and Heidelberg 1385. Emergent pharmacy had not yet found its independent academic place, however, except in the materia medica courses in medical schools, a situation that changed but slowly in most countries until the nineteenth century.

During the Renaissance, drugs brought back from the New World such as ipecacuanha, cascara and coca helped in their turn to stimulate the development of the pharmacopoeia. Originally consisting of a list of medicinal substances in which their origin, collection, preservation and formulation were defined, the pharmacopoeia has developed into a detailed set of reference standards concerned with the nature, substance, purity and quality of drug substances and preparations. In Florence, in 1498, physicians and pharmacists collaborated in the preparation of what is considered to be the first official government-sanctioned pharmacopoeia.

The first of nine editions of the *London Pharmacopoeia* was published in Latin in 1618 and made obligatory for all apothecaries. Its last edition in 1851 was published in English as well as Latin for the benefit of the less well educated apothecaries and chemists and druggists but was still only the size of a small pocket book.

The first local pharmacopoeia of France was published in Lyons in 1628 but it was nearly two hundred years before in 1818 the first edition of the *French Pharmacopoeia* became obligatory throughout France. It is the *Swiss Pharmacopoeia* that is considered to be the first national pharmacopoeia. Among other early national pharmacopoeias, the *United States Pharmacopoeia* appeared in 1820. The first *British Pharmacopoeia* was published in 1864, bringing to an end the three separate official pharmacopoeias published in London, Edinburgh and Dublin.

More recent developments include the *European Pharmacopoeia* and the *International Pharmacopoeia*, the latter being produced by the World Health Organization. *Martindale: The Extra Pharmacopoeia* is an internationally important

compilation based on the world's leading pharmacopoeias and includes extensive evaluated information from the scientific literature. First published in 1883, it is now in its 28th edition and today is available online.

The development of national and now regional pharmacopoeias, such as the European, are a further reflection of the need to develop and extend beyond immediate national boundaries' mandatory standard specifications for drugs, medicinal products, excipients, dressings (plain and medicated), blood products, pharmaceutical containers, reagents used in pharmaceutical analysis, and test equipment to establish minimum criteria for attributes such as the dissolution rate of tablets and capsules. In contrast, the *International Pharmacopoeia* consists of recommended or advisory specifications of particular value to developing countries desirous of compiling their own compendia of reference standards.

1.2 The scope of pharmacy today

Pharmacy has to do with the development, preparation, supply and control of drugs and medicines. The pharmacist (or traditionally the 'chemist' in the community and retail situation in the U.K.) is the expert on drugs and medicines who works closely in professional practice with the medical practitioner, the clinician who prescribes. Most pharmacists worldwide are engaged in community practice, dispensing doctors' prescriptions and supplying medicines not restricted to prescription, giving advice about medicines and health and responding to the symptoms of minor ailments. However, a significant proportion of pharmacists are employed in hospital pharmacy and in the pharmaceutical industry. More limited numbers may be engaged in wholesaling, consultancy, government health departments or in education and research. A degree in pharmacy is the passport to a variety of scientific and professional careers.

Pharmacy is frequently confused with pharmacology, which is the scientific discipline concerned with the action of drugs on the human or animal body. Pharmacology is an academic discipline in its own right and is a most essential component of pharmaceutical and medical education today.

Up to the middle of the twentieth century, pharmacy and pharmacists were primarily concerned (and identified by the public as being concerned) with the preparation and dispensing of drugs and medicines on doctors' prescriptions. Many brand-name medicines (commonly known as 'patent' medicines) were supplied and sold by community or 'retail' pharmacists for the treatment of minor ailments. In most countries, few drugs were restricted to prescription except the addictive narcotics, and most medicines were palliative rather than curative. Hospital pharmacists performed similar manufacturing and dispensing roles, while a relatively limited number of pharmacists were employed in the pharmaceutical industry.

Today the community and hospital pharmacist is much more involved as a member of the health team, working with doctors, dentists, nurses and many other associated practitioners. The pharmacist in industry is now employed in departments other than production and marketing, including research and

development, regulatory affairs, clinical trials, quality assurance and information services. The scope of pharmacy has significantly widened since the 1950s in tune with the more sophisticated and demanding requirements of safety, quality and efficacy for all medicines expected by the public today.

These changes are reflected in the current education of pharmacists (*see* section 1.9.1), which now recognizes the need to include elements of communication skills, information technology, health education and behavioural science in pharmacy degree courses.

Inevitably some of the traditional terms used to describe particular sections of degree courses are falling into disuse or being replaced by what are currently considered to be more apt descriptions.

Pharmacognosy is the term used to identify those aspects of pharmacy which have to do with the study of drugs of natural origin, predominantly of plant origin. In the past attention was paid to the cultivation, collection, drying and preservation of such material; its macro- and microscopic identity and quality control. Pharmacognosy had much in common with historic materia medica. In many academic and research institutions today, the term *phytochemistry* has superseded 'pharmacognosy' and reflects the change of emphasis to the identification and study of the chemical entities that give the plant its pharmacological or medicinal properties. *Clinical pharmacy* is a term that is increasingly used in the practice of pharmacy both in the community and in hospital. It has to do with the optimization of drug therapy in the patient and so may include discussion with the prescriber about the most appropriate choice of medication, advice to the patient (thereby aiding compliance) and — principally in the hospital environment — the monitoring of drug levels in the patient.

The report of an independently instituted inquiry into pharmacy in the U.K. by the Nuffield Foundation was published in 1986 (entry [312] in Part II). Many of its ninety-six recommendations could have far-reaching consequences for the future development of pharmacy not only in the U.K. but in the European Community and internationally. 'In considering the present and future structure of the practice of pharmacy in its several branches and its potential contribution to health care and to reviewing the education and training of pharmacists', the report's principal proposals are: a wider professional role for pharmacists; the controlling of standards through professional rather than regulatory means; the regular assessment of professional competence; the practice of clinical pharmacy in all hospitals; and a test of ability at the end of the pre-registration year. (It is planned to implement this last recommendation in the U.K. by about 1990.)

Pharmacy is a profession with a direct responsibility to patients, for the safe and effective use of medicinal products to treat or cure a disease or illness, or at least to relieve its symptoms. With more interest in and attention being paid to disease prevention, the pharmacist has been increasingly involved in health education. The distribution, accessibility, public image and philosophy of the community pharmacy make it an ideal location for the dissemination of health education literature and information, with the advantage of professional expertise should an

interested enquirer require more information. In a number of countries, including the U.K., national organizations, often sponsored by government, have utilized pharmacies for the distribution of health education literature on heart disease prevention, healthy diet, AIDS, contraception and family planning, and drug abuse. Such health promotion programmes have received media backing, advertising and active support from pharmaceutical professional organizations. In some countries, such as Switzerland, France and the U.S.A., pharmaceutical manufacturers have been very active in providing large-scale display material for use in pharmacies.

In Western Europe, notably in France, many pharmacists carry out biochemical testing, especially of urine, and their professional qualifying courses have reflected this specialization.

In more recent times, community pharmacists from countries in parts of the world as scattered as Nigeria, the U.K., the Far East and North America have provided additional services such as pregnancy testing, blood pressure monitoring, and the measurement, fitting and supply of elastic hosiery, trusses, and incontinence and stoma care appliances. As the world's population gains in life expectancy, community pharmacists from Singapore to Sweden are hastening to provide a plethora of geriatric aids.

These natural extensions of the pharmacist's traditional role create their own knowledge and information demands. With the general exponential increase in knowledge it is difficult to over-emphasize the importance of post-qualification continuing education.

The most significant development in community pharmacy practice in the past decade, at least in the U.K., has been the revitalizing of the pharmacist's role in responding to symptoms as described by patients seeking the pharmacist's advice. Pharmaceutical education has adapted to ensure that undergraduates receive better education to prepare them for this long-established traditional role, which went through a period of neglect. The importance of referring patients to their doctor, when necessary, is paramount. Even if the symptoms indicate a minor ailment the pharmacist must invariably add the caution to seek medical advice should the condition either not clear up in a specified time or deteriorate. Here again the value of close co-operation between pharmacist and doctor for the benefit of the patient is obvious. It has been estimated that only one person in four with identifiable illness actually goes to his or her doctor — although of the estimated 6 million people a day who visit Great Britain's 11,000 community pharmacies, only a proportion do so because they are ill. The pharmacist must be almost alone among professionals in traditionally giving his or her professional advice free, in many cases without even the sale of an accompanying medicinal product.

Figure 1 shows some of the activities relevant to community pharmacy.

1.2.1 Education

The reputation of a profession depends heavily upon the education of its members. In most countries, the long, indentured apprenticeships that prevailed,

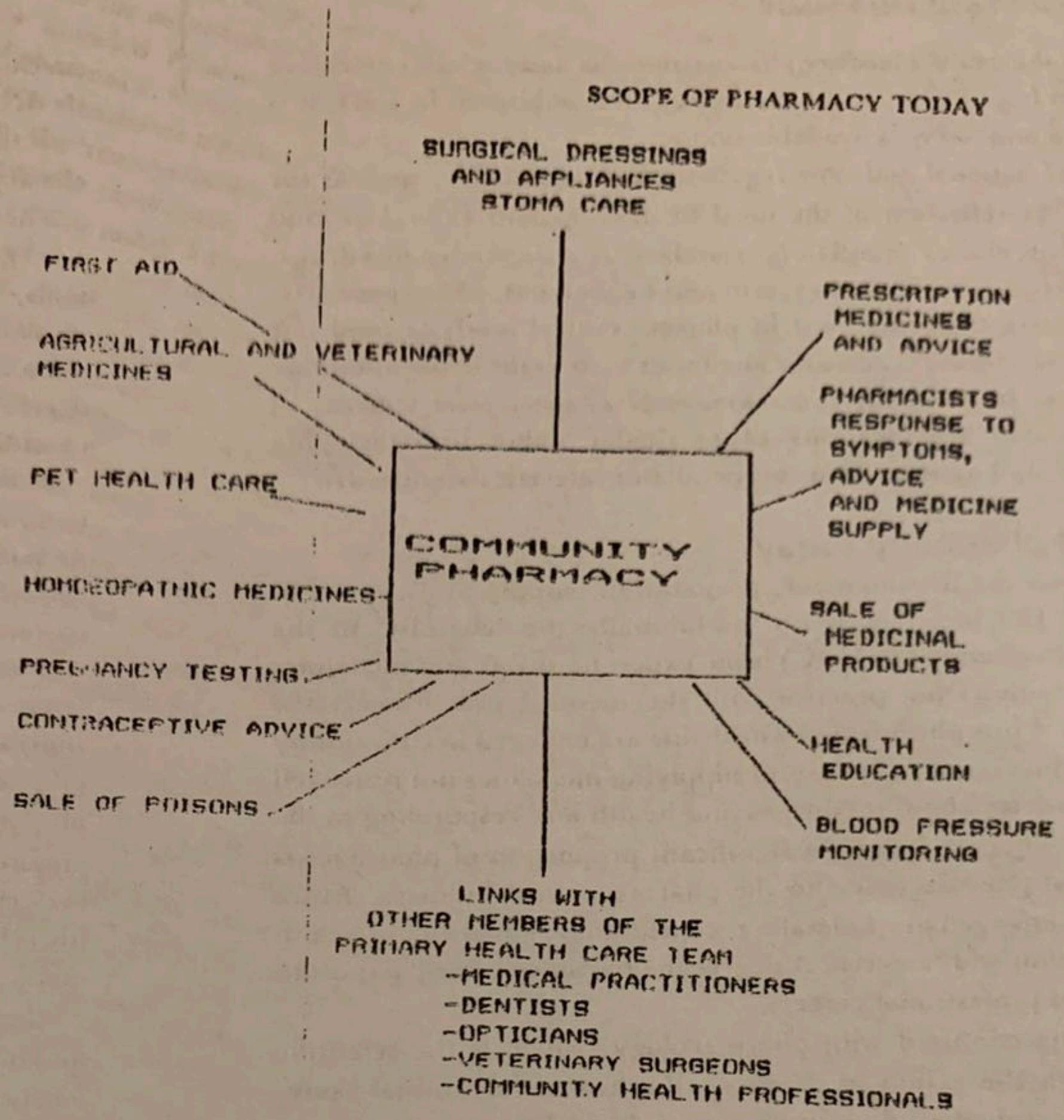

Figure 1 Some health care areas associated with community pharmacy

and which culminated at best in an oral examination, have gradually (since the nineteenth century) been superseded. Pharmaceutical education, with greater emphasis on the academic course, is normally preceded by the attainment of a satisfactory standard in secondary education and basic sciences, confirmed by a national or state certificate such as the baccalaureate or, in the U.K., the advanced level certificate of education. Subjects usually considered essential are chemistry a biological subject, and mathematics or physics. However, in countries such as the U.K., with a tradition of early educational specialization, there is a considerable move towards a broader secondary education and the acceptability of some non-science subjects for admission to the medical sciences, including pharmacy.

In most countries the professional pharmacy qualification is achieved by a university degree or its equivalent with the addition, either during the course or following it, of a period of supervised practical experience in pharmacy. This period of practical experience prior to registration or licensing as a pharmacist

varies from six to eighteen months, depending on country, but twelve months is typical. In the U.K., the pre-registration period is twelve months, of which at least six must be spent in hospital or community pharmacy. Thus the relatively small number of pharmacy graduates undertaking their pre-registration in the pharmaceutical industry are required to gain some experience in community or hospital pharmacy as well. It is usual for the pre-registration graduate to attend seminars, undertake a small research project and keep a detailed record of his or her professional practice experience for submission before licensing or registration.

In the 1840s the newly founded Pharmaceutical Society of Great Britain established its own school of pharmacy, which provided the basis for today's broad-based scientific degree courses. Academic standards have steadily increased as the emphasis has shifted, from the manipulative skills and technical knowledge required to prepare yesteryear's medicines, to an integrated scientific and vocational course designed to enable today's graduate to develop and adapt to the rapidly changing technologies of today and tomorrow. Only pharmacy graduates are instructed in the chemistry, synthesis, purification and extraction of drugs, their design, manufacture, testing, control and formulation. This study is complemented by the teaching of pharmacology, toxicology, and the therapeutic use and clinical effects of drugs, knowledge of which is essential for their safe and effective use. The importance of the cell as a unit in human and animal physiology, as well as in bacteria and pathogenic micro-organisms, its biochemistry and pathology, has resulted in the development in many pharmacy degree courses of foundation courses in cell biology. Physical sciences and the application of mathematics and statistics are associated with professional studies that include the essential commitment to the meticulous, accurate and reproducible dispensing and formulation of medicines and their safe supply for the ultimate benefit of the patient.

In many countries worldwide, as pharmacy has accommodated the speed of the therapeutic revolution, the need for placing more emphasis on communication skills, behavioural studies and clinical pharmacy is reflected both in practice and in undergraduate education. The complexity of modern drug therapy requires the pharmacist to pay more attention to advising patients how best to take or use their medication. This advice can be supported by information in the form of a label or leaflet, with warnings, such as 'avoid alcohol', being emphasized but tempered with reassurance. Patient compliance is of paramount importance if medication is to be worth while.

The influences on the development of pharmacy have been sufficiently similar within the member countries of the European Community for the free movement of pharmacists soon to be realized. Degree courses, however, vary from three to six years between member states. There are also differences in secondary education, with early specialization being a feature of English and Welsh education. Licensing or registration follows either an additional year's postgraduate training or the inclusion in the degree course of a similar period of professional experience. The net result, however, is greater similarity rather than divergence. Except

perhaps in the Netherlands, approximately a three-year period in all courses is pharmaceutically oriented. The remainder of most courses is devoted principally to the teaching of basic science subjects. The time allocated to particular subjects ebbs and flows depending upon scientific developments, research and changes in professional practice. In most countries worldwide, more emphasis has been given to human physiology and pharmacology and less to pharmacognosy (the pharmacy of drugs of natural origin, especially botanical origin). In Belgium, France and Italy, the analysis of foods (bromatology) receives more emphasis than elsewhere, while the clinical pharmacy practice of response to symptoms, a subject currently being given much more attention than formerly, is known in France as semiology.

It is important, however, for universities and polytechnics in each country to be able to adapt the education of their pharmacy students to the changing needs of pharmacy practice in that country, and the developing role of the pharmacist. The need to educate the undergraduate student to be able to adapt to change has become vital. The need, too, for postgraduate courses enabling pharmacists to specialize beyond any modest specialization within the undergraduate degree course is increasingly recognized. Diploma and master's degree courses are available in many countries enabling participants to specialize, for example, in clinical pharmacy, industrial pharmacy, hospital pharmacy, agricultural and veterinary pharmacy or drug information pharmacy. The state of California offers a doctor of pharmacy degree course that specializes in patient-orientated clinical pharmacy. Higher degrees by research at doctorate level (PhD, DSc or their equivalent) are available in pharmacy in most universities in the world where pharmaceutical sciences are studied.

In Europe, France has the largest number of undergraduate pharmacy students, with 35,000 in twenty-four schools of pharmacy and about 3,800 graduates per year. By comparison, the U.K. has sixteen schools of pharmacy with about 3,500 undergraduates; about 1,000 students graduate each year. The ratio of male to female students varies considerably from country to country. In Egypt it is 50:50 while in Sweden pharmacy students are over 97% female. Kenya has only 15% of female pharmacy students whereas the U.K. has about 60%. The seventy-one accredited schools of pharmacy in the United States produce about 5,500 graduates per year, which sustains a figure of just over 170,000 active licensed pharmacists or approximately 65 pharmacists per 100,000 population.

1.2.2 Licence to practice, or registration as a pharmacist

The criteria by which a profession may justify that description include the following: (a) the discipline must be an intellectual one, in which an educational programme is designed to ensure a standard of knowledge appropriate to registration; (b) it must sustain a representative body of practitioners within an organization; (c) it must have an agreed set of standards of conduct or code of ethics; and (d) as part of its role it must give an expert service and advice to the community.

A profession's acceptance of responsibility for the service provided is in return

for the monopoly privilege granted by society in recognition of the expertise available. The regulation of the pharmaceutical profession is achieved by the enforcement of a code of ethics that applies to all pharmacists irrespective of the sphere of their employment. The principal concerns are the protection or safeguarding of the public and the maintenance of standards and of the public's confidence in pharmacy.

In Western European, North American, Commonwealth and many other countries, a licence to practise or registration as a pharmacist is normally granted by the Ministry of Health of the country or state to those nationals possessing a pharmacy degree or diploma. In the U.K. registration is with the Royal Pharmaceutical Society of Great Britain (the word 'Royal' was added to the society's name in 1988), on the delegated authority of the Department of Health, following the completion of twelve months' pre-registration training in an approved establishment under the supervision of a pharmacist.

In the Federal Republic of Germany, the applicant has to obtain from the police a certificate giving details of character and any criminal convictions, as well as providing confirmation of good physical and mental health. It is expected that such provisos will be included in the requirements for free movement of pharmacists within the European Community in addition to language fluency and knowledge of the pharmacy legislation of the particular country involved.

Most countries in the world have their own national pharmaceutical society which performs a professional role, in most cases publishing a regular journal, organizing national conferences (usually annually) and aiding members by, for example, providing library facilities, information services, publications and insurance. Many pharmaceutical societies have a branch system that enables members to meet locally for scientific and professional lectures. The role of the societies is considered further in section 1.2.5.

The majority of countries also have some mechanism by which a pharmacist prosecuted for some serious criminal offence or guilty of serious professional negligence can be disciplined if there is a risk to the public or where the public's confidence in pharmacy may be jeopardized. In the U.K. this power, where the ultimate sanction is the removal of the pharmacist from the register, is actively exercised by the Statutory Committee of the Royal Pharmaceutical Society. In most other countries, however, removal of the right to practise requires the Ministry of Health to take action through the courts, although such cases are surprisingly rare except where the misuse of narcotic drugs is concerned.

In most countries the practice of pharmacy and the licensing of the manufacture of medicinal products are subject to inspection, the inspectors being appointed for that purpose, usually by the state Department of Health. Inspectors are not always pharmacists. In the U.K., medicines inspectors, who have a particular responsibility for the licensing of manufacturers and wholesalers, are employed by the Department of Health and will normally have had reasonable experience in the pharmaceutical industry. The Royal Pharmaceutical Society of Great Britain also has its own inspectors, all of whom are pharmacists, who have a range of

enforcement responsibilities under medicines and poisons legislation delegated to them by legislation.

1.2.3 Ancillary staff

Scandinavian countries and the Netherlands appear to have the best-organized tier structure of support staff in community pharmacy. In the U.K., the hospital service has a structured technician complement and each hospital pharmacy has its technician establishment. Day release courses are available at standard and advanced level for pharmacy technicians. The Society of Apothecaries still runs its Apothecary Hall Dispenser Certificate course and examination, aimed to supply the needs of the dispensing doctor as well as pharmacy.

Regrettably, the standard of dispensing technician training in community pharmacy in the U.K. is very variable. Large multiple groups like the Boots Company run their own well-organized dispensing technician courses. The National Pharmaceutical Association runs a very economic and high-quality correspondence course.

The need for recognition of the role of pharmacy technicians and a more uniform standard of training is essential for the fuller utilization of the community pharmacist's expertise in serving the public.

1.2.4 Relationships with other professions

Pharmacists in community practice have most professional involvement with general medical practitioners (GPs) or family physicians, and to a lesser extent with other prescribers, such as dentists and veterinary surgeons. From their traditional role in preparing and supplying medication prescribed to the patient or for the patient or animal, has developed the often more demanding role of ascertaining the suitability and safety of the medication prescribed. The frequency of dosage or use of modern sophisticated medication, the possibility of drug–drug interaction or of unacceptable side-effects, or the need to minimize side-effects may result in the pharmacist's decision to discuss the prescription details with the prescriber, if appropriate, and to advise some modification for the patient's better treatment. Community pharmacists may also be professionally involved, again usually to a minor extent, with chiropodists, midwives, ophthalmic opticians, and district and practice nurses, mainly as suppliers of medication that needs to be accompanied by appropriate information and advice about dosage and use.

In hospitals, nurses responsible for the administration of medication to the patient may be advised by the pharmacist about the safe and correct way in which the medication should be given. The pharmacist may also co-operate professionally with hospital biochemists, nutritionists and other paramedical staff. When medication has to be added to parenterally given infusion fluids, it may be necessary for the pharmacist to calculate appropriate quantities and add the medication to the 'drip' solution. In this situation the pharmacist must also be sure that such mixing maintains sterility and is physico-chemically stable.

In the public health field, community pharmacists regularly supply rodenticides

co[illegible]munity pharmacies and in the U.K. the corresponding figure is 62 per cent. In Austria and France the figure is over 80 per cent. More modest numbers of pharmacists are employed in hospitals, wholesaling, the pharmaceutical industry and in teaching and research in schools of pharmacy. Some of the aspects of specialization in hospital and industrial pharmacy will now be described.

Hospital pharmacy

The importance for the various health care professions to work together as a team is paramount in the hospital service of any country, whether the hospitals are part of a nationalized health service or run privately. The hospital pharmacist's responsibilities relate to the preparation, control, supply and use of medicines.

Over the years the pharmacist has become increasingly involved in the use and administration of drugs and medicines, having direct contact with patients in hospital wards and the medical and nursing staff. The ward pharmacist is now well established in many countries and reinforces the link with the medical and nursing staff and in turn with other specializations in pharmacy, especially clinical pharmacy. Today's more specific, more complex and more potentially hazardous medicines demand a more specialized back-up information service than that provided by the individual pharmacist's traditional advisory role. Since the early 1970s drug information pharmacy has developed in the U.K. as a speciality, with a principal-grade pharmacist in post in most of England's fourteen health service regions and a staff pharmacist, drug information, in most district general hospitals.

Other important areas of established specialization in hospital pharmacy include: education and training; radiopharmacy; cytotoxic reconstitution; adverse-reaction monitoring; quality control; and specialized manufacture.

On the administrative and managerial side more attention is being paid to the co-ordination of community pharmacy with the hospital service as well as with hospices for the terminally ill and with geriatric units. Developments in these areas have continued through the several reorganizations of the U.K.'s National Health Service, and in many other countries too.

Hospital pharmacists are increasingly involved in the rationalization of prescribing, the introduction or revision of hospital formularies and the keeping of computerized patient medication records. Specialist expertise has been applied to the unit-dose packaging of medication for mentally sick patients allowed home at weekends and the calculation of the constituents of and preparation of intravenous feed requirements of individual patients on total parenteral nutrition (TPN).

Developments in hospital pharmacy may be summarized under three headings: direct or patient services; support services; and managerial services. *Direct* services include:

1. in-patient dispensing and the issue of stock medicines to wards;
2. medication issued when patients are discharged;
3. out-patient dispensing;
4. ward pharmacy — the pharmacist's routine visits to wards to monitor in-

patient prescribing and advise medical and nursing staff;
5. clinical pharmacy — optimization of drug therapy including the monitoring of drug levels in the patient (complementary to ward pharmacy);
6. drug information; and
7. community-linked services.

Support services include:

1. the procurement of medicines, dressings, etc.;
2. non-sterile production of medicines either for reasons of economy or because the specialist nature of the product renders it not generally available;
3. sterile production under strict manufacturing control;
4. radiopharmacy; and
5. quality control of products procured to contract or manufactured.

Managerial services include:

1. departmental management of pharmacists, technicians and support staff; and
2. contribution to the work of hospital committees such as those concerned with drugs and therapeutics and the control of infection.

Hospital pharmacy in many countries has seen some drastic changes well within the professional lifetime of many pharmacists still in practice, and in many places would be quite unrecognizable to a hospital pharmacist of thirty years ago.

The pharmaceutical industry

Many of the world's major pharmaceutical manufacturing firms were first established in the nineteenth century by practising pharmacists. It is interesting to note that a significant number in the U.K. and North America were associated with eminent Quaker families. Several established a reputation for the high quality of their products, including Burroughs Wellcome (founded in the U.K. by two American pharmacists, Silas Burroughs and Henry Wellcome) and Parke Davis. These companies' own self-imposed quality control standards pre-empted the later official compendial standards.

The prime aims of the industry are: to discover safe and effective new drugs; to develop these drugs into effective medicines; and to produce and market these medicines profitably. This third aim may appear to detract from the primary needs of and concern for the patient, and inevitably there have been instances of drugs being marketed either too hastily or too enthusiastically. However, the advances in chemotherapy over the past decades have contributed, alongside vastly improved water and sanitation supplies (and, perhaps, nutrition), to significant reductions in mortality and reduced need for costly hospital treatment. Vaccines in association with improved public health have helped to reduce childhood mortality in the U.K. from pneumonia, tuberculosis, diphtheria, measles and whooping cough between the ages of 1 and 14 years in the last fifty years from 1,570 to 5 deaths per million — a fall of over 300 times. Similar falls have been recorded in most

W[illegible]n European countries and in North America. The in-patient population of me[illegible] hospitals has fallen by 50 per cent within the last thirty years, while during the [illegible]st decade the number of surgical operations for peptic ulcers has been dra[illegible]tically reduced by the availability of H2 antagonists.

T[illegible] pharmaceutical industry is not labour-intensive, but is undoubtedly re[illegible]ch-based. It is currently estimated that it takes about twelve years and about $1[illegible] million to develop a new, successful medicine. At least ten per cent of all gra[illegible]tes employed in the industry in the U.K. are pharmacists.

T[illegible] potential contribution by pharmacists, based on their education and trai[illegible]ng, is most obvious in drug research, product development, production and both [illegible]edical and technical/research information services. Multidisciplinary proj[illegible]t teams are becoming an increasing feature in industry and the pharmacist's bre[illegible]th of training makes him or her an ideal team co-ordinator.

T[illegible] pharmacist's breadth of training also makes a sound basis for the appli[illegible]ation and development of his or her specialist knowledge and skills in, for exa[illegible] quality assurance, clinical trials and product registration or regulatory affai[illegible]s as well as in sales and marketing.

T[illegible]realization that health care professionals need to work together more closely for t[illegible]e be[illegible] of the patient is increasingly widespread. The impact of national healt[illegible]ce systems, the increased sophistication of modern medicine, and the [illegible]treat the whole person have encouraged governments in particular to re[illegible]nd recognize the changing role of professionals such as the pharmacist. It is gove[illegible]uments that often bear considerable financial responsibility for health care syst[illegible]. For example, the U.K. government has proposed a programme for impr[illegible]ng primary health care and promoting better health. This aims to make the serv[illegible] provided by family doctors, pharmacists, dentists, opticians and certain mem[illegible]s of the community health services more responsive to the consumer. At the s[illegible] time the programme should raise the standards of care. The proposals recog[illegible]e the further development of the pharmacist's role in relation to the need for [illegible]health education, the safekeeping of medicines in residential homes and to r[illegible]tion for the elderly. These are issues and concerns throughout the world from [illegible]way to Singapore, Chile to China.

Th[illegible] to many of these changes lies in continuing education, and reports on pha[illegible]y in many countries reflect the recommendations concerning education, train[illegible] and postgraduate education similar to those made in the U.K. in a 1986 R[illegible] of the Committee of Inquiry on Pharmacy by the Nuffield Foundation. Ref[illegible]e has been made to specialization in pharmaceutical education and in the pra[illegible] of pharmacy notably between community, hospital and industrial pha[illegible] as well as within those three major areas. The pharmacist's [illegible]ion in areas such as animal health, agriculture and pet care is certain to expand.

In order to support the response of pharmacists to meet the needs of patients and advise about their medication, new organizations have been formed. Notable among these are clinical pharmacy associations in a number of countries, specialist membership groups within existing organizations and bodies such as the U.K.'s College of Pharmacy Practice, founded in 1981 specifically to advance education and training in all branches of pharmacy practice and at all levels. The application of pharmacy in total health care complemented by research into the practice of