SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

MEDICINE AS A CAREER[1]

Students of Medicine: You have chosen your life work. You have elected to devote your time and energy to the science and art of medicine. It is hoped that you fully realize the importance of this decision and that you have not come here without adequate deliberation and comprehension of the heavy tasks you have assumed in taking this step. In view of the possibility that some of you have made a mistake, I have decided to spend this hour in presenting to you a few of the duties and obligations which you are assuming and if there be among you those who feel that the burdens to be borne are too heavy and the personal gain too light, let such not hesitate to stop and turn back on the threshold. Medicine needs recruits, but it desires and will accept only those who, after severe tests, it deems worthy. I am aware of the fact that the words of the experienced fall lightly upon the ears of the inexperienced, but one who has served in the ranks for nearly forty years offers you advice. I wish to say that the fatality among medical students is great. In the past ten years, less than sixty per cent. of those who have entered this school have succeeded in winning its diploma, and of those who have gained this distinction not all have fulfilled the confidence imposed in them by the faculty. It is not my expectation that you will do better than preceding classes.

Medicine embraces all facts which may be utilized in the prevention or alleviation of diseases. Its chief contributory sci-

[1] Address at the opening of the University of Michigan Medical School, October 3, 1916.

ences are physics, chemistry and biology. It is for this reason that a knowledge of the fundamental principles and facts of these basic sciences is required for admission to the better medical schools. Some of you will fail because your training in these sciences has been inadequate. Teachers in the medical school can not take the time nor can they hold back better trained students to instruct those who are deficient. By the end of the first year most of these unfortunates are asked to withdraw.

With the best possible preparation the medical student finds his daily task quite as much as the strong can carry and altogether too heavy for the weakling. There has been some discussion among medical educators concerning the curriculum, some contending that it is too heavy for the average student. This depends upon what is meant by the "average student." If the standard set in college work is applied, I am of the opinion that medicine does not want such "average students." I am convinced that a strong student, of a high average, can carry the medical work as now imposed and that the imposition of a heavy task succeeds in weeding out the unfit and is therefore desirable. We do not develop muscles by lifting feather weights, nor do we strengthen brain activity without earnest effort. The aim of medical education is to develop strong men, and in order to do so difficult tasks must be imposed in the training.

A strong intellect is not enough to insure success to the medical student. Intellect must be backed by industry, otherwise it is of but little value. For lack of industry many medical students fall by the wayside. After forty years as a teacher in this school, I am of the opinion that lack of proper application to the work is the most potent cause of failure among the students. In his collegiate course the work has been light, easily done. He has had a good record, but has failed to establish habits of study. Some allurement causes him to neglect his tasks for a day and then for a week. Soon, he finds himself quite in the rear. His bluff at recitation does not go. His teachers question his intellectual strength and honesty. He becomes a derelict and must be removed for his own and others' good.

A third essential to success in medicine is integrity. When endowed with a high degree of intelligence, supported by the greatest industry but without integrity, the medical man is likely to prove a disgrace to his profession and a menace to the community in which he lives. That integrity has been regarded as an essential qualification of the practitioner of medicine from the earliest times is shown by the exaction of the Hippocratic oath supposed to have been formulated by the father of the profession. The medical man must be honest with himself, his patients and the public. For personal gain he must not pretend to greater knowledge or skill than he possesses. Professional ethics insist that in the announcement of his purpose to serve the community he must restrict himself to the simplest statement. The public has long ridiculed the restrictions which the medical profession has attempted, with more or less success, to impose upon its own members, but that the public is now reaching a point where it appreciates the righteousness of medical ethics is shown by recent legislation forbidding false and exaggerated advertisements. The first thing for the honest man in becoming a physician to do is to secure the best possible preparation. To enter upon the practise of medicine or to continue in it without adequate preparation is a crime—a moral, if not a statutory one. The public has come to this view and there is no other profession, admission to which is so strictly guarded as that of medicine. State laws set the stand-

ards of admission to medical schools and state licensing boards test medical graduates. The best intentions do not supply the deficiencies due to lack of knowledge and skill. It certainly can be said that in the practise of medicine knowledge is a virtue and ignorance a crime. Recognizing the fact that no man, however great his intelligence and untiring his industry, can be skilled in all branches of the healing art, individuals select specialties in which they strive to make themselves experts and these so group themselves that each patient may have the advice of an expert. The wisdom of this procedure and its advantages to both practitioner and patient must be evident to all. Each individual in such a group must know his specialty and must keep in touch with its progress. Medicine is a progressive science. Each year adds to its effectiveness. Discoveries in physics, chemistry and biology find practical application in the prevention or cure of disease. It follows that the efficient medical man must continue to be a student so long as he remains an active member of the profession. In medicine there are no "papal bulls" no "ipse dixits" and even "precedent" is shown but scant respect. It is best compared to a living plant constantly drawing sustenance from soil and air, dropping its withered leaves and branches, ever putting forth buds and blossoms and bearing each season better fruit. One who is not capable of sustained effort should seek some other calling in life. Occasionally I meet with men who are still living professionally in their undergraduate days, reading the same old books, and writing the same old prescriptions, both blind and deaf to the changed environment. Fortunately the more intelligent of the public easily recognize these fossils and appraise them at their true worth. They are interesting as relics of the past, but worthless in the present.

From the time of Hippocrates to the present, wise men in the profession have always advocated amity among its members and I must say after many years of personal experience that there is no other high professional ideal so difficult in realization, but I am proud to add that there never has been a time when the promise of the realization of this ideal has been so great as at present. In this matter medical men have learned much from the commercial world in which the value of cooperation has been so abundantly demonstrated. The efficiency of the individual has been increased and the value of the product has been improved. Much regret has been expressed concerning what is called the passing or the elimination of the old-time family physician or general practitioner. In the slow development of scientific medicine he served his fellow men, often with the greatest devotion and self-sacrifice. The history of epidemics shows him to have been often worthy of the highest honor. He has faithfully served his fellow men in times of dire distress. Occasionally he has made contributions of the greatest value to science. In the record of the slow progress of man from the marshes of ignorance and superstition to the uplands of knowledge and science he bears a conspicuous and honorable place, but in the practise of modern medicine his part is a subordinate one.

In any community in which several physicians are singly doing a general practise, cooperation, with the development into skilled specialists, results in individual efficiency among the medical men and better service to their clientele. With a properly equipped hospital at their service, a group of village physicians may give their patients the same scientific and effective treatment that they can secure in larger medical centers. I have no sympathy with the contention that our rural population de-

mands cheaply educated physicians. With trolley cars and automobiles there are but few in need of medical aid who are so located that a good physician may not soon reach them, or what is better, that they can not soon be transported to a hospital. A friend who has long practised in a small Montana city recently told me that twenty and more years ago his ride sometimes carried him one hundred and twenty-five miles from home. One such visit to a case of pneumonia is unsatisfactory to the doctor and of but little benefit to the sick man. Now, the automobile brings the patient to a well-equipped hospital where several physicians may daily consult concerning the case and trained nurses be constantly in attendance.

When I was in medical practise, like the milk man, I made my daily rounds, seeing cases of scarlet fever, diphtheria, sometimes smallpox, pneumonia, various nervous diseases, attending cases of labor and in short I was a general practitioner. Like others of the kind, I did the best I could for all and I am able to say with some pride that in no case did I carry infection from house to house. However, in order to avoid this I often had to change my clothing and disinfect my person many times in one day. This kind of practise is still largely in vogue, but it is gradually being displaced by hospital treatment in which specialists direct and trained nurses administer. The greatest need of practical medicine to-day is more and better equipped hospitals. With these the specialist and the skilled nurse will multiply and improve. Such hospitals should be supplied with thoroughly equipped and competently manned diagnostic laboratories which should serve not only curative but preventive medicine. Water and milk supplies should be examined daily and visiting nurses under the direction of a competent health officer should constantly patrol the community. Adjunct dispensaries which should serve as schools of instruction in baby feeding and care, child welfare, home sanitation and in everything pertaining to healthy living should supplement the community hospitals. When in addition to these agencies the people generally can be educated to see the benefits that would follow the periodic thorough examination of all in order to detect the first departure from the normal, then medicine will be able to render its highest service to mankind.

It must be evident that if these hopes are to materialize the practise of medicine must become more and more a state function. That the tendency is in this direction and that this should be encouraged for the public good are not matters of doubt in my mind. Only a few years ago some of the most eminent men in the profession combated earnestly state support of medical education. They claimed that the state had no right to establish and maintain medical schools and that such aid was not fair in competition with the proprietary schools, which at that time educated more than ninety per cent. of the annual recruits to the profession. Now, no one questions either the right or the duty of the state to establish and support medical schools, while the proprietary schools, having proved wholly inadequate and inefficient, have practically ceased to exist. Even the man in the street sees the advantages that have resulted from these changes. To state that a medical school is a proprietary one, in the sense generally understood by that term, immediately condemns it with intelligent men. Courts from the lowest to the highest in the land have uniformly held that the state has the right to maintain its own medical school, also to pass upon the merits of other schools both within and without its borders, to set up standards

of medical education, to define the requirements of admission to medical schools, to submit those who wish to practise within its borders to certain intellectual and moral tests in order to pass upon their professional fitness and to revoke the licenses of the unworthy. The federal government has its public health service which passes upon immigrants, controls national quarantine, maintains a research laboratory, supervises the manufacture and sale of vaccines and antitoxins, and stands ready to aid any state in combating epidemics. Each state has its board of health, the powers, functions and efficiency of which vary widely. Our great municipalities have their boards of health and commissioners of health which for the most part are efficient, but in some instances are parts of a political machine. Our smaller cities and rural communities have their boards and health officers, which with some notable exceptions, fortunately in increasing numbers, are cheap, ignorant and inefficient.

By means of these organizations, imperfect as many of them are, the death rate in the registered area of the United States has been reduced in the past thirty years from twenty to fourteen per thousand, the average life has been increased more than ten years, and the mortality from tuberculosis and other infectious diseases has been reduced about fifty per cent. On account of the greater efficiency of the health service in our larger cities, the reduction in the death rate has been more marked in these than in smaller cities and rural communities. The greatest reduction in mortality has been secured in our cities of one hundred thousand or more. Our metropolis, New York, has a municipal health service which is second to none in the world. It supports a research laboratory in which the highest grade of scientific investigation is done, diagnostic laboratories in which diphtheria cultures, suspected sputum, blood examination and other tests essential to scientific medicine are made and laboratories in which water and food supplies are carefully guarded. It has a corps of expert diagnosticians ready to aid the practitioner in all suspected cases, free of charge to either the medical man or the patient. It provides medical-school inspectors who detect infection in its earliest stages, excellent hospitals in which the sick have the best care and treatment and nurses who patrol the tenements and other homes of the poor and give instruction in sanitation. It examines cooks and waiters to see that none of these may distribute typhoid fever, tuberculosis, syphilis or other infections. It inspects meat markets, bakeries, milk stations and other places of food supply and has the authority to close these when unsanitary conditions are found.

The last legislature of Michigan made an appropriation of one hundred thousand dollars and directed the state board of health to expend it in attempts to restrict tuberculosis. Several thousand citizens have already been examined free of charge in order that this disease may be detected in its early stages when it is amenable to hygienic treatment. These people are not only examined but those found infected are instructed how to live in order to avert the progress of the disease.

I have chosen to bring these matters before you in order to impress upon you the relation which the profession, which you have selected, bears to the public. Even the physician who devotes himself wholly to what is known as private practise does not escape his duties to the public. He is morally bound not only to do his full duty to the individual who employs him, but to protect the community. You have chosen to come to a school supported by the state.

Michigan practically gives you your education. Why does it do this and what does it demand of you in return for this great gift? It expects that you possess intelligence, for without this the gift is valueless; that you manifest industry both during and after your student life, for without this you bury your talent; that in all your actions, both professional and nonprofessional, you show the most sincere integrity, for without this you become a menace to your benefactor. The state has selected this faculty to ascertain to what extent each of you possesses these essential qualifications and I can assure you that those found wanting will not find their way into the profession through these doors. To those who prove worthy, every reasonable encouragement and proper assistance will be given.

I am sometimes asked what financial reward can the medical man reasonably expect? This is a proper question and I am ready to give it my answer. In the first place, a medical education, even with the relatively small tuition one pays in a state university, is the most expensive professional education, both in time and money, both to the state and to the student.

The laboratory expenses of the medical student are higher than those in any other school. Where other students buy books, he buys not only more expensive books, but he must also purchase a microscope, blood counter, and other expensive instruments. After graduation most medical students spend from one to three years in hospital work and at least one of these promises soon to become obligatory on all. When he begins practise the medical man must have a respectable office and a well-equipped laboratory. He must continue to buy expensive books, for the average medical book is out of date almost as soon as it leaves the press, so rapid has been the advance in scientific medicine in the past thirty years. He can not do without the best professional journals, and, being a member of a learned profession, he is ashamed to be ignorant of the best general literature. In his consulting room, his visits to the homes of his patient and in his association with his fellows he must be neatly, though he need not be expensively, dressed. He must supply himself with means for quick and comfortable travel. Without going into further particulars I may say that by the time he is ready to begin his professional work the most economical medical man has already made an investment of from ten to twenty thousand dollars, counting his actual expenses, allowing a fair amount for his time and calculating the interest on these amounts, and when he begins he must have the wherewithal to make his work successful. No medical man can neglect the financial side of his life's work. Without an adequate income he can not reach a high degree of efficiency in his work. However, the medical man who is imbued with the right spirit will use his financial gains largely in increasing his professional efficiency. After setting aside enough for the fair support of himself and those dependent upon him, he will devote the surplus —and there must be a surplus if he is to be successful—to better equipment, both physically and mentally. It has been my observation that the more intelligent laity respects the physician who endeavors to keep himself well posted and well equipped in his professional work. Medical men who attend their local, state and national societies are, as a rule, successful financially, while those who think that they can not leave their work even for self-improvement have a hard time in making ends meet. One who wishes to accumulate a fortune, or to become wealthy as that term is now understood, should choose some other call-

ing. I know of no one who has placed himself in this class by the reputable practise of medicine. Some medical men have made riches by fortunate investments, but this is an exception. Some marry wealth, but this is usually fatal to professional efficiency. I know of but one man who has demonstrated his ability by winning the highest distinctions in the profession notwithstanding the fact that he married a wealthy woman. While on this point, I may say that practise coming from the ultra rich is not to be coveted. They are exacting in their demands for service. They object to ordinary bills and cry out that they are being sandbagged. As I write this, I have before me such a letter from a millionaire. He admits that he selected the medical man on account of his recognized skill, that he knew what the charges would be before the services were closed and that he did not object at that time, because he was afraid that the medical man would desert him, but when payment was demanded, he claimed that he was being sandbagged because he was known to be rich. The ultra rich are familiar with the use of the sandbag in extorting money from others and they see its phantom in even the most moderate bills presented them.

The medical practitioner endowed with intelligence, fortified with industry and with his every action controlled by strict integrity is sure to make a decent living, care for himself and family in comfort and he need not sleep in a pauper's grave. He is not compelled to sacrifice his self-respect to expediency. His calling is quite as independent as any other. He can choose his own friends, church and political affiliation. The man who is sick with pneumonia or has an inflamed appendix does not consult the society columns, the church directory nor the polling lists when he selects his medical attendant. He prefers the man who is likely to render him the best service, and the intelligent public in the long run and on the whole judges wisely. There never has been a time when individual worth among medical practitioners was more correctly evaluated and, I may add, more highly estimated, than the present. Medicine has cast off the veil of mystery which once covered her face and walks among men uncovered and unashamed. The days of "divine healers," Indian medicine fakirs, and of Mrs. Winslow and Lydia Pinkham, are passing away. Some may say that these statements are contradicted by the wide prevalence of christian science, osteopathy and other cults. These are only the vagaries which have taken form in the delirium-racked brain of a fast-dying superstition. Did our government select any of these agencies in its successful combat with yellow fever in Cuba or on the Canal Zone? Has it relied upon them to keep Asiatic cholera or the plague out of this country? Did it send christian scientists or osteopaths to stay the epidemic threatened by the Dayton floods? Are these cults now busy healing the wounds and adjusting the dislocated bones so abundant on European battlefields? Our Lady of Lourdes and Ste. Anne Beauprie are apparently not on duty at a time when shell-torn and flame-tortured humanity is in greatest need of their much extolled, miraculous powers of healing. The genuine worth of scientific medicine has never been so thoroughly tested as in the present war. Amid unprecedented difficulties, in the camps where millions are congregated, in the quick transportation of corps after corps, in the trenches and even among the prisoners of war, always cared for grudgingly and reluctantly, everywhere, preventive medicine has successfully met her old foes, typhoid fever, dysentery, cholera, tetanus and other epidemics, which in

former wars have usually been the most destructive factors in the midst of contending armies, and have often decided battles and determined the fate of nations. Decisive victories have not yet followed the flags of the central or the allied armies, but in all the red cross signalizes the most triumphant achievement of man. International laws have been torn into shreds and become mere scraps of paper, moral and religious precepts and codes have been supplanted by brutalities never practised by primitive man and the foundations of civilization have seemed to be on the point of disruption and final collapse, but the spirit and ideals of scientific medicine remain unsullied and a new world in which these shall dominate will be created.

Medicine offers a number and variety of special activities to those who choose it as a career. First, there is the grand division into preventive and curative. The former is a product of the nineteenth century, the latter as old as the records of man. The oldest and still a widely dominant theory, as to the cause of disease is that it is an infliction laid upon man by some supernatural being. Primitive man, which term once embraced all, and in this particular, still includes many, probably a majority, even among the most highly cultured nations, believed in the existence of powerful spirits, who measured out good and ill to individuals as their own will might indicate. The religion of such believers consisted and still consists in attempts to propitiate these powerful, or one omnipotent, spirit. They built and still build altars of sacrifice and temples of devotion in which they proclaim their own weakness and implore divine protection and guidance. They still beseech a supreme ruler to shower blessings upon themselves and curses upon their enemies. In the hands of the Jehovah of the Jews disease was a scourge for the punishment of those who merited his displeasure. In the adoption and modification of the Hebrew religion by the Christian world, the idea of a God of wrath was adopted, and still prevails. Even to-day in battle-scarred Europe, the same God is invoked and his aid asked in each contending army. With this inborn superstition transmitted through countless generations, scientific medicine has had to contend. The combat has extended through centuries, as is shown by the earliest records of human achievement. The first signal victory was won when Jenner robbed smallpox of its horrors by the discovery of vaccination and success was assured by the labors of Louis Pasteur who marked the way by which each infection may be identified, controlled and abated.

An enlightened public is beginning to recognize that many diseases, especially the infections, are preventable and the medical profession is being called upon to plan and direct this work. Many of the smaller cities and some rural communities are providing for full-time health commissioners and the demand is greater than the supply. This and other universities are conducting courses specially suitable for public health officials. I am sure that some of you will select this field for the development of your life work. In it there is abundant opportunity to do credit to yourself while you serve the highest interests of your fellow man. The labors of Reed and his colleagues demonstrated the agencies by which yellow fever is spread, and Gorgas and his helpers freed Cuba from this disease and won a greater triumph in the Canal Zone. Laveran and Ross did even a greater service in showing how the world may free itself from malaria, which in all times has held some of the fairest and most fruitful lands under its curse. Preventive medicine is now capable of opening up the tropics as

suitable habitations for civilized man, of removing the stigma of being the "home and nursery of disease" from the fertile valleys of the Nile and of returning to cultivation the banks of the Euphrates and the Tigris on which the cradle of civilization was rocked. I can not believe that coming generations will be so insane as not to use this most potent agent in reclaiming the marsh, the wilderness and the barrens, and converting them into fields, rich in agricultural products and abundant in happy homes. Man's destiny is in his own hands and he may make of this earth a heaven of peace, plenty and prosperity, or he may mar it into a hell of strife, rapine and murder. In knowledge he has advanced to a position in which he becomes a co-worker with the Creator and he must bear the responsibilities which such power imposes. In the struggle between good and evil, knowledge and ignorance, science and superstition, medicine has, and must continue, to lead the way, and you as its standard bearers must serve your day and generation with intelligence, industry and integrity. I do not mean that you are to do your work, always conscious of the burden of duty. With all its imperfections this life is worth living and its highest joys lie in its contests. The man who does not get real pleasure out of his work remains a poor workman and his products do not find ready sale in the market. Even the bitterest disappointment, when you have done your best, often becomes a beacon light warning you of the rocks and leading you into a safe harbor.

It must not be inferred from the great stress that I have placed upon preventive medicine that the curative art is not equally worthy. Moreover, cure is not going to be replaced wholly by prevention. Disease and accident will continue so long as man reproduces his kind. The history of this, the older, branch of medicine is that of man's efforts to relieve the distress and to minister to the needs of his fellow man. Born in ignorance, nourished on superstition, clothed with mysterious rites and ceremonies, medicine has had a hard task to free itself from hereditary and environmental influences. Attempts to break away from these adverse and retarding conditions has marked the highest efforts of the race. During nearly every century since recorded history began, there have been some superior men, intelligent and far-seeing above the masses, who have contributed something to science. Such were Hippocrates, Galen, Pare, Servetus, Harvey and others whom we now delight to honor as contributors to knowledge and benefactors to the race. The discoveries, by empirical methods, of the specific effects of Peruvian bark in malaria and of mercury in syphilis did much to improve the condition of life and to enlarge the field of human endeavor. Since the scientific era began, the marvelous virtue of antitoxin in diphtheria; its great value in tetanus; the relief of cretinism by thyroid feeding; the action of thymol in hookworm disease; the benefit of salvarsan in the treatment of syphilis; the Pasteur treatment of hydrophobia; the prevention and cure of beri-beri by nutritional regulation—mark some of the most evident achievements in curative medicine. For diagnostic and prognostic purposes the medicine man of primitive peoples consulted oracles, watched the peristaltic movements of the intestines of animals offered in sacrifice, or read the fate of his patient in the positions of the stars. The physician of to-day employs the discoveries in physics, chemistry and biology for these purposes. The physician of fifty years ago was compelled to rely largely upon the study and interpretation of symptoms in which the best became highly proficient,

to-day he supplements these studies with the microscope, Roentgen ray, test tube, and other instruments of scientific precision. Then, his conclusions were drawn largely from guesses, now they are founded upon exact and positive knowledge. A large part of your undergraduate education will consist in familiarizing yourselves with the use and application of instruments of precision for diagnostic purposes. Each year brings forth advances in the fundamental sciences and medicine is ever ready to utilize such discoveries as may be of service in the prevention or cure of disease. It has been demonstrated that the physiological action and therapeutical effects of a chemical compound can be modified by changes in its molecular structure. The genius of Ehrlich produced salvarsan and its later substitutes in accordance with this principle, and the possibility of finding curative agents in other diseases by similar investigations is now occupying the time and energy of many laboratory students. While the achievements of preventive medicine have greatly reduced the numbers of those infected, medicine is not neglecting its curative agents and we can confidently expect great results in this direction.

The advance of modern surgery has been marvelous. No greater gifts has science brought to suffering man than surgical anesthesia, the discovery of which American medicine can justly boast, and aseptic surgery, made possible by the fundamental work of Pasteur and given practical application through the genius of Lister. These discoveries enable the surgeon to penetrate every part of the body and remove diseased tissue, repair injuries, extract foreign bodies and restore the individual to health and efficiency while he sleeps wholly unconscious of the operation. Plastic surgery has become a fine art and the successful transplantation of tissue is being practised in the base hospitals of Europe, where the brutalities of man are being ameliorated by skilful operation. The possibility of not only preserving but of growing animal tissue *in vitro* has been demonstrated and has developed a reasonable hope that the surgeon of the future may do still greater miracles.

The development of medicine must be preceded by scientific discovery, because medicine consists in the application of these discoveries. It follows that the highest duty of the medical man is to make contributions to scientific advances. In the past medical men have made an honorable record in this direction and there is no branch of science to which they have not brought valuable contributions. Even at the present, the open field of knowledge is of small dimensions, while on every side extends the boundless wilderness of ignorance. It has been a great privilege and a joy to have lived at a time when my chosen profession has been so rapidly moving forward and to have met face to face so many of its leaders. It has been my fortunate lot to work in the laboratory of that great German, Koch, to have listened to the words of that great Englishman, Lister, to have enjoyed the friendship of that great Russian, Metchnikoff and to have looked into the kindly face of the greatest man of the generation, if greatness be measured by good done one's race, that Frenchman, Pasteur. May some spark of the genius which led these men to great accomplishments descend upon and abide in you.

V. C. Vaughan

KEITH LUCAS

In the death of Keith Lucas on October 5, 1916, physiology suffered the loss of a really great investigator. At thirty-seven years of age he and his junior co-workers had already, as I see it, thrown more light on the fundamental functional properties of the excitable