son Medical College, in which chair he had succeeded Dr. Keen on the retirement of the latter from active teaching. Dr. William H. P. Faunce, president of Brown University, of which institution Dr. Keen is an alumnus, and of which he has been for many years a most active trustee. Dr. William H. Welch, professor of pathology in Johns Hopkins University, and like Keen a strong exponent and defender of the field of experimental investigation in medicine. The Hon. David Jayne Hill, former ambassador to Germany, who spoke of the interest and efforts of Dr. Keen in the large problems of civic and national welfare, and of his sturdy Americanism. The many letters of congratulation to the guest of the evening had been collected and bound in three volumes, and these were presented by Major General M. W. Ireland, surgeon general of the United States Army, who detailed Dr. Keen's connection with the Medical Department of the Army, beginning with his services in the field and in the hospitals during the Civil War, and down to, and including the World War, when he held a commission as a reserve officer, with the rank of major. A bronze bust, by Samuel Murray, of Dr. Keen in his uniform as an officer of the Medical Corps, U. S. Army, was presented to him on behalf of the subscribers to the dinner, by Dr. William J. Taylor, president of the College of Physicians, and for many years his private assistant.

Dr. Keen responded in happy vein, reviewing the many world changes transpiring during his long life, with special reference to the revolutionary advances in the sciences, and particularly in medicine and surgery, in many of which he had indeed played a leading part. His address is printed below. A reception to Dr. Keen followed the dinner.

John H. Jopson

Philadelphia, Pa.

ADDRESS OF DR. KEEN

As I have listened to what I might call "oral photographs" of myself, I assure you that it has been with genuine humility, as I realized how far short I had come of these fine ideals. I lay no claim to superlative virtues. I am only a loyal American, who, to the best of his ability, has tried to do his daily duty to his fellowmen, his dear country and his God. You have looked on my homely merits with more than kindly eyes, and have regarded my faults and my failings with more than friendly forgetfulness. I thank you again and again from the bottom of my heart.

This bust, the product of Mr. Murray's skill, I accept for myself and my descendants with special pleasure from you, Dr. Taylor, so long my able assistant, later my colleague and always my dear friend. It is the visible evidence of that precious, imponderable, yet all powerful force—the affection of many friends.

What shall I say through you, General Ireland, my distinguished pupil, to the writers of these many letters in three stately volumes. They are generous libations poured out on the altar of Friendship. "Timeo Danaos et dona ferentes" was a valid warning in ancient Troy, but *my* gift-bearing Greeks I welcome with fearless and profound gratitude.

It may be a happy augury that we meet to-day rather than yesterday, the actual anniversary of my birth. By a little stretching of the imagination to-day, I can describe myself as "well along"— a phrase with a truthful indefiniteness—"well along on the way to my 85th birthday," and what is imagination for if not to stand by us when we need help?

To-morrow, in spite of the terrible temptation you have held out to me to do otherwise, I promise you that I shall wear the same Stetson hat as heretofore. I hardly can call it the companion of my youth, but I do treasure it as an old acquaintance which still fits well.

My manner of life from my youth up has been known to you among whom I have lived for four score years and four. It is a source of sincere gratification to me that, in spite of all my faults and shortcomings, of which I am fully conscious, on the whole you seem to approve of it.

When one has reached the altitude of 84, it is natural that he should turn and scan the

far distant horizon and note the outstanding features of his long journey. A brief mention of a few of the more striking events which have occurred during my long life may, therefore, prove of some interest.

My ancestor, Jöran Kyn (George Keen), following the Mayflower pilgrims only 23 years later, left Sweden in the retinue of John Printz, the first Governor of New Sweden, and reached the Delaware River in 1643. He founded the nearby city of Chester. We, his descendants, I think may fairly claim to be truly Americans.

During my lifetime, the United States has (observe *not have* but *has*) grown from a small and isolated nation of only sixteen millions in 1837 to a nation rapidly approaching one hundred and sixteen millions. We have also spread from the Alleghanies to the Pacific. Instead of being isolated, we are bound to all the world by a splendid devotion to Liberty and Law. What a free Democracy can do, even across 3,000 miles of boisterous water, to aid in crushing a tyranny which threatened to engulf the whole world, is the most splendid episode in our entire national history.

Yet how short our life as a nation is may be better appreciated when compared with the life of a single citizen. From the date of my birth, January 19, 1837, back to July 4, 1776, is only 61 years and a half. From that same date to yesterday is 84 years!

One man links me to the first Napoleon, for, in 1862, I assisted the elder Gross in an operation on a Frenchman for a wound received in the Russian campaign of 1812. One woman, my maternal grandmother Budd, links me even with Washington himself. She often related to me how he used to caress her as a young girl, when seeking food and forage from my great-grandfather's farm just across the ridge from Valley Forge in that fearful winter of 1777.

The first six-weeks of my life were spent during the reign of that sturdy old patriot, Andrew Jackson. He and I had at least one thing in common—we were profoundly ignorant of each other's existence. In another matter, our attitudes were miles apart. He was obsessed as to the removal of the deposits of the United States Treasury from that stately building at 4th and Chestnut Streets, while I well recall how utterly indifferent I felt about that exciting subject. But I made the air vibrant if my daily ration was too long delayed.

Long since, I gave up the rather opprobrious phrase "Old Age" and have substituted for it the more seductive locution "accumulated years." The latter connotes a certain joy in continued acquisition, a sort of pride in adding one annual sparkling jewel after another to an already precious store.

I was asked recently how it was that I had managed to accumulate so many years, to which I promptly replied, "Nothing is simpler —don't stop. Just keep right along." Mix merry laughter with earnest labor. Always have some as yet unfinished, but not too urgent job waiting just outside your door. Then you will never know ennui. To "kill time" is murder in the first degree.

William Dean Howells, one of the privileged few who spell their names in the plural because they are such multiplied personalities, in his delightful essay on "Eighty Years and After," first pays his respects to several nonagenarians. He then turns upon those of us who have accumulated ten fewer years (he actually being also one of us) and says, "As to the Octogenarians, there is no end of them; they swarm, they get in one's way."

I humbly crave pardon of any of you if I occupy a place in the sun to which you have a better right than I. Ultimately, no doubt, I shall get out of your way, but do not overlook the fact of my maliciously good health, and that a collateral forbear reached the mature age of 106. The prospect, therefore, of speedy relief, I regret to say, seems rather discouraging. I commend to you the philosophy of life of the woman who, when asked by her minister what passage of Scripture gave her the greatest comfort, promptly replied, "'Grin and bear it' helps me most."

The development of industry, of commerce and of the material things which minister to

man's comfort and health, during my lifetime have been marvellous.

The shrill whistle of the locomotive had been barely heard before 1837, but few there were who foresaw what a revolution in transportation and in industry steam was to produce. Steamships, depending wholly on steam, first ventured across the Atlantic when I was a year old.

The early staccato of the telegraph had also made itself heard, but its future growth and possibilities on land, and under the sea, and in the air could not have been even imagined.

The typewriter, the telephone and the automobile have tripled the efficiency of the doctor. Possibly the airplane in time may quadruple it.

May I venture here to digress for a moment to let you enjoy the recent experience of one of my London scientific friends. In writing a letter he dictated to his secretary, an ardent suffragette, the phase, "When Plancus was Consul," alluding to the friend of Horace to whom he addresses the seventh in the first book of his Odes. What was his amazement to read in the letter presented for his signature, "When *Pankhurst* was Consul." He was so appreciative of the joy that this variant reading would give his friend, that he signed the letter unchanged.

Science has progressed by leaps and bounds. "The most fruitful periods of Science," says Duclaux, in his recent Life of Pasteur, "are those in which dogmas are shaken," that is to say when every postulate is ruthlessly re-examined. This "shaking of dogmas" has given us radio-activity, and has divided the "atom"—that supposed ultimate particle of matter, whose very name means "indivisible"—in some cases into hundreds of electrons.

By the Spectroscope which, in my university days at Brown, existed only in embryo as the curious "Fraunhofer lines" of the solar spectrum, we now analyze the chemical elements of suns many millions of times larger than our own and so distant that the light now reaching our eyes from them started on its earthward journey hundreds of thousands of years ago. Even light itself has been measured and weighed, and Einstein's formulation of the doctrine of relativity is proclaimed as the most fundamental discovery since the days of Sir Isaac Newton.

In 1876, scarcely 45 years ago, electricity had progressed but little beyond the point where Franklin had left it at the time of his death in 1790, just eighty-six years before the Centennial Exposition. Now, the slogan, "If it is not electric, it is not modern" is almost literally true.

At the Centennial Exposition, modern electricity was represented by Professor Farmer's *one arc light* on the roof of the main building, the "avant courier" of a mighty host. The dynamo—appropriately named. Might, Force, Power—had been slowly developing in the brains of Faraday and his successors. Within the last two score years, that giant has been harnessed and has become our obedient slave in heat, light and power, on land and on sea, in mine and in mill. In fact, the catalogue of the things that the dynamo *can not* as yet do would be shorter than the things it *is* actually doing—and the end is not even yet in sight.

My professional life covers sixty-one years of study, active practise, writing and teaching. At its very outset occurred the most fortunate event in my professional life—I fell under the spell of Dr. S. Weir Mitchell. I have met many eminent medical men at home and abroad, but I do not hesitate to say that he was by far the most alert, original and stimulating mind with which I have ever been in contact. I have often called him a "yeasty man" for he leavened and set in fermentation every mind which touched his own. He gave me my first scientific impulse and set congenial tasks for my mind and pen. For over 53 years we worked together in many activities of the profession, with never a cloud between us.

Close upon making his acquaintance came the Civil War. By a curious accident[1] I became an assistant surgeon in the Army on

[1] Keen's "Addresses and Other Papers," p. 421.

July 1, 1861, before I was a graduate in medicine. I knew but little medicine but I replaced a predecessor who demonstrably knew still less, for, at the end of my first year, I coached him for graduation at the end of his second year. I am in doubt whether I ought to be commended or condemned for the result, for he actually succeeded in achieving his diploma.

As to myself, my very ignorance was a safeguard to those under my care for I was inidsposed to take any serious risk by heroic treatment. After this service with a regiment of "three months' men," we were honorably discharged August 1, 1861. I then completed my studies and obtained my M.D. in March, 1862. After a real examination, I reentered the service, fortunately for me not in the regulars to which I was entitled, but as an Acting Assistant Surgeon.

Again Mitchell's inspiring touch was vouchsafed to me. At his request, I was assigned, by Surgeon General Hammond, to the neurological ward under Mitchell and Morehouse. I became the junior in what might be called a neurological "firm." "Mitchell, Morehouse & Keen" became very widely known to the profession because Mitchell made it so. His generosity to me when my diploma was hardly dry, in associating my name with his own, already widely known as that of a distinguished physiologist, was as fortunate for me as it was generous upon his part. Our studies, especially in the Turner's Lane Hospital, Philadelphia, laid the foundations of modern Neurological Surgery.

Returning from study in Europe in 1866, I took over the Philadelphia School of Anatomy —founded by Lawrence in 1820—and taught anatomy and operative surgery to large private classes of medical students (1866–1875) when the government took the property for the use of the present postoffice.

From 1866 to 1875, I taught surgical pathology in the Jefferson Medical College. In doing this, I learned ten times as much as my most studious pupil. From 1876 to 1890, I lectured on artistic anatomy in the Pennsylvania Academy of the Fine Arts.

From 1884 to 1889, I was professor of surgery at the Women's Medical College, and from 1889 to 1907, I was professor of surgery in the Jefferson Medical College, a total service as a teacher of 41 years (1866–1907). No one, not himself a teacher, can imagine the joy of that long service. To meet daily scores of earnest, alert minds, greedy for knowledge, was a daily inspiration and developed the most intense desire to give of one's very best.

In 1901–02, with two of my daughters, I made a tour around the world. We penetrated into Java and beyond the Caspian into Turkestan, almost to the western border of China. It is no wonder that, having taught many thousands of students, I was heartily welcomed by some of them in country after country. From the Golden Gate, all the way to Russia, traveling over westward, in Hawaii, Japan, China, the Philippines, India, Egypt, Greece and Palestine, in every land save Java and Turkestan, I had old students. In Korea, also, several were and still are doing splendid service as medical missionaries and others again as teachers in the Medical College in Siam. Even in Persia, there was one—a Persian who returned to his native land as a Christian Medical Missionary. Early in the World War, when the Turks captured Urumiah, where he was dispensing health and happiness to his fellow countrymen, they seized him and gave him the fearful choice—Mohammedanism or the stake—and Joseph Shimoon, the martyr, was burned alive for his faith, by the unspeakable Turk!

The nine epoch-making medical events in the last century and a quarter are:

1. Vaccination against smallpox (1796).
2. Anesthesia (1846).
3. Pasteur's researches were the foundation of the new science of bacteriology (1850 to 1884).
4. Pasteur's chief claim to fame is his further and "fundamental discoveries in immunology, or the science of the specific *prevention* of disease" (Flexner).
5. Pasteur's and Lister's researches resulting in antiseptic and aseptic surgery and obstetrics.

6. The discovery that insects carry disease (1889).
7. The discovery of radio-activity and especially for medical use, the X-rays (1895).
8. The development of a medical literature written by American authors (1859–1920).
9. The founding of great laboratories of research.

With the exception of the first, *every one of these wonderful discoveries has occurred during my own lifetime.*

The first research laboratory was founded in 1884 by Andrew Carnegie, in connection with the Bellevue Hospital Medical College in New York. Others, larger and more elaborate, soon followed, usually in connection with other medical schools. The greatest and most useful of them all is the wonderful Rockefeller Institute for Medical Research, an independent institution in New York City. From that busy center has come one beneficent discovery after another, the last being the discovery by that remarkable genius, Hideyo Noguchi, of the germ of yellow fever, and the preparation of a vaccine which in case of exposure, has proved to be not only a means of protecting those who have never had an attack, but to be actually curative of the fever if administered very early.

In my student days, practically all of our important medical text books were of European, and especially of British origin. The sole exception was the elder Gross's two-volume Surgery (1859) and, twenty years later, Agnew's Surgery in three volumes. Now, there is hardly any department of medicine in which there are not several American text-books of great merit, and our medical journals rival those of Europe.

The first text-book of Surgery in the English language, founded upon bacteriology, the corner stone of modern surgery, was the "American Text-book of Surgery," which I organized, and later, with the assistance of Dr. J. William White, as co-editor, and eleven other American surgeons—published in 1892. It passed through four large editions. I have just finished a still larger work by about 100 American and British authors in eight volumes, averaging 1,000 pages each. It took 18 years of labor ere I could write "Finis" as 1921 was ushered in.

Every intelligent person knows of the actual revolution in surgery, medicine, obstetrics and all the specialties, which has taken place of late years. Anesthesia has robbed surgical operations of nearly all their pain. Antiseptic, and later, aseptic methods, have made the old operations safe, as shown by an unparalleled diminution of the mortality. It has made possible, also, a vast number of operations which were absolutely prohibited in the first twenty years of my professional life, because of their fatality. "Noli me tangere" was writ large on the head, the chest and the abdomen. To-day, we invade these earlier sacrosanct cavities with a free hand and with glorious life-saving results.

Medicine has progressed equally far. We know the causes of various diseases, which we were fighting in the dark until bacteriology revealed to us the realm of the almost infinitely little, but they put the multiplication table to shame by the incredible rapidity of their growth. It is Lilliput versus Gulliver.

Medical science, however, girded up its loins in our laboratories of research and at the bedside, and resolutely attacked the enemy, and has won victory after victory. We learned soon not only the cause but the mode of transmission of these various diseases, especially the remarkable discovery that insects—the mosquito, the louse, the tick, the flea and the fly—and some of the lower animals, especially the dog and the rat, were the means of spreading disease.

The results of these combined discoveries are seen in the imminent banishment from the whole earth of yellow fever, the immense diminution of typhoid, tetanus, diphtheria and other germ diseases, and the curbing of tuberculosis and other diseases, barring, of course, the results of the war.

Maternity, which nature surely intended to be a normal and a safe physiological event, was very dangerous for years after I graduated. The *usual* death rate in the '60's and

'70's was from three to five mothers in every hundred, and sometimes childbed fever raged in epidemic form and killed at the rate of 20, 40 and even 55 mothers in every hundred!

Now, this most beautiful of all human relations has been made safe—mark my words—*made safe* by the researches, especially of Pasteur and his successors. *Bacteriology has won this splendid victory.* Within the last decade, series of 6,000, 7,000 and even over 8,000 cases have been reported *without the death of a single mother from infection.* Is not that a cause for a Te Deum?

But I must call a halt though I have not told even a small fraction of the fascinating story, of what, remember, I have been an enthusiastic living witness.

And what of the future? Have we any reason to expect other astonishing and beneficent discoveries? I answer with an unqualified affirmative. And it may well be still greater and still more beneficent discoveries.

With this word of cheer, I face the coming year or, if it so please God, the coming years, with a confidence which is enhanced by your wonderful tribute of affection.

THE RELATION OF MENDELISM AND THE MUTATION THEORY TO NATURAL SELECTION[1]

Two marked tendencies are evident in the history of any important theory after its publication.

First. The followers of the discoverer carry the theory too far and attempt too universal an application. This is manifestly true of Wallace and Weismann who out-Darwined Darwin in their claims for natural selection; of the followers of Mendel, such as Morgan and Pearl; and of many mutationists who make much greater claims for that theory than does De Vries himself.

Second. Each generation of biologists is so occupied with its own work and contemporary theories that it makes no real effort to understand preceding theories.

[1] Read before the American Society of Naturalists at Chicago, December 31, 1920.

This second tendency seems to me most marked in the attitude of present workers along genetic lines towards natural selection. They reveal an apparent lack of understanding of what Darwin really meant and of what he claimed; and when criticising that theory they are often engaged in the classic, but unprofitable, exercise of "fighting windmills."

In view of these facts I hope you will pardon me if I present in as few words as possible just what I believe to be the main factors which Darwin presented as resulting, in their actions and reactions, in natural selection. These factors are three in number:

First. *Heredity,* by which the progeny tend to resemble their parents more than they do other individuals of the same species.

Second. *Individual variation,* by which the progeny tend to depart from the parental type and sometimes from the specific type.

Third. *Geometrical ratio of increase,* by which each species tends to reproduce more individuals than can survive.

Each of these factors is practically axiomatic, so little is it open to argument.

No one doubts the *fact* of heredity, whether pangenesis, Weismannism or Mendelism be the correct expression of the mechanism involved. These do not affect the *fact* of heredity nor invalidate it as a factor in natural selection.

No one doubts the *fact* of variation; whether it is the "individual variation" of Darwin, the "fluctuating variety" or the "mutation" of De Vries. All that is necessary for Darwin's purpose is that there be heritable variations. That there are such things all parties agree and it matters little what you call them. They are adequate to act as a factor in the Darwinian scheme.

No one doubts the *fact* of geometrical ratio of increase. It is a proposition easily capable of mathematical demonstration, and that it *is* is sufficient for Darwin's purpose.

These three factors, then, are not debatable as facts, whatever their mechanism or causes.

A moment's reflection will show that geometrical ratio of increase is a *quantitative* factor, giving an abundance of individuals