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PROBLEMS AND PROSPECTS OF A PHARMACOLOGICAL CAREER IN INDIA

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The Editorial Committee of the *Annual Review of Pharmacology* has requested me to write the Prefactory Chapter for the 5th volume which appears in 1965. This is an honour and recognition which I appreciate greatly. I am aware that I may not be able to place before the readers anything particularly interesting or attractive from the point of view of modern pharmacology, which is one of the fast growing scientific disciplines of the mid-twentieth century; however, the early historical beginnings of pharmacology in India may be worth recording, as they are probably typical of similar developments in most middle-eastern and southeastern Asian countries of the world outside of Japan. I am probably also the senior-most pharmacologist in this zone of the world and have had the unique opportunity of playing the part of a pioneer in introducing modern methods of experimental pharmacological studies in India. A record of my reminiscences and early experiences during the twenties, in a comparatively under-developed area of the world, would, therefore, be expected to provide stimulating and refreshing reading to many readers interested in the evolution of pharmacology and its emergence as an important world science of today. Because of my rather indifferent health in recent months, my first reaction was to decline the kind invitation; however, on second thought, I decided to undertake the task and called upon my former student, later a valued colleague and co-worker, Dr. B. Mukerji, to associate with me in recording some of my earlier ideas; and he has very graciously agreed to do so. But for his help, this account would not have been written.

In 1903, it was my good fortune to join the University of Cambridge as a student for the study of medicine. Among the subjects of study in the pre-medical stage, only descriptive materia medica was taught; pharmacology, as it is generally understood and taught today, was conspicuous by its absence. Both the theory of drug action on living things and the metabolism and fate of drugs and their experimental and biochemical aspects were entirely ignored. The teacher of materia medica was the Downing Professor of Medicine who gave lectures on the applications of materia medica and the actual use of drugs and recipes then known, on patients in the wards of the hospital.

In 1904 or 1905, the independent post of a Reader in Pharmacology was created, and Dr. Walter E. Dixon was appointed to the position. Soon after, possibly in 1907, a professorship in pharmacology was created; and Dr. Dixon was appointed as the first Professor of Pharmacology in the University

of Cambridge. In this way, a beginning was made in Great Britain into the teaching of one of the most important of basic medical sciences for the more effective treatment of diseases in men and animals and for safeguarding the health of the people through the use of preventive drugs.

The appointment of Dr. Dixon as Professor was most opportune; he was a keen experimental pharmacologist and also was very greatly interested in infusing a spirit of experimental pharmacology among his students. Because we were the very first class which attended his course of lectures, as well as experimental demonstrations sometimes along with the lectures, the enthusiasm amongst us for this new subject of study was very great. I well remember my feeling of surprise and wonder, when I first saw a mammalian isolated heart being infused and its reactions to various drugs which were added to the infusing fluid. The wonder was that the heart went on functioning for many hours after it had been removed from the body of the animal.

Professor Dixon, who was among the earliest group of British pharmacologists, was a most impressive teacher; and his lectures, often interspersed with amusing remarks and humorous comments, left a deep impress on his students. In the practical classes also, Professor Dixon encouraged his students to help him in setting up experiments; and he would stand by and allow them to do the experiments themselves at a time when the agitation against vivisection was at its height in Great Britain. Because of his pleasant and sympathetic approach to individual students, many, like myself, afterward became his ardent admirers and inwardly resolved to follow his footsteps in our later medical careers. Looking reflectively back, I feel that Professor Dixon was really eager to build up a School of Pharmacology in Cambridge on the lines of the sister subject of physiology in that university, which was then at its zenith with such eminent physiologists as Gaskell, Langley, Barcroft, Hopkins, and others on the staff.

By such contacts with Professor Dixon, I became more and more interested in experimental pharmacology and began to spend most of my afternoons with him in his laboratory when he was carrying out experimental work on his own immediate research problems. It was during these hours that I sometimes had the opportunity of having discussions with him about the different systems of medicine practised in India and especially the drugs used in these recipes, some of which were known and reputed to be highly effective. His answers to my questions were never categorical; and, like a true scientist, he would urge me to keep an open mind and try to provide answers to the questions, if possible, through an experimental approach to drug actions on living mammalian systems, not depending on purely theoretical premises.

Later, Professor Dixon encouraged me to perform independent experiments and gave me problems on which to work. I well remember the day when he brought to me a small apparatus which he had designed to record

ciliary movements on a small moving drum and suggested that I work out the action of various drugs, expectorants and others, on the ciliary movements. This work was most fascinating, and I carried it out for a year or so and obtained very interesting results. When I presented to him all the data which I had gathered, he carefully went through it and, after thorough discussion, suggested that I should write a paper which would serve as a thesis for my Doctor of Medicine degree from Cambridge University. I was, naturally, very diffident at first, but he encouraged me and said that it was a good piece of work and was suited for a thesis. After writing the papers for the M.D. examination, and during the course of practical exercises afterwards, I performed an experiment which demonstrated the action of various drugs on ciliary movements. This work was considered a satisfactory performance by the assessors, and in 1908 I was awarded the degree of Doctor of Medicine by Cambridge University. In the same year, I succeeded in entering the Indian Medical Service in the competitive examination. Afterwards I returned to India, early in 1909, to take up a medical service career.

On returning to India, I carried with me the enthusiasm instilled in me by the personality and the scientific stature of Professor Dixon and was more eager than ever to take up an early opportunity of establishing myself as a teacher and researcher in modern pharmacology. Unfortunately, the climate of medical teaching in India universities was not then ready for the introduction of pharmacology as a distinct discipline in the medical curriculum. No suitable placement, therefore, could be found for a young specialist in pharmacology, such as I. As an officer of the Indian Medical Service, I was posted on general medical duty in eastern Africa and in several military outposts in northern India. After nearly a decade, an opportunity came my way, and I was appointed Professor of Pharmacology in the newly established Calcutta School of Tropical Medicine. I was also appointed to the Chair of Pharmacology at the Calcutta Medical College.

One of the duties of the Professor of Pharmacology at the Calcutta School of Tropical Medicine was to undertake research investigations into the merits and demerits of the Indian indigenous drugs which had been used for centuries in ancient Indian and folklore medicine and to explore avenues for finding suitable Indian substitutes for imported drugs. The responsibilities attached to the professorial chair at the Calcutta Medical College were to deliver lectures and demonstrations in pharmacology and therapeutics to the undergraduate medical students preparing for the Calcutta University Bachelor of Medicine degree of the Calcutta University; a prototype of the same degree as recognised by the University of London. Thus began my career as a pharmacologist in India, fulfilling my early, student-day ambition of following in the footsteps of Professor Dixon. Like Professor Dixon, I also started out as the first professor to give lectures in pharmacology, as distinguished from the age-old *materia medica*, taught there before by the pro-

fessor of clinical medicine at the hospital. Researches on experimental pharmacology were soon initiated at the Calcutta School of Tropical Medicine with equipment and apparatus imported from Great Britain. In setting up the first pharmacological laboratory in India. I had the good fortune of securing the able help of one of my colleagues at the School, the late Colonel H. W. Acton, Indian Medical Service, Professor of Pathology and Bacteriology, who was earlier associated with Sir Henry Dale at the National Institute for Medical Research in London and had made important contributions there to the pharmacological action of the cinchona alkaloids. Another voluntary helper, in my uphill task of standardisation of pharmacological techniques in experimental animals, was the late Professor B. N. Ghosh, Professor of Pharmacology in another medical school in Calcutta, who had earlier been temporarily associated with the late Professor Arthur Cushney, the celebrated pharmacology professor of Edinburgh and London.

My dual role as Professor of Pharmacology in a postgraduate research institution (School of Tropical Medicine) and, simultaneously, in the undergraduate teaching centre (Calcutta Medical College) afforded me wonderful opportunities of putting pharmacology on the "medical map" of India and, although I often grumbled at the heavy load of work that I was obliged to carry in the rather uncomfortable climatic conditions at Calcutta, I nevertheless tried to meet the challenge with patience, perseverance, and the development of a "team spirit" amongst the workers associated with me. I realized quite early, that if I had to accept and develop a pharmacological career in India, this could not be done single-handedly with the comparatively poor resources in men and money that were available to me at the turn of the year 1922. It was, therefore, necessary for me to attract people of different scientific disciplines to my pharmacology laboratory at the School of Tropical Medicine and simultaneously to launch a programme of training more medical students at the Calcutta Medical College to take up careers in pharmacology and in medical research, generally. This was a task of no mean magnitude, as full-time opportunities for following teaching and research in scientific medicine, as distinguished from the stereotyped professional medical and surgical fee-paying practice, did not exist in India 40 years ago. However, in spite of initial difficulties and many opposing forces, I was fortunate in gradually being able to establish myself; and, during the next twenty years of uninterrupted teaching and research in Calcutta, I built up an active and, one may even say, flourishing school of pharmacology in India, which contributed in no small measure to the scientific study and ultimate utilization in modern medicine of many Indian plant remedies and also served to focus the attention of world science on the creative potentialities and prestigious status of pharmacology, as an essential basic medical and pharmaceutical discipline. At the time of my retirement from the active Indian Medical Service Cadre in 1941, I was privileged to see the establishment of independ-

ent chairs in pharmacology in most medical schools of the country; my students, colleagues, and co-workers occupied, at one time or another, forty teaching and research positions in pharmacology and allied subjects in various Indian educational institutions. In addition, a small band of devoted young workers, including Dr. B. Mukerji, remained in my original establishment to follow up the pharmacological work that I started at Calcutta.

The School of Tropical Medicine at Calcutta was established through the untiring efforts of a British Officer of the Indian Medical Service, Sir Leonard Rogers, and was planned to operate as a laboratory combined with a clinical research centre for the better management of the more common tropical diseases prevalent in India. The Professor of Pharmacology had clinical beds in the adjoining hospital, and this permitted a wide scope for pharmacology to serve as a connecting link between laboratory and hospital medicine. This happy feature, although now hardly supported by modern schools of pharmacological thought, made it possible for me to interpret pharmacology in its broadest spectrum in India. Researches on various aspects of tropical medicine, therapeutics, chemotherapy, experimental pharmacology, toxicology, clinical evaluation of drugs, drug addiction, indigenous drugs, drug standardization and biological assays, pharmaceutical problems and problems pertaining to clinical medicine, and diagnostic services emanated from my laboratories from time to time. While many research projects which were undertaken appeared unconnected to a central pharmacological theme, I was not sorry to permit such a multipurpose and diversified approach. The climate of medical science in India at that time needed a dynamic experimental and rational appraisal of many theoretical concepts and dogmatic beliefs. Pharmacology could come forward with its broad-based, factual orientation to tackle, interpret, and integrate many problems of diverse interests in widely remote fields of scientific medicine and rational therapeutics. One of the first few research papers that I published from the Calcutta School of Tropical Medicine was on the therapeutics of emetine and cinchona alkaloids. These hardly represented any significant contributions to pharmacological science, but such publications, based on studies on experimental animals, demonstrated, for the first time in India, the dangers involved in employing heroic doses of alkaloidal drugs in the treatment of all types of dysentery and malaria. Through such applied and broad-based activities in the early days, the cause of pharmacology in India was advanced, its essentiality as a cog in the wheel of medical education was proved, and it could secure for itself an honourable place in the medical curriculum of Indian universities.

In spite of the many distractions to which my pharmacology laboratory was then exposed, and to which I had often to submit because of the prevailing medical environment, I never deviated far from my central interest and first love in the development of pharmacological researches on Indian indigenous drugs. The aim and scope of the work, as envisaged by me around

1924, were (a) to make Indian pharmacology self-supporting by enabling her to utilize the locally produced drugs economically, under standardized laboratory conditions and (b) to discover remedies, from the claims of Ayurvedic, Tibbi, and other indigenous sources, suitable to be employed by the exponents of western medicine. Such a programme necessarily demanded a multi-pronged attack by a team of workers from botany, pharmacy, chemistry, pharmacology and clinical medicine. In full realization of this, I initiated a collaborative enterprise with the Botanical Survey of India, located in Calcutta, and with Professor S. Ghosh, Professor of Chemistry at the School of Tropical Medicine. This collaboration with botany, chemistry, and pharmacology lasted throughout my career at the Calcutta School and yielded very fruitful and far-reaching results in the field of Indian drugs. From scientific and academic viewpoints, the work on indigenous plant products has set up a high standard of medical and chemical research in India and has focussed international attention to it. While not many startling discoveries of new drugs from this survey of ancient Indian materia medica have been made, I can at least lay claim to the first introduction and systematic pharmacologic study of the now world-famous Indian drug, rauwolfia, from the laboratories of the School of Tropical Medicine. It is a pleasure for me to record here that Dr. B. Mukerji, my lifelong co-worker, was associated with me from the initial stages of this investigation; our first paper on the subject was published as early as 1933 in the *Indian Journal of Medical Research*. As is now clearly recognised it did not fall to our lot to discover the most important alkaloidal constituent of this plant, reserpine, and to explain all the complicated mechanisms of action of this sovereign Indian remedy. However, our early pharmacological studies did not fail to spotlight the two important basic actions of the active principles contained in the plant on high blood pressure and on the central nervous system. The problem of rauwolfia was much more complicated than the parallel problem of the ancient Chinese drug, Ma Huang, from which Chen & Schmidt isolated ephedrine, which also found an honourable place in international medicine. Much of the joint work on Indian medicinal plant products carried out under my stewardship has since been recorded in my publications entitled *Indigenous Drugs of India*, *Poisonous Plants of India* (two volumes), and *Drug Addiction in India*. The therapeutic uses of some of the more acceptable plant remedies have been incorporated in my other treatises on *Tropical Therapeutics* and *Anthelmintics in Medical and Veterinary Practice*. The first *Indian Pharmacopoeia*, compiled in 1955, introduced a few indigenous drug items based on my work at the School of Tropical Medicine; and in the companion volume entitled the *Indian Pharmaceutical Codex*, Dr. B. Mukerji recommended the use of several standardised solid and liquid pharmaceutical formulations of Indian plant drugs for wider use by practitioners of modern medicine. Indian pharmacology has thereby placed on record quite a satis-

factory, if indeed not a creditable, account of its achievements during the past 30 years, in the area of vegetable drugs.

Space will not permit a more detailed account of my reminiscences and early experiences as a British-trained pharmacologist, in an Indian research institution, where everything had to be started from scratch. Slowly, however, the difficulties were overcome; and, actually, considerable headway was made in establishing this new scientific discipline in different centres in India. As a basic medical science, pharmacology is now taught in 64 medical schools in India and in other schools teaching other health professions such as nursing, dentistry, pharmacy, veterinary science, etc. Pharmacologists in India are being increasingly called upon to apply their skill in pharmaceutical industries interested in the development of new drugs for medical and veterinary use, for the control of pests, and for the promotion of plant growth. Research institutes are needing the services of pharmacologists to study the action of poisons and to find suitable antidotes, to study radiation damage and its prevention, and to maintain quality control on drugs, etc. which cannot be adequately standardized by chemical means. All these developments followed in the wake of the small beginning that I was privileged to make as early as 1922. During the post-war period and following the declaration of Indian independence, there was a general scientific upsurge in India, and, along with this, pharmacology was given a big boost through the establishment, largely through the efforts of Dr. B. Mukerji and me of the first National Drug Research Institute of India. In this institute, located in Lucknow, collaborative teamwork between several scientific disciplines related to pharmacology was ably initiated and built up, under the able guidance of Dr. B. Mukerji, on the same lines as were originally proposed by me, but which could not be made to operate because of difficulties in obtaining trained pharmacologic personnel. A good deal of pharmacologic research is also now emanating from the many medical and public health institutions in India.

After retirement from Calcutta, upon reaching the official superannuation age, I came to my hometown in Srinagar, Kashmir. Here, also, I built up another research centre and was able to give considerable attention to the cultivation problems of reputed Indian medicinal plants. My eldest son, Dr. I. C. Chopra, has been induced to accept pharmacology as a career and has been helping me a great deal in the further development of my interest on Indian medicinal plants.

All these experiences naturally, make me feel satisfied at this evening period of my life. I now only wish that the pharmacologists in India shall continue their activities more zealously: they have better laboratories and more trained personnel and should, therefore, more effectively contribute to the storehouse of world knowledge in drugs. The Indian materia medica is a rich mine of knowledge and provides an open challenge to Indian pharmacologists to probe scientifically into its secrets with an open mind. With

modern pharmacological methodology, a new study of old empirical *materia medica* is called for, not necessarily from the point of view of only nitrogenous active principles (alkaloids, etc.), but also from the angle of organo-therapy, deficiency diseases and imbalance of metabolism, and cell growth and proliferation. Such evaluations by new standards and new measurement techniques might yet yield further interesting new knowledge and perhaps bring to world medicine fresh life-saving and life-prolonging drugs.

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