REMINISCENCES

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Dedicated to the families and friends of
James Murray Luck
and
Eroeda Nicholaevna Sinitskaya Luck.

PORTRAIT

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FOREWORD

This is a ramble through innumerable byways of an interesting, productive and long life. James Murray Luck's tenure on the planet spanned most of the 20th century, from 1899 to 1993; its venue reached from his birthplace in Paris Ontario, to Cambridge England, and to Stanford California, with a significant tour in Switzerland. He was one of the pioneers of Biochemistry; but its establishment as a separate department at Stanford ensued only after his retirement from Chemistry in 1964. He is perhaps best known as the founder of the *Annual Review of Biochemistry* and as the architect of the larger series of Annual Reviews that followed, which have become a major organ of communication and assimilation among scientists. An invitation to contribute to an Annual Review has long been a mark of peer appreciation and prestige.

Notable was Murray's generosity in basing this enterprise in a not-for-profit organization when it might well have been a highly lucrative business operation. That act was simply in keeping with his dedication to voluntary co-operative movements of all kinds, from the Rochdale consumer co-ops to faculty housing ventures like the Ladera subdivision near Stanford. That same spirit pervades the structure of Annual Reviews today, embracing the authors, editors, and board, all serving with no or nominal compensation in a common effort. I have been affiliated with Annual Reviews since 1949, when I wrote about "Bacterial Variation" for Volume 3 of the *Annual Review of Microbiology*; it was my privilege to serve with Murray on its board since 1972, and as that board's chair after 1976. We always welcomed Murray to our deliberations, long after his formal retirement; he in turn was careful to offer his wisdom only when it could be useful and appreciated. The period of my own participation with Murray at AR seems a long one, yet it spanned hardly more than half of his own lifetime.

Perhaps another book remains to be written about his experiences at Stanford University. Here is only the briefest mention of his research and teaching; but a bibliography of some 200 scientific papers, and a full collection of these reprints is available in Stanford's Luck archives. (The bibliography can also be accessed at the Annual Reviews Web site: www.AnnualReviews.org.) From my own experience, I know the encouragement Murray gave to Edward Tatum for the teaching of comparative biochemistry in 1941. That course flowered into the conception of the biochemical genetics of *Neurospor*a and later into the Nobel Prize Tatum shared with G. W. Beadle (1958). Maclyn McCarty has recorded his early training in biochemical separations as an undergraduate with Murray, a precursor to his stunning identification (in 1944 with Avery and Macleod) of DNA as the genetic molecule.

We are regaled with anecdotal accounts of figures like Sir Gowland Hopkins, Joseph Needham, and J.B.S. Haldane. Murray writes movingly about his involvement with one science-based policy issue after another. Earlier than

most biologists, he was engaged with the challenges of global human nutrition in the face of the Malthusian predicament. He did not hesitate to call the *Wall Street Journal's* complacency on such issues gibberish, nor was he afraid to speak out (among the very first) on behalf of women's free choice of abortion as one mode of regulating births.

In 1962, Murray was seconded to the post of science attaché at the US Embassy in Switzerland. These positions were founded after Sputnik (1957) had aroused the US government's attention to science and technology, in which it could no longer rely upon assured supremacy. The State Department then (as now) hardly knew how to manage Federal involvement in scientific issues. When Murray queried the Ambassador about his expected duties, "His reply was immediate and somewhat unexpected, '(Expletive deleted), that's for you to find out.'" Murray carved out a niche very promptly, leading many overtures toward scientific cooperation and supporting policy education on the interplay of science and technology with public and international affairs. He was often consulted on these matters in later life.

His tour in Switzerland led him to an enduring interest in that country; and it may come as a surprise that this visiting scientist wrote and edited not only a series of volumes on science and other aspects of contemporary Switzerland but also the first comprehensive history of Switzerland in English.

Meanwhile Murray was as good a citizen of Palo Alto as he was of the world, continuously involved in projects of community improvement.

At the memorial service shortly after his death it was said of him that "if ever there was a twentieth-century Renaissance man, J. Murray Luck was that man. [Over] a span of ninety-four years … this giant among us was at the task of exploration, of discovery, of research, of teaching, of encouraging, of launching, of serving, of advancing, of writing, of publishing, of improving, all in the advancement of human knowledge and the improvement of human existence."

Joshua Lederberg
President emeritus, Rockefeller University,
Annual Reviews Board of Directors

I. INTRODUCTION

Perhaps everyone who occupies himself in writing his reminiscences should have good reasons for doing so. I learned very little about the Lucks and the Coulsons from my parents; in fact, any curiosity about my "roots" was late in emerging: I must have been 60 or 70 years of age before any interest in my predecessors appeared. Thus far, the pursuit of my curiosity has been restricted to the Lucks. I may never "do" the Coulsons and in "chasing down" the Lucks my efforts have resulted only in a family tree sort of thing. Records of births, marriages, and deaths reveal little, if anything, about the activities and qualities of the individuals concerned. But even this "bare bones" investigation of the past may be of some interest to members of the "clan." Actually, this account is restricted to the doings of the writer himself except for incidental descriptions of the doings of brothers, sisters, uncles, aunts, cousins, wives, sons, daughters, grandchildren, etc. Included also are descriptions of several events that are quite apart from personal activities. Hence the book is also a record of a few happenings that aroused great public interest, excluding, however, the many wars of the 20th century. Of course, I cannot feel assured that those who read or skim through the following pages will do more than yawn a few times and say to themselves, "so what " However, here it is, hopefully of interest to some present-day members of the clan and, eventually, to those who are yet to come.

Genealogy The Luck Clan

> LUCK Opinions differ with regard to the origin of this place name, which became a famous family name. For instance, Canon Bardsley in his book, *Our English Surnames,* says that he finds a progenitor of our Lucks and Luckies inscribed in the Hundred Rolls (1274 A.D.) as Luke of Lucca. Lower, another authority, in his book *Patronymica Britannica,* thinks that the original bearer of the name was a native either of Lucca in Italy, or of Liege (Lewke) in the Netherlands, or it may be that he came from Luc-sur-mer, or Luc-le-Chateau in Normandy. Barber again, who is evidently in error, in his book, *British Family Names,* says that the name is a Flemish personal name, Luc or Lucq. Horsfield, in his *History of Susse ,* writes thus: the family of Luck was of considerable antiquity at Rotherfield, it is mentioned in the visitation of 1634, and it is there stated that John Luck, then living, was one of the coroners for Sussex. Lower, another historian of the county writes as follows: A gentle family named Luck were connected with the parish of Rotherfield during the sixteenth and two following centuries.
>
> It is supposed that every Englishman who bears the surname of Luck, whether he be a country gentleman or a chimney-sweep, a clergyman or a costermonger, is the offspring of a certain individual and his belongings, who came into this country about the year 1260. There does not appear to be

> any record of the name prior to 55 Henry III. In ancient manuscripts the name is written indifferently, de Luk, de Luc, de Lucca, de Luca, de Luco, Luk, Luc, Lukke, Lucke, and finally Luck. Spelling in the former age was notoriously a matter of taste.[1]

Most of the following pertains to the descendants of Edward Luck II and his wife, Jane Elphinstone Caller (see Appendix I).

General Themes and Purposes

These reminiscences have also given me an opportunity to reflect upon some of the major interests I have pursued and in which I believe I may have made some modest contributions.

1. Economic and financial cooperation (consumer cooperatives, cooperative housing, and credit unions) and also the very important field of political cooperation, especially international cooperation instead of confrontation between the nations of this troubled world.

2. Teaching biochemistry to generations of university students and founding the *Annual Review of Biochemistry* (the first of many Annual Reviews of the expanding literature of science and cognate fields of study).

3. Population Overpopulation The wisdom of *Homo sapiens* is trivial. Our leaders ( ) in government at all levels, especially in the so-called developed countries, are delighted when more and more people crowd into our towns and cities, and industries and businesses of all sorts join the crowd in increasing numbers. The tax base is increased, but so also is pollution and the loss of precious open space. Let us vote such "nit-wits" out of office. Of course But let's not forget that their successors probably will be no better, since they will soon be destroyed by their newly acquired power and distorted sense of values. We are caught up in a losing battle to preserve our social progress. Fortunately, "hope springs eternal in the human breast" but can perish if we abandon the struggle. It should, of course, be noted that overpopulation is worsened by the increasing drain of resources from the underdeveloped countries by the industrialized ones.

4. Industrial Peace the Swiss solution of employer-employee confrontations (strikes) a negotiating technique which should be tried elsewhere with every hope of achieving industrial peace by avoidance of strikes and lockouts.[2]

[1]From *A Pedigree of the Families LUC and LOC ,* compiled by Edward John Luck; printed by the Army Navy Co-operative Society, Ltd., 105, Victoria Street, Westminster, S.W., London, 1900 (E.J.L., 3, Nevern Mansions, South Kensington, 1 January, 1900).

[2]J. Murray Luck, Lukas F. Burkhardt, and Hans Haug, Editors, *Modern Switzerland,* Society for the Promotion of Science and Scholarship, Palo Alto, California, 1978, 515 pp. See page 181.

I regard the contents of this book as reminiscences rather than memoirs. By and large, my achievements have been modest certainly not earthshaking or momentous. To me, reminiscences connote something at a much lower level than the term memoirs, which term would apply to the writings of the great figures such as an Albert Einstein, a Winston Churchill, a James Fenimore Cooper, a Leo Tolstoy, or others of such stature, with a global reputation. The book is written as a source of family information on the Luck "clan." (Important in this connection is the preceding section on genealogy.) I cannot conceive of it as something of interest to others.

I have omitted virtually all mention of publications descriptive of my research in biochemistry. A single exception can be made to permit mention of an article in the *Stanford Illustrated Review* for May 1930 that describes in quite general terms the research activities of academic biochemists in the good old days and what I did during my first few years at Stanford. The publications are encompassed in some 200 papers in various scientific journals. Copies of the papers are collected and bound in four volumes, appropriately indexed and currently shelved in our home at 101 San Mateo Drive, Menlo Park, California.

Before concluding this introduction, I must mention the enormous help I have received from my niece, Merle Howes, whose interest in the Luck clan is as great as my own. Also, the genealogical arm of the Church of the Latter-Day Saints (the Mormons) with its tremendous fund of information about many people, their present and their past, has helped greatly. Finally, I acknowledge the very great help of my friend, Michael Kirkness[3] of Tunbridge Wells, England, who took me to the Archives in Canterbury Cathedral and drove me over much of Kent and East Sussex where a great many Lucks live and where a great many more lie six feet underground.

From the beginnings of this project I have enjoyed the unstinted cooperation of Judith Mueller, Administrative Secretary at Annual Reviews Inc. Without her encouragement and her active weekly participation in preparing this material for publication, it is probable that the project would have died in its infancy. Finally I express my indebtedness to William Kaufmann, Margot Platt, Ike Burke, and Ruth Saavedra. They did "the necessary" in making the copy ready for desk-top publishing.

CHILDHOOD EARS

I was born October 23, 1899 in Paris, Ontario, Canada, as the youngest of five children,[4] fathered by Horatio Washington Luck,[5] who was the youngest of 16

[3]Died in October 1990 soon after his 80th birthday.

[4]Norville Edward (1885 1960), Myrtle Annie (1887 1922), Ada Elphinstone (1890 1979), Thelma Victoria (1897 1940), James Murray (1899).

[5]Horatio Washington Luck (1859 1925).

children born to Jane Caller and Edward Luck. My mother was Nina Victoria Coulson.[6] My paternal grandfather, Edward Luck II (1806 1890), married Jane Elphinstone Caller (1815 1902). Of their 16 children, one died in infancy (by drowning), one died in his sixties, but the remaining 14 "held in there" until their seventies or eighties.

I remember little about my earliest years. As I already noted, I was born in the 19th century, but after several months in the 19th, I moved on into the 20th. The system of values to which I unwittingly clung belonged to the 19th century and never permitted me to embrace fully the ways of the 20th. I suppose it had to be so, inasmuch as my three sisters and one brother were my close associates, and they held me, innocently enough, as a fledgling of the 19th century. My parents had spent about 40 years in the 19th century. Their genes became our genes; all five of us children, accordingly, were trapped in the 19th century.

In retrospect, it was a good time in which to live. Motor cars were few in number. Traffic problems were unknown: horses neither crashed into other horses or horse-drawn vehicles nor did they run over pedestrians. I grew up in the small city of Brantford, Ontario. Few of the roads were paved. The sidewalks in many of the residential sections consisted only of wooden planks. Open, untouched, areas were abundant. A large pond next to our house (still standing in 1992) at 81 Superior Street froze over every winter and ice skating was a daily pleasure. A canal, approached through a small forested area, connected the Grand River with a small lake. The lake and canal also froze: more winter skating and ice hockey. In the summer we boys fished for catfish and carp, and a few other scavengers.

The closing days of the 19th century and the first few years of the 20th lacked a few things that we now consider to be indispensable. The outdoor toilet, housed as a two- or three-holed commode in a small wooden privy, was the predecessor of the comfortable indoor "john." Toilet paper was lacking but the catalogues issued by various companies served in its stead. What a punishing experience a visit to the outdoor facility in a freezingly cold Canadian winter could be I was about ten years old before our toilet was moved indoors. By then, but not before, we had running water. Until that happy day we depended on well water and hand pumps. One well provided us with good cold drinking water, pumped up from an aquifer about 20 feet or so below the surface. A second well held the "soft" rain water that drained from the roof of the house. This was used for washing dishes, clothes, floors, and people.

Electric lighting was not to be had by the Luck family during the first decade of my life. At first we depended on kerosene lamps. Next, with the installation of natural gas, we enjoyed tungsten-filament gas lights. The kerosene

[6]Nina Victoria Coulson (1863 1922).

lamps, not to be abandoned, were carried to the bedrooms and elsewhere; we had only two gas lights. Electricity was next installed; in each room a carbon-filament bulb dangled from the ceiling. Finally, we had a telephone — the old hand-cranked variety. Multiple-party lines (MPLs) were common, especially in the farm lands.[7] My sister, Ada, married to Ross Merriam, lived on a farm at Norwich Junction, Ontario. When the phone rang (for example, three longs and one short) she would rush to the phone and listen in: the call might not be for the Merriams (two longs and two shorts). "Ross, the baby expected by Mary Jones was born this morning: it's a boy" or "Harry Brown sold that old brown nag for 15 dollars" or "Bill Smith says the price of seed corn has been increased by 10 cents a bushel." The multi-party phone system was a marvelously effective means of communication; everyone on the line knew what was going on in the neighborhood.

The 19th century lacked some of the amenities that came with the 20th century — the fruits of research and development in the chemical and physical sciences and in engineering. The 20th century also witnessed remarkable advances in the biomedical sciences, such that most of the infectious diseases were wiped out and organ transplants became commonplace. And yet, as I write this, the whole world is caught up in the terrible disease AIDS (acquired immune deficiency syndrome) for which there is no known cure. We also face drug problems so widespread and so ingrained that they almost defy solution: addictions to heroin, cocaine, morphine, marijuana, etc. that are not readily overcome. Also, the drug traffic generates enormous profits for the drug producers and distributors, which serves to increase the "pushers" to numbers that are terrifyingly great.

We of the 20th century face other problems that are sinister and very resistant to resolution — in brief, all stemming from overpopulation. There are too many people and all efforts to stem the increases in population are having a negligible effect. More people means more and more houses, huts, tents, shacks, etc.; more and more cars, trucks, trains, aircraft, and other means of transportation; roadways and related facilities; mountainous accumulations of garbage and a shortage of dumping grounds or of other acceptable means of disposal. We are also running out of prisons in which to keep the erring members of society. Hospitals are suffering a lack of space and of facilities to house and treat the growing numbers of those who are ill. Water shortages are fast increasing in prevalence; pollution of the air we breathe, of the water we drink, and of the soil in which we raise our foodstuffs is steadily increasing

[7]I learned from Roger Orr of Pacific Bell that there may still be (in 1988) some multiple-party lines in rural midwestern USA, in the northeastern states of the country, and possibly in Montana and Wyoming. MPLs went out of fashion in the mid- to late 1950s. After World War II, with expansion of services and new technology, MPLs were no longer being installed. In California, some old installations were still in use in the mid-1960s.

at a rate that parallels our growth in industrialization. And so it goes. The alleged injunction to the survivors of the great flood, "Go forth and multiply," has been followed all too literally and with results that are becoming catastrophic.

Sometime between 1897 and 1900 my parents moved the family bag and baggage to Brantford,[8] about seven miles from Paris. Why did the family move Because Paris, Ontario, was not as gay as Paris, France Certainly not. Most of the residents of Paris, Ontario, including my parents, would have strongly disapproved of the "loose livers" of Paris, France. The real reason for the move was employment. My father was a blacksmith in Adams Wagon Works, which later became the Cockshutt Plow Co., a farm-implement manufacturer in Brantford. He covered the seven miles on foot, five or six days each week, arriving by 7:00 a.m. and leaving for home at 6:00 p.m. Ten-hour work days (7 12 and 1 6), frequently including Saturday morning, were commonly observed in many industries. Thus the move from Paris to Brantford.

My mother[9] Nina Victoria was the fourth child in a family of eight children born between 1858 and 1876. Her father, born in Ireland, was the eldest in a family of eleven children born between 1834 and 1855. My mother died in 1922 and when my father died in 1925, the surviving members of the family had already scattered (my brother in Toronto; Myrtle, deceased in 1922; Ada, married in 1917, in Norwich Junction, Ontario; Thelma, an asthmatic, in Western Canada, Denver, or elsewhere wherever the climate was more favorable than in Brantford). I was then (1925) a research student in Cambridge University, England.

My childhood years were rich in trivia which I recall vividly but which can only be of interest to few, if any, of the Luck clan. Our next-door neighbour in Brantford was a family named Patterson. They had a daughter, Grace, of about my age. We played together frequently. When three or four years old, I was called home on one occasion by my mother to whom I vigorously replied, "No, me needs Gracie "

The third house up the street from our house was occupied by an elderly man named Lidgett in whose front yard were two thriving mulberry trees. When the fruit was ripe, black in colour and delicious in taste, my friends and I helped ourselves to the crop. At first we kept one eye focused on the house, fearing that at any moment Mr. Lidgett might emerge and, rightfully angry at these young thieves, might punish us as trespassers. Actually, he proved to be a

[8]Originally Brant's Ford (where the Grand River could easily be crossed). Brant was the name given by the English to Thayendanega, chief of a local tribe of the Six-Nation Indians, who was a major figure in the "Border Wars" of the American Revolution.

[9]Daughter of James Wylie Coulson (1834 1925) and Mary Ann Hunt (1839 1884).

nice old man and when he finally caught us in the act he was very friendly and encouraged us to help ourselves whenever we chose to do so.

Across the road from our home at 81 Superior Street lived a family named Durham, in between the corner grocery store and the home of a family of four or five, all but one of whom were deaf and dumb. I remember that the exceptional one, Hazel, was several years older than I and was known to my parents and neighbours as a very bright woman. My memory of the grocery store is much better. I recall that the proprietor of this family enterprise, who alone served his customers, had to retreat into another room from time to time to procure a few items that were not shelved in the store proper. On one of these occasions I found myself beside an open barrel of dried coconut slices. Temptation was irresistible. I helped myself generously to the coconut and hastily attempted to devour some before the proprietor returned. Punishment was swift and appropriate: the coconut slices proved to be soap chips and I was frothing at the mouth, and probably blowing bubbles, when the owner returned. From his hearty laughter, I quickly learned that crime does not pay.

Next to Mr. Lidgett's place was and still is Wesley Methodist Church. It is rich in memories. Every Sunday for some years I attended Sunday School at 10 a.m. and, with my parents, the morning church service at 11 a.m. My parents, deeply religious themselves, refrained from urging me to attend; I did so because I wanted to.

For some years, indeed as long as I can remember, my father supplemented his income as a blacksmith at the Cockshutt Plow Co. by serving as the church janitor. I helped by sometimes sweeping the floor and also, on Sundays, by ringing the bell in the tower to summon people to church at eleven. Best of all, I was able to gorge myself on cake and other goodies whenever the Ladies Aid, or some other church organization, had a social affair. The leftovers were marvelous and to me there was always the opportunity to attack the best of the lot before the ladies reappeared some hours later to carry off the remains.

Several other memories of the church should be mentioned. Every Christmas a huge cedar tree was mounted in the church. It was loaded with presents for the children none was forgotten. Those who went to Sunday School with an attendance record of 100 , including me, received a "silver" Ingersoll dollar watch in a special little ceremony.

During the years that I remember best, the pastor was a man named Liddy. He was said to be of Irish extraction and was sometimes trapped by curious mix-ups in sentence structure. On one occasion, his sermon included the biblical story of Elisha and the bear. Finally the trap closed when we heard Mr. Liddy say "and Elisha ran through the woods with a bear behind."

In the course of time the Reverend Mr. Liddy was succeeded by the Reverend Dr. D. E. Martin whose D.D. degree was acquired by purchase from a USA "diploma mill." His brother-in-law, also a Methodist minister, was the

Reverend J. W. Baird, whose daughter, Eloise, lived for some time with the Martins in the church parsonage. I was then in my late teens and was nearing the end of my years as a high school student seeking senior matriculation. At first I noticed her only on Sundays when she was seated in church with her aunt, Mrs. Martin, only two or three rows ahead of the Lucks. The back of her head was appealing and an occasional view of her face in profile was even more so. I cannot recall the circumstances under which we met in Brantford and became acquainted. A year or two later she returned to her home in Hamilton, where her father was a minister. By that time I was a student in the University of Toronto. I visited Hamilton on an occasional weekend on invitation from Eloise and her parents. Eventually in 1922 we were married.

The Reverend J. W. Baird, her father, was a peculiar mixture of kindness and warmth with frequent reminders to his parishioners of the fire and brimstone that awaited the unbelievers and those who strayed from the straight and narrow path. He took his responsibilities seriously and worked hard at the business of marrying and burying people and saving the souls of the living. I recall an occasion, during one of my weekend visits, when he tried unsuccessfully throughout the day to get one of his parishioners on the phone. It was by then time for dinner. With heads bowed, Mr. Baird asked the blessing. It was short and to the point: "Regent 2743." I don't believe the Deity responded to his urgent plea for help.

The first school I attended was King Edward School, located within easy walking distance from home. In kindergarten the teacher was a kind and softhearted young woman, Miss Milne. Having misbehaved and having failed to mend my ways despite her gentle words of correction, I was told one day to remain in school after dismissal of my classmates. "Murray, I am sorry but I must punish you hold out your hand " Down came the strap. "Did that hurt " "No," I replied. Again the strap. "Now, did that hurt " "Nope " Then a third and final effort to break the stubbornness of the recalcitrant one. It failed. Miss Milne broke into tears and I was permitted to go home.

But in grade school things were different. The teacher I remember best was Miss Cleaver. She was a sadist. It was clear that she derived pleasure from punishing her pupils for their misdeeds. "Murray, you must not chew gum in school," or "you must not use a peashooter," or "you must not talk in school to neighboring pupils." "At four o'clock when the class is dismissed, you must remain here and I shall punish you." At four o'clock: "Hold out your hand." The strap came down several times, with all the strength she could muster. "Do not misbehave again. Now, go home." An alternative punishment for minor infractions of the rules such as arriving two or three minutes late (after the bell rang): "remain in the classroom at four o'clock and write on the blackboard 50 times, 'I must not be late for school'." She was a competent teacher but one

who apparently found pleasure in punishing her pupils. Because of her keen eyes and well-functioning ears, always focused on the human environment, I found it difficult to get away with anything.

TEENAGE EARS

At the age of 14 I entered Brantford Collegiate Institute. The first World War was under way and many Canadians volunteered for military service. Rifle practice in a shooting gallery in the basement of the school was very popular and was much encouraged by the authorities. I was fairly good with a rifle and in a competition within the school I won the greatly coveted prize a Birmingham Small Arms .22-caliber rifle which has reposed for years in a clothes closet out of reach of the "small fry."

I was then saturated with jingoism, which one could hardly escape in the wartime environment of super-patriotic Canada. I remember writing a letter to the *Brantford E positor* urging that junior cadet corps be formed throughout the country. These would consist of young high school teenagers who would thus receive a preliminary training that would prepare them for an easy transition into the armed forces at 18 years of age. The suggestion was commented upon favourably by a number of *E positor* readers. We had a cadet corps in the Brantford school under the active instruction of a tough English sergeant-major. I soon became captain of the corps and strutted around from time to time in a captain's uniform with a ceremonial sword by my side. What a contrast to my later beliefs By the time I was in my twenties I abhorred war and regarded it as a non-solution to international problems that governments fail to resolve by negotiation.

Social events in the school were stodgy if judged by present practices and rules of conduct. They did not consist of dances: promenades were the thing. The boys dutifully, but frequently too shy for words, approached the girls and filled out their cards for promenades one to ten. The music commenced and, with partner number one, we walked arm-in-arm or hand-in-hand around the large auditorium. When the music stopped we abandoned partner number one and left her standing helplessly in her tracks while we hurried off to find partner number two. Brantford Collegiate Institute was a public school, not an educational arm of a religious institution. The embrace of the dance, however, was regarded by many in the community as too intimate for school children. A touch of puritanism was widespread but it was not oppressive. I remember that my parents regarded one of my uncles (by marriage) who lived near us as somewhat of a lost soul: occasionally he drank alcoholic beverages

During my last two years in public school, I delivered newspapers (the *Brantford E positor*), as did several of my classmates. The remuneration was a

pittance which we managed to supplement at Christmas by boldly reminding our customers that a gift to their paperboy would be gratefully received. A few did not respond to such an approach but usually we received 25 cents or so and a "Merry Christmas" greeting. My route led me into the countryside as far as two miles from home. With the help of a bicycle, the work was fun in good weather. In winter, one was compelled to go by foot: there was too much snow on the countryside roads to permit use of the two-wheeled helper. The temperature was frequently well below the freezing point and I remember that frozen ears and tip-of-the-nose resulted unpleasantly often unless I wore a good woolen headpiece.

While in high school I enjoyed a quite different kind of employment. After school (from 4 p.m. or so to 6 p.m.) and all day Saturday I had a job in Peachey's grocery store eight or ten blocks from home. The first responsibility was to sweep the floors and sidewalk in general to provide much of the janitorial service. But on Saturdays I was permitted to wait on customers and keep the shelves stocked and the bins of rolled oats, sugar, etc. well filled. In the warehouse to the rear Mr. Peachey had boxes of "goodies" which, surreptitiously, I managed to sample: cookies and "ice wafers" were the favorites. Once in a while, after slicing boiled ham for a customer, it was possible, inconspicuously, to "wolf" a slice or two without being caught in the act by Mr. Peachey.

From time to time I found myself serving without any remuneration as a substitute teacher in the high school. I had to teach my classmates or some other class whatever was scheduled for each hour of the day. I enjoyed teaching mathematics and did so whenever Mr. Coates, the teacher, was absent. I was never told why they rarely hired a trained professional substitute. I suppose the money for payment was lacking and since I could be pressed into service, at no charge to the authorities, and apparently did a fairly acceptable job, this seemed to be a good solution.

In my senior year I won an oratorical contest and received as the prize a set of the complete works of Walter Scott. When I was a candidate for senior matriculation much time was given over to the study of Latin. Our teacher was a strict and humorless teacher of the old no-nonsense variety. Promptly, on entry to the classroom, he would point, for example, to Jones, trembling in his seat. "Jones, conjugate amino " "Amo, amas, amat, etc.," Jones replied. However, I recall the occasion when we all agreed to really "get" "Bunny" Passmore the teacher. As he entered the room, someone quickly rose and asked, "Sir, how must one conjugate 'imano' The reply was prompt, "imano, imanas. Tut, tut, scholars, there's no such word." I must have been fairly smart in algebra, geometry, and trigonometry because I ended my high school years with a silver medal and free tuition at the University of Toronto for proficiency in mathematics.

July and August were vacation months. During the public school days I was able to spend two or three weeks of the summer with relatives[10] who were farmers near Norwich, Ontario. Although play was "the thing," I was "permitted" to help clean the cow stable and horse stalls and the ever-filthy pig pen. Perhaps this experience stood me in good stead when, in the next two summers, I gained employment on the farm of a Mr. Good.[11] Room and board were provided free, supplemented by a cash remuneration of 30 per month. I learned how to milk cows which, to my surprise, had to be milked twice daily before breakfast and after supper. Most of the day, except for milking cows, was spent in pitching hay, cleaning the stables, repairing fences, etc. I discovered that cold water, in which rolled oats had been soaked, was superior to water itself as a summer beverage. Mrs. Good, in mid-morning and mid-afternoon, brought a bucket of this oatmeal water to those of us who were working outside in the heat of a typical summer day: frequently only Mr. Good and myself.

On rereading the introductory pages, I sense something nostalgic in much of the preceding a "good-old-days" sort of flavor. In some respects, the good old days were good. In other respects, they were anything but good, as Otto Bettmann has pointed out in a book entitled The Good Old Days: They *Were Terrible.* Let me first of all mention some of the unpleasant qualities of the past. I would have to emphasize the lack of adequate information about the cause and treatment of disease, and the absence of many diagnostic aids that are now virtually indispensable. As a child, I suffered through several of the common diseases that were rampant among the young: measles, mumps, whooping cough, chicken pox, and perhaps one or two others. But so also did my playmates. Our parents believed that such diseases were inescapable; they were part of the business of growing-up. Among the adults, and perhaps also the young, diphtheria and typhoid fever were all too common. Respiratory diseases and epidemic influenza were experienced by many, especially in the winter months. As a freshman in the University of Toronto, I was hospitalized

[10]The Smyths and the Smarts. Ray and Mary Smyth brother and sister were probably in their 30s or 40s at the time. The parents were Martha Ann (1839 1913) my father's sister (fourth child among the 16 sons and daughters of Edward Luck II and Jane Caller). Martha Ann's husband was James Smyth. My aunt Martha was also the mother of Nellie who married a neighboring farmer named Smart. The Smarts had two children of about my age: Vernon, the older of the two, and Gladys. I was then 9 or 10 years of age and spent more time at the Smarts, where I had more playmates than at the Smyths.

[11]My employer was a remarkable man. He graduated from the University of Toronto with the usual B.A. degree in General Arts. He was not interested in education for a vocational degree in engineering, law or medicine etc; he returned to the farm from whence he had come. He was a man of broad intellectual interests, highly regarded by his neighbors who, knowing him as an honest, wise and "level-headed" person, elected him as their representative in the Federal Parliament. After serving a single term in parliament he decided that farming was more to his liking. From then on he declined every opportunity for "white-collar" employment.

Table 1 Death rates in Switzerland[a] (numbers per 10,000 of population)

	1880	1930	1978	1989
Diphtheria	6.12	0.55	0	0
Erysipilas[b]	0.42			0.02
Enteritis of young children	14.6	1.05	0	
Measles	0.84	0.10	0	0
Puerperal fever	1.27	0.73	0	0.002
Poliomyelitis		0.05	0	0
Scarlet fever	2.66	0.10	0	0
Smallpox[c]	0.61	0	0	0
Typhoid fever (inc. paratyphoid)	3.68	0.10	0	0.02
Whooping cough	2.05	0.32	0	0
Tabes (locomotor ataxia)[d]		0.32	0	0.01
Other diseases of the nervous system		2.84	4.4	1.6
Syphilis		0.42	0.03	0.002
Tuberculosis, pulmonary[e]	19.4	9.4		0.09
Tuberculosis, other respiratory	24.0	0.16	0.24	0.02
Tuberculosis, other locations		2.8		0.02
Cerebrospinal meningitis		0.12	0.25	0.06
Influenza[f]		1.26	0.76	0.3
Apoplexy	7.8	5.02		
Pneumonia and other respiratory diseases	24.0	15.2	1.90	5.5
Heart disease		15.3	15.6	28.9
Arteriosclerosis	7.36	10.2	12.9	1.8
Other diseases of the blood-vascular system		1.1	3.21[g]	1.3
Blood metabolism		3.15		
Cancer		16.4	20.7	27.4
Other malignant tumors		0.73		
Ulcers of stomach and duodenum		0.80	0.60	0.4
Appendicitis		1.24	0.09	0.026
Nephritis		2.57	1.46	0.3
Other renal disease		0.65		
Sex organs		1.03	0.27	0.1
Congenital debility		2.50	0.03	0.008
Senility		4.20	0.42	0.3
Suicide[h]	2.47	2.60	2.40	2.3
Traffic accidents[h]	6.70	1.80	2.20	1.6
Other accidents[h]		3.90	2.49	3.4
Homicide	0.38			0.4
Death by unknown causes		2.85	0.50	

Table 1 (continued)

	1880	1930	1978	1989
Other deaths, medically attested	85.2			
Other deaths, without medical attestation	34.4			
Total deaths from all causes	228	115	92[i]	77.6

[a]Adapted from Luck, J. Murray, *The History of Switzerland From Before the Beginnings to the Days of the Present* (The Society for the Promotion of Science and Scholarship Inc., 1985), p. 504.

[b]Erysipelas: An infection caused by *Streptococcus* bacteria and having conspicuous cutaneous symptoms. Until the advent of antibiotics, it was a serious disease, sometimes being a more generalized infection and occasionally fatal. Not listed in the mortality tables for 1930 and 1978.

[c]Smallpox: Last reported death was in 1926. Not listed in the mortality tables since 1933.

[d]Tabes: Not listed prior to 1921.

[e]Tuberculosis: In 1880, only pulmonary tuberculosis (phthisis) is listed; in 1930 and later, other forms and other locations of tubercular lesions are included.

[f]In the influenza pandemic of 1918, deaths from influenza totalled 21,491 (5.5 per 10,000 of population). The number of cases reported to the Federal Public Health Service was 664,463. Because many with influenza fail to see their doctor or the doctor considers reporting to the cantonal or federal authorities to be unnecessary, it is believed that the actual number of cases was probably as great as two million about one-half of the total population of Switzerland in 1918.

[g]Leukemia, all forms.

[h]In the age group 20 to 39, accidents were responsible for 40 to 42 of the deaths in 1974. Suicide came next, with 19 to 21 of the deaths among women and men, respectively. In the age group 1 to 19, 41.4 of the deaths were due to accidents.

[i]Deaths from all causes (1965 78): 87 to 93.

with many others in 1918 because of the terrible influenza epidemic. It was worldwide and more people died of the disease than were killed in World War I. Hospital space was insufficient in many towns. In Brantford, a huge circus tent was erected to take care of the hospital overflow.

Sanitary facilities outdoor privies in abundance were not good. Waterborne diseases were common. There was little protection against infectious diseases. From the biomedical point of view, the good old days left much to be desired. The statistical summary presented in Table 1 concerns the state of the public health in the past 100 years in Switzerland, which I happen to have conveniently at hand. Data for the United States are presented in Table 2. I suspect that the corresponding data for Great Britain and Western Europe would be similar. The remarkable progress in public health in recent years and the virtual elimination of many diseases is largely due to biochemical and microbiological research.

The good old days were also good; the underlying reason in the early years of the century was the low population density in the towns and countryside. All of us lived close to Nature. The radio, television, and movies had not yet in-

Table 2 Death rates and percent of total deaths for the 15 leading causes of death: United States, 1989 (rates per 100,000 population)[a]

Rank order	Cause of death[b]	Rate	Percent of total deaths
…	All causes	866.3	100.0
1	Diseases of heart	295.6	34.1
2	Malignant neoplasms[c]	199.9	23.1
3	Cerebrovascular diseases	58.6	6.8
4	Accidents and adverse effects	38.3	4.4
…	Motor vehicle accidents	19.2	2.2
…	All other accidents and adverse effects	19.1	2.2
5	Chronic obstructive pulmonary diseases and allied conditions	34.0	3.9
6	Pneumonia and influenza	30.8	3.6
7	Diabetes mellitus	18.9	2.2
8	Suicide	12.2	1.4
9	Chronic liver disease and cirrhosis	10.8	1.2
10	Homicide and legal intervention	9.2	1.1
11	Human immunodeficiency virus infection	8.9	1.0
12	Nephritis, nephrotic syndrome, and nephrosis	8.5	1.0
13	Atheroslerosis	7.8	0.9
14	Septicemia	7.8	0.9
15	Certain conditions originating in the perinatal period	7.6	0.9
…	All other causes	117.5	13.6

[a]Adapted from *Monthly Vital Statistics Report,* Vol. 40, No. 8(S)2, p. 5 (1992)
[b]Ninth Revision International Classification of Diseases, 1975.
[c]Including neoplasms of lymphatic and hematopoietic tissues.

fected our lives with a sham sort of entertainment. We did not experience life in the shadows of a ghetto. A crowded life, attended by the mounting pressures of the 1980s, was unknown in much of Canada and the United States. Our present frantic concern over diminishing resources, our energy needs, and the heavy hand of government were nonexistent. But, unrestrained growth of the human population, which many seem to regard with great satisfaction, is now "doing us in."

The dusty or muddy unpaved streets in many towns and villages of my boyhood years never seemed to be worrisome until the automobile came into use. At first the automobile was a novelty and, among the wealthy, it must have been most ostentatious. I remember well that Brantford was almost free of motor vehicles.

For many of us, the family income did not permit us to enjoy the products of "technology," which were slow in coming anyway. In time, however, we, the ordinary citizens, got most of the new gadgets and services. Kerosene lamps were abundantly used in the homes and how overjoyed we were as a family when natural gas was introduced and tungsten-filament lighting illuminated several of the rooms. The well from which we pumped the drinking water and the cistern where rainwater was stored continued in use for many years. But while I was still young, water lines were laid down and indoor faucets came into use. Sewage lines also were installed and the outdoor privy disappeared. The electric light followed the tungsten-filament lamp and shortly thereafter we had a hand-cranked telephone.

And what about keeping up with the exciting news on the forefront of scientific research The annual meetings of the professional scientific societies in the good old days were stimulating and delightful. A meeting was almost a family gathering One knew almost all of the other participants and discussions were lively and exciting. Multiple contemporaneous sessions were not yet invented, thanks to the small number of papers. The huge meetings of the present are of dubious value and should be abolished or replaced with small working sessions. Our universities might be well advised to give to their research people a few hundred dollars for staying away from monstrous meetings rather than for attending.

My father was born in the good old days of the 1850s the youngest of a family of 16 children. He was a good man whose goodness had depth and substance; it was not veneer. He seldom chastised or rebuked his own five children, even though the youngest was inclined toward waywardness and a questioning of the "eternal verities." Neighborliness in the good old days was common and it was good. The family was accepted and recognized as the irreplaceable unit in the social structure. I believe that the bonds between the members of a family were stronger then than now perhaps a dubious generalization because great differences can exist from family to family and from one social order to another.

My father was a blacksmith and, later, a workman in an implement factory. He never enjoyed much of an income. It was a hand-to-mouth existence for the family, but none of us suffered. Brantford is an industrial town seven miles from Paris, where I was born in October 1899, the youngest in the family. All but a few in the town knew only a very simple life. Incidentally, strikes were unknown. Doubtless there was exploitation of the working class, but industrial peace, however shaky its foundations may have been, managed to prevail.

In general, the schools in the days of my youth were better than they are now. Teachers were overworked but dedicated. Much was demanded of the pupils, discipline was severe, and substantial homework assignments could not be taken lightly.

UNIVERSIT EARS

After exposure to a rigorous and highly disciplined schooling through the high school level, I was fortunate in being awarded a four-year scholarship that gave me tuition-free undergraduate instruction in the University of Toronto.

During my first year in the University I was enrolled in University College as a major in Chemistry. I shared a room in a nearby private house with a student enrolled in Science and Engineering. It was my good fortune to meet a small group of students, several of whom were headed for careers in Medicine. Among them was Fred Hamilton who, with eight or nine others, entered the University from the University of Toronto High School. They all shared an interest in astronomy and implemented this by forming a "Star Club" which met monthly (more or less) to discuss relevant topics in which all were enthusiastically interested. I was invited to join the group. Occasionally we had an outside speaker, among them a man whose name I have forgotten but who, as a flat-earth believer and exponent, stands out in my memory. He spoke to us at least twice, and although none of us became converted to Flat Earthism, we enjoyed his vigorous presentations. The members of the club, at least those whose names I remember, were Ross Kerr and his brother John, Fred Hamilton, Oliver Stanton, Walter Rowlands, "Doc" Cavin, R. B. . Scott (a theologian and later a Professor of Old Testament Literature at Princeton University), and Allan Crawford, who later served as the Canadian representative on a U.S. team that was sent by the famous Arctic explorer and publicist, Vilkjalmur Stefansson, in 1921 to establish by occupancy, "ownership rights" to Wrangel Island, which was also sought by the USSR.

Wrangel Island Occupation

It should be mentioned that Stefansson, who was extremely active in pursuing plans for the economic development of the Arctic islands, was deeply involved in urging the Canadian government to act speedily in claiming ownership of the Arctic islands by occupation. Stefansson was pushing ahead with his own campaign to have Canada acquire Wrangel Island. First he approached the Hudson's Bay Company with a suggestion that it would be desirable for the company to establish a trading post there. Then he advised Prime Minister Meighen that the company wished to open a post on the island but needed some indication of support from the Canadian government. Meighen put the matter before the Cabinet on February 19, 1921, then dashed off the following note to the waiting Stefansson:

> I have discussed the matters which you laid before me today and desire to advise you that this Government purposes to assert the right of Canada to Wrangel Island based upon the discoveries and explorations of your expedition. I believe this is all that is necessary for your purposes now.

Stefansson hastened to inform the Hudson's Bay Company that the Canadian government supported the company's plans for Wrangel Island "and would look with the greatest favour" on its going ahead since "their plans for making secure the claim of Canada to Wrangel Island would be materially helped if a British concern were to start a post there in the summer of 1921."

Unfortunately for Stefansson the government quickly had second thoughts. Faced with strenuous objections from Pope and his colleagues, Meighen abruptly withdrew his endorsement on March 1, after just ten days: "The Prime Minister asks that pending further advice you make no use of his letter to you of February 19th about Wrangel Island."

The project seemed lost, but Stefansson remained undaunted and continued to make plans to have the island occupied by a private Canadian expedition in the hope of compelling the government to support a *fait accompli.* He organized a small expedition of three American protégés and a young University of Toronto undergraduate, Allan Crawford, to occupy the island in 1921. Despite his inexperience, Crawford was named commander to sustain the fiction of Canada's involvement. The flag was immediately hoisted over Wrangel Island, and Stefansson tried unsuccessfully to manipulate the federal government into resupplying the expedition on humanitarian grounds. The team was to be relieved by a second expedition at the end of the first year of occupancy. The weather, however, became unusually severe and the relief party could not get through because the water in the channels was solidly frozen. The members of the original team tried to make their way on foot to the USSR but, apparently, froze to death. The ship Stefansson sent out in 1922 failed to reach the island, and a supply ship in 1923 found that the men had perished. The Canadian member (Crawford) remained on the island, accompanied by one or two native women who endeavored to save his life by a desperate search for food and providing body warmth. The efforts were in vain and he too lost his life. When the expedition of 1921 failed in its efforts, the debacle hastened the precipitous fall of Stefansson as a proponent of development of the Arctic islands.[12]

Victoria College

At the beginning of the second year I transferred to Victoria College, a part of the University of Toronto system. I did so because my brother, Norville, having just returned from Europe when World War I came to an end, proposed to continue his studies which had been interrupted by the war. We shared a room in Burwash Hall. The College consisted of two faculties, Arts and Theology.

[12]Morris Zaslov, *The Northward E pansion of Canada,* , pp. 18 19, McClelland and Stewart, Toronto, 1988. I am grateful to Roderick McFall of the National Archives of Canada for reference to the Zaslow book. Much of my account, however, comes from other sources which I am now unable to identify.

The theologs, as we in arts called the others, were in training for the ministry in the Methodist Church of Canada.

It may be of interest, however, to mention that quite by accident I met a young woman, Laura Luck, who lived nearby in a residence for women. Laura, it turned out, was the daughter of my uncle, Samuel Luck, who had moved with his family from Hamilton, Ontario, to Pullman, Washington. I also met, during those years in Victoria, Henry B. Sharman, a wealthy retired Canadian who had written a book of some interest entitled *Jesus as a Teacher.* In this he made a critical study of the biblical records and other material pertaining to the life of Jesus. Sharman appeared in Burwash Hall once a week for quite some time to lead a discussion group concerned with this subject. Later on, when I was married to Janet Ingalls and living again in my hometown of Brantford, Sharman again appeared as a guest of Professor Harry Rathbun and his wife. Again, Sharman led a discussion group which my wife, Janet, regularly attended. I went with her a number of times but was somewhat in disfavour because I made many critical comments and asked too many questions of Sharman. This greatly embarrassed my wife.

In the College I was very active in a quasi-parliamentary group modeled after the famous Oxford Union. Although I was leader of the opposition most of the time, I did not develop a lasting interest in politics. In the University of Toronto, I was a member of the Students Council of which I became president, only to resign a short time later, in August or September of 1922, on the eve of my departure for Cambridge University (see page 18 24).

Book Salesman

In the University of Toronto, the summer months were recognized as vacation months. As a freshman, I became interested in an opportunity to spend the summer in Western Canada as a book salesman. I was always a lover of books. As a boy I read everything by G. A. Henty and Horatio Alger that I could find. Some of the works of James Fenimore Cooper and Mark Twain were delightful. And there were many others.

The book to be sold was a very large volume entitled *Better Farming* (or *Farm Economy* I forget which). It was not difficult to persuade a few fellow students to join in the venture. We took the required Knox Course in Salesmanship. Then, youthfully confident that we could sell the book to anyone, we went to Saskatchewan, where each was assigned a huge block of the province as his exclusive territory. We almost felt as if we were mediaeval counts, each with vested property rights in a few hundred square miles of prairie. The *Hauptdorf* in my vast territory was the small town of Lanigan. Each of us travelled by bicycle over roads of a sort to reach our "tenants," some of whom farmed an entire square mile (640 acres) while others had a mere 160 acres. The distances between farmhouses were considerable and we spent the night in the last

place we visited in the late afternoon. We were always received as welcome guests (lodging and meals freely provided) because social gatherings were infrequent and visitors were few in number in such sparsely populated regions.

The selling procedure was marvelous. In the distance, several hundred yards away, we might see the farmer at work on the land. We knew his name, for it had been given to us by one of his neighbors. "Good morning, Mr. Brown," we would say with a friendly handshake, "I am Dick Turpin [for example]. Such wonderful weather for the crops but also for smut, which of course goes after everybody's wheat at some time or other." "It sure does," says Brown. "Well, I'm here as a representative of the Better Farming Association to talk to everyone I meet about plant diseases." Taking two small vials from a pocket, I continue, " ou will recognize, Mr. Brown, this one here as a specimen of wheat infested with 'loose smut,' the other is 'stinking smut.' Which one do you usually have around here " Before he can answer, I reach for a good-sized prospectus in my rucksack and continue, "I just happen to have here some very good pictures of both." If lucky, I open the prospectus at the right page instead of one which pictured a cotton plantation or a watery field of rice. Then the real sales talk began and I answered all possible objections against purchase we had learned the answers in the course on salesmanship Finally, opening the prospectus at the last page, where I had already inserted the names of a few of the prominent farmers in the area, and holding it so Brown could see the names, I give him the final thrust I'm sure, Mr. Brown, you want one of these books like the rest of your neighbors. The reply that I always received was, "No, I don't want it." To this, as we had learned, there was no triumphant reply and I had to accept defeat.

As itinerant salesmen we were supposed to carry a provincial license, obtainable for a significant fee. If, however, one was selling hymnals, bibles, or religious publications, the license was not required. In consequence, we also had in the rucksack a second prospectus descriptive of religious literature. We were instructed to switch promptly from one prospectus to the other if we ever saw a uniformed member of the Royal Canadian Mounted Police approaching in the distance, and to engage Brown in a serious conversation about the Bible. I never met an RCMP under such circumstances, although later I met one who served in the Lanigan area and I accompanied him on several occasions when he held court in neighboring towns as judge and jury to adjudicate various petty crimes.

As a salesman of books, I was a total failure and soon abandoned the job. Instead, I served as bookkeeper for the Ford McLaughlin garage in Lanigan, wrote the tax notices for the town, audited ( ) the books of the Lanigan branch of the Saskatchewan Grain Growers Association, and worked part-time in the local dairy determining the fat content of milk received daily from Lanigan-area farmers.

Marine Biological Station

I spent the summer of 1922 in research at the Marine Biological Station of Canada in St. Andrews, New Brunswick (Director: Professor A. G. Huntsman). The problem to which I was assigned pertained to the growth of halophilic bacteria on codfish which, after evisceration, had been temporarily packed in large quantities of sodium chloride. After an appropriate time the fish were removed from the resulting brine and placed on racks in the open air to dry out — at least to an extent that permitted them to be packed for shipment. What happened next was of real concern to the industry. Bacteria grew merrily on the salted fish. Ten or more varieties were usually present, including one or more that caused the salted fish to develop a pink red coloration on the exposed surfaces. The infestation of the salted fish led to serious financial losses. However, I was told that the colored fish were regarded as a luxury item in France, to which many salted cod were then being exported.

Beyond plating out the ten or so varieties of bacteria that thrived on the salted fish, I was unable, in the time available, to pursue the problem further. Otherwise it would have been interesting to search for a bactericidal substance which, mixed in with the salt, would prevent the growth of these troublesome organisms but would be harmless to man and devoid of any unpleasant flavor when the salted fish were eaten.

Late in the summer I learned to my surprise that I had won an 1851 Exhibition Scholarship — nominated by the University of Toronto — for several years of postgraduate study in Great Britain. The Trustees of the Foundation proposed that the studies be pursued at the Lister Institute in London or in Cambridge University. The Lister was highly regarded as an institute with a top-level staff, which at the time was heavily oriented towards biochemistry. But life in a big city did not appeal to me. I chose Cambridge University, to which I was duly admitted as a research student after acceptance by Gonville and Caius College. Biochemistry was to be my field of research.

Cambridge University

On admission to Gonville and Caius College, I soon learned that within the college most of the students were attached to one or more clubs of a sort, such as tennis, soccer, swimming, rowing, and a variety of clubs for literary and cultural pursuits. I was invited to join one, the name of which I do not recall, but membership therein required each member, sooner or later, to give a talk on something assumed to be of interest to the members of the club.

When my turn came I gave one on the origin of life — very speculative indeed. The text is much too long to include in these reminiscences. After spending about twenty minutes in a struggle with the definition of “life,” I found myself making backward glances of twenty to thirty million years with

the admission that even those early days were far short of the beginnings of life. uite a bit of time was devoted to speculations of a religious and philosophical character and concluded with concepts that were deterministic and mechanistic. The talk ended with consideration of the origin of the carbon and nitrogen presumed to be necessary for the formation of even the simplest organisms. Reference was also made to the fact that the appropriate irradiation of simple gaseous forms of carbon (such as CO_2) and of nitrogen (such as oxides) yields reaction products containing some organic products which are known to be constituents of most, if not all, living organisms.

What an interesting collection of biochemists occupied the laboratory Each was different from the next, and each, in his own way, contributed to the exciting, entertaining, and brainy atmosphere of the place. I can well recall only Sir Gowland Hopkins the lovable Hoppy[13] Rudolph Peters, J. B. S. Haldane, Marjorie Stephenson, The Hon. Mrs. Onslow, R. A. McCance, Dorothy Moyle (later Mrs. Needham), Joseph Needham, Tim Hele, Robin Hill, Malcolm Dixon, H. F. Holden, Hans Krebs, Bill Pirie, J. H. uastel, Margaret Whetham (later Mrs. Bruce Anderson), Vincent Wigglesworth, and my research partner for a time Trilok Nath Seth. There were others, many others, each pursuing his or her research in glorious independence.

Joseph Needham

I must add a few paragraphs about Joseph Needham with whom I have enjoyed a lasting friendship. During the second World War, 1942 1946, Needham was sent to China to serve as Scientific Counsellor at the British Embassy in ChungKing. His interest in China appears to have commenced somewhat earlier with the arrival of three Chinese research workers in Cambridge with whom Needham came to be very favorably impressed. One was Gwei-Djen Lu, Needham's wife since September 1989. She was his close colleague for at least 50 years and had worked on aspects of muscle biochemistry with Dorothy Moyle, Needham's first wife.

During the period 1922 1925 when I was a research student in the biochemistry laboratory, Needham, much interested in chemical embryology, was engaged in studies of the chemical changes that proceed in the fertilized hen's egg during development of the embryo. He is reported to have published in 1942 a remarkable work on *Biochemistry and Morphogenesis,* a compre-

[13]I met Professor Hopkins within a few days of my arrival in Cambridge. After warmly welcoming me to the laboratory, he asked *inter alia* about my financial resources. After learning that I was to be supported by a grant from the 1851 Exhibition Foundation, also that I had recently married, he said in effect, "the income you will receive as an 1851 Exhibition research scholar will certainly be inadequate. Let me discuss this with Sir Hugh Anderson (Master of Gonville and Caius College)." He did so and shortly thereafter I learned that the College proposed to grant a generous supplement to my income during the ensuing three years as a research student.

hensive review of over 300,000 words and more than 8,000 references. Prior to this tremendous accomplishment, he had already published, even before attaining the age of 31, five volumes of essays and three volumes of *Chemical Embryology,* a massive work of great breadth and depth. In itself it is outstanding evidence of Needham's erudition and competence as a scholarly expositor of science.

During his years in ChungKing he became captivated by a new interest, the history of science and civilization in China. He was the recipient of a multivolume set of books on this broad subject that was a duplicate of another set in the Library, donated by the Vice Chancellor of Chichiang University Library. With this material in hand, together with some hundreds of other volumes acquired later, Needham has been engaged in preparing a series of volumes in English on *Science and Civilization in China.* Gwei-Djen Lu has assisted indefatigably in this monumental task. Fifteen volumes have thus far been published; an additional nine volumes or so are expected to complete the series. This is an achievement in scholarship for which the world of learning will forever be indebted to Needham. For his memorable contributions he received an honorary Litt.D. degree. He already held an Sc.D. as an earned degree.

As a noteworthy result of his interest in world science, Needham persuaded the Council of the United Nations to change the name and responsibilities of UNECO to UNESCO. He was appointed the first Director of its Science Division.

Needham was also much interested in the association of Science and Religion. For quite some time he was a Lay Brother of the Oratory of the Good Shepherd an Anglican religious Order. Eventually he resigned from the Order because of a doctrinal policy and practice which he was not prepared to accept. But he learned much from his fellow members and recalls his days in the Oratory with great affection and gratitude. Although the Oratory still exists, the Cambridge Chapter is gone.

During his membership in the Oratory, Needham invited me to dine with him in the Oratory. I gladly accepted. I recall that the Father sat at the head of the table with Needham on his left while I was on his right. With his studies of embryonic development very much in his mind, Needham talked with hardly a pause about his work on the egg. The Father stood this as long as he could; then, turning to Needham, he said "My son, *laborare est orare sed oratory non est laboratory.*"[14] This gentle reprimand quieted Needham for all of two minutes or so.

I conclude this section on Needham by mentioning my indebtedness to him for a recent letter pertaining to some portions of his career. I am equally obliged to Professor Mansel Davies for an article in the *Caian* (November

[14]To work is to pray, but the Oratory is not a laboratory.

1990)[15] in which he beautifully describes Needham's great intellectual accomplishments, reminding us that "contemporaries may well be proud to have lived in an age adorned by a man of such intellectual stature."

Incidentally, Needham was elected a Fellow of Gonville and Caius College in 1924 and Master of the College in 1965. He continued to serve the College in that capacity until 1976. He became a member of the Royal Society in 1941.

J. B. S. Haldane

Hoppy, with much on his mind, seldom knew what each of us was up to but was always interested in hearing about our biochemical doings, and was ever affectionately concerned about our welfare. J. B. S. Haldane was a walking encyclopedia. He came to Cambridge in 1922 as the Reader in Biochemistry and soon knew what everyone was doing. He was an avid reader of the biochemical journals in the well-stocked library. In his constant roamings about the laboratory, and in frequent chance encounters, he would discuss with remarkable insight the intricacies of one's research activities.

Hoppy suggested to Robin Hill and me that it might be interesting, as a starter, to collaborate with Haldane. It was indeed interesting He strongly believed in "being one's own rabbit." As such, he swallowed in three days a 3.5-liter aqueous solution of 85 grams of calcium chloride to induce a marked acidosis. Robin and I were responsible for analyzing the great man's urine. He developed an acidosis that was noteworthy.

I recall swimming in the river Cam on a Sunday during the height of the 13-day experiment. Haldane was also there. Soon, a punt, bent on descending the river, made its approach. Seated therein were Hoppy, who had been knighted but recently, Lady Hopkins, and two distinguished-looking guests. Haldane at once swam under and around the punt, describing in his booming voice his experiment on acidosis: "I am now excreting the most acid urine that has ever been excreted…." " es, yes," replied Hoppy, rubbing his brow in characteristic fashion. Later it emerged that someone, somewhere, had reached a slightly higher acidity but Haldane took his "defeat" in stride.

In my post-Cambridge years, I have felt greatly indebted to Haldane for the introduction in physiology he gave to four or five of us from the lab. We met in his rooms in Trinity College on frequent occasions. uestions and more questions always preceded a very informal but informative "lecture" by Haldane. At the first session, I remember he started off with the query, "How big do you think my liver is " He weighed 100 kg. We answered with widely different percentages of his body weight. "How much blood do you suppose I have "

[15]The Annual Record of Gonville and Caius College, Cambridge (1 October 1989 to 30 September 1990).

Answers: A few pints up to a few gallons. “How may one determine the blood volume ” And so on. At the end of the evening, there was always an unorthodox and enlightening summary by Haldane.[16]

Thesis Research and E aminations

Shortly after finishing the acidosis collaboration, I investigated sources of the amide nitrogen of caseinogen. The phosphotungstate precipitate of the basic fraction was extracted with an amyl alcohol ether solution. A remarkable discovery followed: not only ammonia but methylamine constituted the volatile components of the bases Fortunately, a control run established that the methylamine originated as an impurity in Kahlbaum’s C.P. (chemically pure) amyl alcohol. Strange as it may seem, the “discovery” thrilled me immensely almost as much as if methylamine had been proven to be a product of caseinogen hydrolysis. ears later I had a somewhat similar experience. I have had to conclude that the joy of discovery in research is not necessarily limited to the discovery of truth but can also stem from the discovery of error.

I lived in Cambridge as a research student from 1922 to 1925. The thesis required of Ph.D. candidates was finally submitted and approved (*The Origin of Blood Ammonia*). Two examiners next “worked me over.” The internal examiner (from within Cambridge University) was Sir Gowland Hopkins; the external examiner was Professor J. C. Drummond of University College, London. The questions were straightforward certainly not designed to baffle and confuse the candidate. When an hour or so had elapsed I was told by the examiners that the examination was concluded. A few minutes later, Professor Hopkins informed me that the examiners would report to the appropriate authority that I had passed the oral examination to which I had been subjected.

Sir Joseph Barcroft, Professor of Physiology at Cambridge, with whom I had had conversations on a number of things, including oral examinations, told me of his own experiences some years earlier. “Mr. Barcroft,” asked examiner number one, “what substances turn blue litmus paper red ” “Acids, sir” was the reply. Next, a question from examiner two. “And what class of substances, Mr. Barcroft, turns red litmus paper blue ” “Alkalies, sir.” “Thank you, Mr. Barcroft, that completes the examination.” Of course, the point of this anecdote was to exemplify the fact that examiners, if satisfied in advance that a can-

[16]If a reader of these reminiscences is interested in further information about Haldane, I can recommend the following:

1. Ronald W. Clark, *J. B. S. The Life and Work of J. B. S. Haldane,* (Coward-McCann, New ork, 1969, 304 pp. of text plus 22 pp. of Bibliography and Index)

2. Michael Lerner and William J. Libby, *Heredity, Evolution and Society*, (Freeman and Company, New ork, 1968, 1976). This work contains a concise one-page biography of J. B. S. Haldane (1892 1964).

didate was competent and adequately knowledgeable of the broad field of study in which he was specializing, would not waste their time or his with a barrage of needless questions.

Later, as an assistant professor of biochemistry at Stanford University, I found that Ph.D. examinations throughout the university were required to be of three hours' duration at least. The structure of committees of examiners was also carefully defined. By the 1980s, and probably much earlier in some departments, the examinations became less rigidly defined and were frequently rather short in duration.

T. R. Parsons and E. B. Ludlam

My years in Cambridge were rich in a variety of experiences that to me were memorable although many were trivial in a larger frame of reference. Within a few weeks of arrival in Cambridge, I had the pleasure of meeting T. R. Parsons of the Physiology Laboratory. I never inquired about his position on the academic ladder. He was the author of a well-written and popular book entitled *Fundamentals of Biochemistry* (Cambridge University Press, 1923). His research in physiology is mentioned in several publications by Sir Joseph Barcroft with whom he was associated. At that time, Parsons had made considerable progress in a study of the Russian language in fact, so much so that he had moved on to the study of Finnish, which he knew would be an exciting linguistic challenge.

It was from Parsons that I learned a lesson about English weather: never change your plans for an outdoor picnic or other outdoor activity because of inclement weather. Obviously you must admit defeat if a torrential rain is pouring from the heavens and you had planned to lie in the sun until well baked or blistered.

The lesson, so-called, came about as follows: Parsons and his wife invited my wife and me to go on the river the following Saturday and to go by punt a few miles downstream. We would, of course, take the makings for a fire and a jolly good tea party alongside the river. Parsons promised to pick us up at our lodgings on Halifax Road at ten o'clock on the appointed day. But the heavens had decided that a good rain was called for on the appointed Saturday. My wife and I looked from the window while having breakfast and saw the rain coming down at a pretty good pace. We knew, of course, that the tea party was a "no-go," but to our surprise the Parsons came by at ten o'clock as promised. We hastily got ready, joined the Parsons, drove to the river, hired a punt and took off. At four o'clock or so we came to a place where we tied the punt and, somewhat sheltered by a huge willow tree, we put our supply of dry wood to work and eventually had a tea kettle of boiling water. The hot tea, sandwiches, and cookies joined us in ignoring the rain. We had a thoroughly good

time; perhaps enhanced by overcoming the challenges hurled at us by Jupiter Pluvius.

Later I met E. B. Ludlam (1879 1958) who, in 1912 or 1913, had been engaged in research at the Cavendish Laboratory in Cambridge under Sir J. J. Thomson. With the outbreak of war in 1914, and as a conscientious objector, he served in London with the Friends' Emergency Committee for the Relief of Aliens, returning to Cambridge in 1919. He, his wife, and his mother-in-law were uakers (members of the Society of Friends), as we heard from others after another month or so. Thus it was that we had many conversations in the weeks that followed about uakerism. I became much interested in the life of George Fox and I read with pleasure and enlightenment the *Journal of John Woolman*. I asked the Ludlams if my wife and I could go with them some Sunday to the Friends' Meeting House. This we did and participated in the meetings frequently thereafter. The Ludlams moved to Edinburgh in late 1922 where E.B. had accepted an appointment as Lecturer in Physical Chemistry. I became a convinced Friend (uaker) and, on moving to Stanford University in 1926, attended the Friends' meetings that were held in the home of Augustus Tabor Murray, Professor of Latin and Greek; a meeting house came into being several years later.

Apart from research in Cambridge, I had the never-to-be-forgotten and humiliating experience of "baptizing" the new laboratory (the Sir William Dunn Institute) into which Hoppy's "family" moved in 1924. Trilok Nath Seth and I occupied a laboratory on the top floor. Late in the day I opened several faucets to be sure that water running through a condenser was cold. An hour or so later, I left for home and forgot about the wretched faucets. One of them misbehaved; during the night the water overflowed, reached electrical outlets in the floor, shorted the building's electrical circuits, and soaked the beautiful plastered ceiling below. All of this happened only a few days before the building was to be dedicated and a great assembly of distinguished visitors would be present. Hoppy, though visibly dismayed, never even hinted, at least to me, that biochemistry was possibly not my "cup of tea."

The three wonderful years at Cambridge ended in the summer of 1925. I had submitted a thesis on *The Physiology of Ammonia and Urea.* Armed with the seemingly indispensable degree of Doctor of Philosophy, I was appointed Demonstrator in Biochemistry at the University of Toronto on the recommendation of Professor Andrew Hunter. I remember a seminar in which the Professor discussed the biochemistry of arginine. He was known to be meticulous and precise in speech, as I soon discovered. "But Professor Hunter," I asked, "*can* one determine the concentration of arginine by the enzymatic method you described " "Of course one can, I just did it" the professor replied, "but *may* one do so is what you probably intended to ask."

In April 1927 I attended the annual meeting of the American Physiological Society, held in Rochester, New ork. In those early days biochemists were regarded by physiologists as their blood relatives a relationship that was mutually helpful.

In the course of the meeting, Frederick F. Tisdall, a pediatric biochemist from Toronto General Hospital, presented a paper on the calcium content of the blood of infants. He used a method published in collaboration with Benjamin Kramer in 1921 (*J. Biol. Chem.* 48:223, 1921). An analysis required only 7 cc of blood, a technique that was in sharp contrast to other methods that called for 25 to 100 cc of blood. Having presented the paper, the chairman threw it open for discussion. A.B. MacCallum, Emeritus Professor of Biochemistry in McGill University, Montreal, Canada, who had determined the inorganic content of blood years earlier, rose to the occasion. "Professor Tisdall, the calcium content of blood cannot be determined from the small samples of blood that you have used." "But, Professor MacCallum, situations arise in which the calcium content of the blood of infants must be determined. How may one proceed with an analysis if the large volume of blood that you and others have employed in studies on adults and domestic animals must be used " " oung man, with age comes wisdom "

II. ANNUAL REVIEWS INC.

I suspect that I am best known to scientists and scholars generally through my founding of Annual Reviews Inc. and its family of 27 Reviews that appear annually. I organized and edited the first of the series, namely *Annual Review of Biochemistry,* published in 1932, and continued to participate in an administrative capacity for the whole enterprise until 1967. The story is not without its points of interest and is described in detail in "Confessions of a Biochemist," in the *Annual Review of Biochemistry,* Volume 50, pp. 1 22, 1981). Excerpts from that article comprise the following section.

Beginnings of Annual Reviews Inc.

I regard it as an honor to be invited to write the Prefatory Chapter for the fiftieth volume of the *Annual Review of Biochemistry.* Anyone who was born in the nineteenth century can only be flattered when those about him entertain the belief that he is still able to write something that might be worth reading.

That 50 is more significant than 49 or 51 in the commemoration of events is lacking in any rational explanation. et I confess that I have been charmed and enslaved for years by a peculiar attachment to the number 50. On April 18, 1956, I found myself at the Golden Jubilee dinner of the American Society of Biological Chemists. As President of the Society, it was clear that I should address the members and guests who were present, if only in obedience to a circular letter to the Council in 1912 which would oblige future presidents to address the Society, in order to "show to the world at large that the President of our Society is capable of exerting a function." At this event, with fiftieth anniversaries in mind, I mentioned the *Biochemical Journal* and the *Biochemische eitschrift,* both of which were launched in 1906, and told of several other notable events in 1906. When I had concluded my remarks, Newton Richards, my next-chair neighbor, lost no time in reminding me that I had failed to mention the great San Francisco earthquake, possibly the worst calamity, apart from forest fires and floods, in the history of California. This earthquake had occurred exactly fifty years earlier, to the very day.

The Editorial Committee of the *Annual Review of Biochemistry,* concerned lest I might forget another fiftieth anniversary the birth of the *Annual Review of Biochemistry* in 1931 issued a strict injunction in its invitation to me that I should discuss the origin and early years of this Review.

I suppose it all began with my coming to Stanford University in September 1926, as Acting Assistant Professor of Biochemistry. The settling-in process lasted for two or three years, during which I wrestled with the problem of fashioning lecture and laboratory courses in biochemistry, appropriate to the presumed needs of medical students. The nature of laboratory instruction in biochemistry in those far-off days can be inferred from a laboratory manual entitled " uantitative Analysis of Blood and Urine" which, as author, and until I knew better, I inflicted upon the students. Meyer Bodansky's book

Physiological Chemistry was the recommended textbook for the lecture course, supplemented by a miscellany of fact and theory from other sources. The pearls of wisdom that dropped from the lips of this youthful novice were avidly seized upon by a few, some of whom behaved as if they were inspired. This was so rewarding to the lecturer that he decided to give a course on current research in biochemistry to a group of ten or fifteen graduate students. *Chemical Abstracts* and three or four of the principal periodicals in biochemistry provided the material for the course. I soon found myself knee-deep in trouble, and this brings us at once to the conception of the *Annual Review of Biochemistry.*

The chemistry and metabolism of amino acids and proteins and two or three other areas in biochemistry were the only parts of the whole field wherein I was sufficiently knowledgeable to feel comfortable before those advanced students. Doubtless there were those gifted biochemists who could review with authority and confidence any area of biochemistry. But I was not among them. However, I was possibly not the only one who suffered from this painful ignorance: there must have been others and, among them, some kindred souls who sought to review for advanced students current research in biochemistry, only to find themselves as dismayed as I was by the immensity of the task. We must remember that even in 1930 *Chemical Abstracts* published about 6,500 abstracts of papers on biochemistry, as it was then defined.[1]

In mid 1930, I inquired of about 50 well-known biochemists in the United States and abroad whether an annual volume of critical reviews on the research of the preceding year or two in biochemistry would be a useful addition to the biochemical literature. The volume, of course, would be international in scope and the 30 or so cooperating authors would have, so it was hoped, the necessary expertise to satisfy the expectations of their fellow biochemists the world over.

The responses to the inquiry were numerous and encouraging. A suggested list of topics received the benefit of very helpful advice by many old hands at the game who knew more about the structure of biochemistry than the young fellow who made the inquiry. Out of this emerged a list of 31 topics for the introductory volume and 14 more to be included with others in Volume II. The names of possible authors were also submitted. The invitations were extended and the declinations were surprisingly few.

Carl Alsberg (Stanford), Denis Hoagland, and Carl Schmidt (both at the University of California, Berkeley) agreed to serve as an Advisory Committee. And so we were off and running almost. All that remained was to find a publisher. Six commercial publishers regarded the project as interesting but not the kind of a venture they would choose to undertake. Stanford University would publish the Review if it were adequately subsidized. Fortunately, the Chemical Foundation came to the rescue. We needed 10,000 to cover the deficits anticipated during the first three years. With the help of

[1]The number of biochemical abstracts published by *Chemical Abstracts* in 1979 was over 148,000, the increase being attributable to a more comprehensive coverage of the literature, a more expansive definition of the subject, and an enormous increase, worldwide, in the number of research projects being pursued in biochemistry.

Carl Alsberg, a man of considerable influence, and with a few letters to the "right" people, the Foundation granted our request. Very few strings attached, other than annual reports, of course those were the days We had the money, we had a publisher, we were on our way. Volume I, 724 pages, with authors from nine countries, came off the press in July 1932. All of the authors who promised to prepare the 30 reviews kept their word: there were no defaults The volume sold for 5 as did succeeding volumes until 1948 when the list price was increased to 6.

The Advisory Committee, meanwhile, organized Volumes II and III, each with a lead time of two years. With myself as editor and chairman, the Committee functioned as an embryonic Board of Directors as well as an Editorial Committee for the *Annual Review of Biochemistry.* Except for occasional trivial spats between the publisher and the Advisory Committee (which had the money) in matters of policy regarding, *inter alia,* advertising and sales price, the relations between the two parties were most cordial and the Stanford University Press served us well. However, on termination of our three-year contract, our relationship changed fundamentally. It had become more and more apparent that the Advisory Committee should assume a legal identity and accept the responsibilities of a publisher but with Stanford University Press continuing as our printer. On December 12, 1934, the Articles of Incorporation, signed by the four members of the predecessor committee, were filed with the California Secretary of State, and Annual Review of Biochemistry, Ltd., was formed (changed to Annual Reviews Inc. in 1937).

The company was organized as a nonprofit corporation which means, in effect, no shareholders, no dividends, no division of earnings among the members of the corporation, and, in the event of dissolution, no division of the assets among the members. Why did the incorporators not follow the usual route and become a commercial publisher Briefly stated, "it was the only way to go." The enterprise was totally committed to the unstinted cooperation of all participants for the benefit of the worldwide community of scientists. From the beginning, the Directors and the Editorial Committee Members have donated their services, except for a modest expense allowance for meetings attended. The editors receive a token honorarium. The authors receive neither honoraria nor royalties. No less than 1,974 of our colleagues have "done their bit" as authors during the first half century. Their only reward has been a short-term complimentary subscription to the Review, a number of reprints of their article, and the unsung gratitude of many fellow scientists. There is an implicit understanding that Annual Reviews Inc. is uniquely a service organization.

Life can be a grand adventure, rich in excitement and thrills of accomplishment, withal punctuated by many errors and narrow escapes. Annual Reviews Inc., now 50 years of age, has had a full life and has run the entire gamut of corporate hazards, perils, and modest achievements in the face of growing complexities.

At first, it was all delightfully simple. For 18 years, as editor of the *Annual Review of Biochemistry,* I could boastfully claim to know by name and close acquaintanceship all who had served on the Advisory Committee Board of Directors and the Editorial Committee. It was easy. Apart from myself, only twelve were involved: Alsberg, Hoagland, and Schmidt all three

passed away in the 1940s Herman Almquist (elected in 1940, retired in 1972), Herman Spoehr (from 1940 to 1953), H. Albert Barker (from 1946 to 1962), Harry Deuel (from 1946 to 1953), John Fulton (from 1946 to 1950), Henry Eyring (from 1948 to 1969), Ernest Hilgard (from 1948 to 1973), Andrew Ivy (from 1950 to 1953), and Douglas Whitaker (from 1950 to 1956). Until 1950 the Board of Directors and the Editorial Committee were identical in composition. For the next seven years the Editorial Committee of the *Annual Review of Biochemistry* consisted of two or three directors and several other biochemists (Arnold Balls, Floyd Daft, Zev Hassid, Bernie Horecker, Tom Jukes, and Emil Smith), each of whom served for five-year terms. The Board members were gradually rotated into retirement. By 1956 the Editorial Committee was entirely external to the Board of Directors, except for myself, who is still "hanging in there," though rather tenuously.

During my 33 years in office, I received invaluable help from those who served as associate editors: Carl Noller in 1938, James H. C. Smith (from 1939 to 1946), Hubert Loring (from 1946 to 1956), Gordon MacKinney (from 1946 to 1965), Frank Allen (from 1947 to 1963), Robert Sinsheimer (from 1965 to 1972), and Alton Meister (1964 to the present). Paul Boyer and Esmond Snell have served with conspicuous ability and devotion as editors, jointly or on an alternating basis, since 1962.

There have been many corporate adventures, the first in 1938 when Annual Reviews and the American Physiological Society (APS) agreed to share in the production of an *Annual Review of Physiology* (ARP). The numerous discussions with officers of the Society and their Board of Publications Trustees are minutely documented in the files of Annual Reviews. From the first it was perfectly clear to both parties that, ideally, they should initiate the new Review under a plan of joint participation. But it soon emerged that the obstacles to be overcome were numerous and the initial resistance within the Society was formidable. The details need not be recited. The names of those who were singularly helpful deserve to be mentioned. Their wisdom, good sense, integrity, and simple honesty had earned for them the deepest respect of their fellow physiologists: A. J. Carlson, Walter J. Meek, Wallace Fenn, Frank C. Mann, Carl J. Wiggers, and Ralph W. Gerard. Participation of the Society in publication of the Review was formally approved and a Joint Board of Management (JBM) was agreed to: Walter Meek and Chauncey Leake as representatives of the APS and Carl Schmidt and Murray Luck on behalf of Annual Reviews. Volume I appeared in 1939. After a few years of JBM direction, and a subsequent series of gradual transition, the ARP became a full-fledged member of the Annual Reviews family with its own Editorial Committee responsible to the Directors of Annual Reviews.

It was just as well. uite innocently, the two parties had fashioned a working arrangement that seemed to make sense: Annual Reviews would be the business partner, the APS would elect the Editorial Committee of the new Review, and the two parties, year by year, would share equally in any profits or any losses. But it was quite illegal: Annual Reviews Inc., in charge of operations, was thereby enabled to jeopardize the assets of its partner and might indeed run the APS into bankruptcy So said the attorneys. A new agreement provided that the two parties would divide equally any profits, but any losses

would have to be borne by Annual Reviews. Finally, at the request of the Society, the annual operating surplus, if any, ceased to be divided.

Without any special fanfare or problems the *Annual Review of Microbiology* was initiated in 1947. Until his retirement in 1972, Charles Clifton (Stanford) served as editor and Sidney Raffel (Stanford) loyally did his part as Associate Editor from 1947 to 1979.

The inception of these two new Reviews presented scheduling problems to our printers. Stanford University Press, responsible as it was for the timely appearance of the University's Bulletins, Announcements of Courses, Schedules, and many other items, indicated that the production of our Reviews on rigid and rather inflexible time schedules would no longer be possible. Hence it came about that Annual Reviews Inc. contracted with the George Banta Company in Menasha, Wisconsin, to print the *Annual Review of Physiology* from Volume I forward, the *Annual Review of Microbiology* from its beginnings in 1947, and the *Annual Review of Biochemistry* from Volume 16 forward. The cooperation of the George Banta Company was unstinted: it was more than we could reasonably expect and perhaps more than we deserved.

An ancient Chinese philosopher is alleged to have said, "Since everything is full of something it is not possible to create anything new without pressing that which already exists into an uncomfortable position." In spite of this sage warning, the Company in 1950 plunged deeply into the unknown and, with the assurance of many knowledgeable colleagues in the sciences that the four proposed Reviews would satisfy a very real need, founded the *Annual Reviews of Medicine, Physical Chemistry, Plant Physiology,* and *Psychology.*

Something should be said about our relations with Stanford University. In 1931, the University generously made office space available to us to house the editorial and business operations of the enterprise. For 25 years we continued to occupy these premises on a rent-free basis with the University assuming almost all of the costs of utilities and general maintenance. In the meantime, the University became beset with serious occupancy problems. Pressures had developed for additional space for purely academic purposes. With great understanding, forbearance, and patience the Administration permitted us to continue occupancy of the very choice space that had been granted us, until we were able to find other appropriate quarters.

In 1956 we managed to construct a suitable building in nearby Palo Alto that served us well for the next 11 years. The county government, however, eventually cast its covetous and acquisitive eyes upon the building. By exercise of the right of eminent domain, the County forced us to move. Fortunately, they gave us plenty of time to acquire another building site and to construct a new and larger building into which we moved in 1968 and which should be adequate for quite a few more years. The company is now the publisher of 24 separate Annual Review series and a number of special publications.

During these first 50 years we have witnessed a progressive fragmentation of the sciences and a loss of any possibility to integrate the bits and pieces into a comprehensible whole. Biochemistry, almost by metastasis, has penetrated many other fields of science and may never again be reassembled

into a neatly defined discipline with well-recognized boundaries. Nevertheless, the Annual Review series continue to provide a valuable overview of the important research being done in the various disciplines.

There are many who, over all these years, have helped greatly in the initiation, development, and progress of the Company. It is not possible to mention by name all who, as members of the Board of Directors, have provided the leadership from which the Company has benefitted. However, it is appropriate to record the names of those who served in the early years when problems were numerous and our corporate experience in publishing was minimal: Volume 1 of the *Annual Review of Biochemistry,* under the direction of C. L. Alsberg, D. R. Hoaglund, C. L. A. Schmidt, and J. M. Luck as an Advisory Committee, came off the press in 1932. I did the work but the other three told me what to do and all four of us joined in decision making on all major business and editorial matters. The publisher was identified as the Annual Review of Biochemistry, Ltd. Our printer was Stanford University Press. In 1935, with Volume 4, we dropped the Advisory Committee title and became an Editorial Committee with no change in functions and responsibilities. We also decided to be "Inc." instead of "Ltd." With Volume 7 in 1938, Carl Noller, Professor of Organic Chemistry at Stanford, joined the group as an Associate Editor. His assistance was invaluable but came at the expense of other duties that made heavy demands upon his time. As a result, commencing with Volume 8 in 1939, James H. C. Smith of the Carnegie Institute of Plant Biology at Stanford replaced Noller as Associate Editor and continued to give us his devoted assistance until 1946. With Volume 10 in 1941, Herman Spoehr, Director of the Carnegie Institute, joined the Editorial Committee as a fifth member. In 1940, we suffered the loss of Carl Alsberg (1877 1940), who had helped gladly and mightily in the early days of the enterprise. He was succeeded on the Editorial Committee by Herman J. Almquist of the University of California at Davis. Meanwhile, Hubert Loring, my colleague in Biochemistry at Stanford, was persuaded to join the project as a second Associate Editor, commencing with Volume 15 in 1946. In 1947, Gordon MacKinney joined us as an Associate Editor, succeeding J. H. C. Smith. In 1949, H. J. Deuel of the University of Southern California joined the Editorial Committee. By 1992, 61 volumes had been published, the latest being the largest ever (1359 pages). I shall not attempt a detailed description of the founding of the other 26 reviews. It should be sufficient to refer to another paper descriptive of the first 50 years of Annual Reviews Inc.[2]

Several of those who have been connected with Annual Reviews Inc., in some capacity or other (authorship excluded), have been involved in other activities which have been mentioned elsewhere in these reminiscences. E. R. (Jack) Hilgard, a renowned Professor of Psychology at Stanford who was

[2]Luck, J. M., "A 50- ear History of Annual Reviews Inc.," *Bioscience* 32:868 70, 1982.

President of Annual Reviews for 25 years and Chairman of the Board, was also conspicuously active in leadership in the Consumers' Cooperative Society of Palo Alto.

Windsor Cutting, Esmond Snell, Paul Boyer, George Beadle, Joshua Lederberg, James Howell, and Edward Tatum must also be mentioned. As good friends of the enterprise, they participated actively in administration and authorship. Josh is deserving of special mention: he served as Chairman of the Board of Directors for many years and because of his wide acquaintanceship and great reputation in scholarly activities has been a tower of strength to the Company.

Of course, Annual Reviews Inc. as an enterprise consists of more than telephones, typewriters, computers, and paper. It is individual people, who are to be recognized and thanked for the success that the company enjoys. First of all I suggest that the authors who write the articles contained in the volumes must be recognized as the principal recipients of our gratitude. The worldwide acceptance of the publications testifies to their indispensability to the thousands engaged in research the world over. The authors do what they do and they do it well. They receive no royalties; the company is not permitted by its Articles of Incorporation to make such payments. The authors, as a material compensation for their efforts, receive only a five-year subscription to the series and a stated number of free reprints of their review. Beyond this they receive the grateful thanks, frequently unspoken, of the many who read the reviews.

And a word about those who serve the company as production editors and as the responsible ones who run the business affairs of the company. I cannot mention them all by name but I must not ignore those who, in positions of management, must see that all concerned do their part in maintaining a smoothly running operation with a minimum of troublesome problems.

I must mention first of all John McNeil who has been with the company since February 1962 when he was appointed Business Assistant to the Managing Editor (Editor-in-Chief). In mid-1968 he left us for a period of service in the administrative offices of the University of Hawaii Medical School. He returned to Annual Reviews Inc. in October 1972 as Business Manager later promoted to Publisher and Secretary-Treasurer. He and I worked closely together from his initial appointment in 1962 until my retirement in 1967. I doubt that the company could have found anyone else who would have served Annual Reviews as loyally and competently as John McNeil.

When John's duties and responsibilities became much too burdensome for one person, even for John, a Business Manager, responsible to him, was selected. The appointee was Donald Svedeman, who, in January 1981, accepted the position. He has been with the company for over ten years. I am confident that all who know him hope that he will be with the company for many more decades.

From 1935 on I carried the title of Managing Editor until at a later, but unrecorded, date this was changed to Editor-in-Chief. For several years following my retirement the company struggled along with several different appointees who served successively as Editor-in-Chief. This proved to be a troublesome period the appointees were lacking in competence and in personal qualities necessary for the position. The Company was fortunate when, in June 1973, we persuaded William Kaufmann, who had been a senior member of the staff of W. H. Freeman and Co., to accept the position of Editor-in-Chief. In mid-1981 he resigned to pursue his many other publishing interests, but in December 1983 Bill returned to us as a consulting Editor-in-Chief. Five years later, in January 1988, he became, officially, a member of the regular staff as Editor-in-Chief. His rich experience in publishing, and his ever-widening circle of friends and acquaintances in the universities and scientific institutes of the USA and Canada have made him invaluable. Also, his knowledge of the writings of a great many authors of the present and the past is remarkably extensive. I have turned to him on many occasions when I was eager to find out who it was who said, or wrote, this or that. I trust that he will never retire from Annual Reviews and that no one else will ever be expected to "wear his shoes." May he be immortal [3]

In early August, 1992, through the generosity of Annual Reviews, I was enabled to attend the meeting of the Editorial Committee of the *Annual Review of Phytopathology* in Corvallis, Oregon. Without the help of Bill Kaufmann, who made all the arrangements, transported me to the Madison Inn in Corvallis and, two days later, back to San Mateo Drive, I would have been unable to go. He even carried my suitcase for me and, almost as a crutch, helped "Old Man Luck" in walking. I was suffering from *Trochanteric Bursitis* which has plagued me for several months and makes walking, even, prolonged standing, somewhat painful. In Corvallis it was a great pleasure to meet once again Kenneth Baker, who with James Horsfall had edited the first volume of the Review in 1963.

As manager of Marketing and Promotion, the company long enjoyed the services of Mickey Hamilton, who retired in June 1992. She had been with Annual Reviews since February 1980. The company continues to expand by a continuing increase in the number of titles under publication and other new services. Marketing and promotion are, obviously, of prime importance to the company and require the dedicated services of the appointee.

[3]Immortal or not, Bill decided to retire as Editor-in-Chief. He was succeeded in May 1992 by Dr. Robert Haynes, Distinguished Research Professor of Biology Emeritus from ork University in Ontario, Canada. His credentials are good and all of us interested in the welfare of Annual Reviews wish him well. Fortunately, for a period of at least two years, Bill will continue in the service of Annual Reviews as Managing Editor to assist his successor during the transition.

The Administrative Secretary of the company is Judith Mueller, who has been with Annual Reviews since January 1984. I have been fortunate in receiving her part-time help with these reminiscences and with many miscellaneous tasks. She is known to me and to the company as a person of outstanding competence. And withal, she is delightful as a person. I hope that she likes her position with Annual Reviews as much as we like her as a person.

THE SOCIET FOR THE PROMOTION OF SCIENCE AND SCHOLARSHIP (SPOSS)

I recall that in the early 1970s, John McNeil and I had a few discussions concerning the possible expansion of Annual Reviews Inc. to include the publication of scholarly works other than those pertaining exclusively to science. It was a time when requests were coming in to Annual Reviews from prospective authors who had completed their requirements for an advanced degree (Ph.D.) and were hoping to find a publisher who would be interested in accepting their doctorate dissertations for publication. In the 1970s the great majority of USA publishers had to anticipate the sale of several thousand copies of a publication to cover costs and produce modest profit. It was generally assumed, and with good reason, that a doctorate dissertation, unless it was of unusual quality, could not be expected to sell more than a few hundred copies mainly to libraries. In discussing the situation, which also involved Professor Peter Stansky from time to time, we felt confident that a company comparable to Annual Reviews Inc. could be set up with relatively low publishing costs and by specializing in the works of the younger authors, fresh from college, might be able to render a service which could not be given by the usual publisher for simple monetary reasons. Out of these discussions there finally emerged a nonprofit publishing company named the Society for the Promotion of Science and Scholarship.

The first Board of Trustees consisted of Eroeda S. Luck, Edward E. Luck, J. Murray Luck, Nadya L. O'Connell, and Douglas A. Leihy, all of whom felt that there was a place in the scheme of things for the new company. Annual Reviews Inc., with 30 to 40 years of experience, generously cooperated by the provision of housing for SPOSS and providing some of the essential services. The first publication of the new company, *Modern Switzerland,* enjoyed a substantial publishing subsidy from Pro Helvetia (an agency of the Swiss Federal Government) and came off the press in 1978. Subsequently, the company organized and published *Modern Austria,* with the help of a subsidy from the Austrian government. *Modern Belgium* and was financed by a complicated arrangement involving one or two Belgian banks. Eight other scholarly works have been published thus far, having nothing to do with *Modern Here or There.*

The Society is organized much like Annual Reviews Inc. in the sense that there is a Board of Directors (Trustees) which serves also as an overall editorial committee entrusted with the selection of the works to be published and the appointment of editors. As is to be expected, the Trustees are responsible for many other matters of detail and general supervision which need not be described here.

It should be mentioned that Annual Reviews Inc. is empowered by its Articles of Incorporation, as amended, to publish scholarly works other than Annual Reviews: in other words, scholarly works which serve as the bread and butter of SPOSS. Some years ago some thought was given by Annual Reviews Inc. to the possible absorption of SPOSS as a subsidiary publisher. It has been advised that this would encounter no legal difficulties, but neither the Directors of Annual Reviews Inc. nor the Trustees of SPOSS are currently interested in pursuing the matter further.

The current Board of Directors (Trustees) of SPOSS consists of the following: Peter Stansky, Peter Duignan, Milton Van Dyke, Grant Barnes, Susan Groag Bell, Gordon Craig, Edward Luck, John McNeil, Norris Pope, and Kurt Steiner. Dr Janet Gardiner is the Executive Officer. The following works have been published thus far by SPOSS: *Ancestral Houses*; *Art and Society*; *Austrian E pressionism*; *Drink and the Politics of Social Reform*; *Egon Schiele*; *From William Morris*; *History of Switzerland*; *Modern Austria*; *Modern Belgium*; *Modern Portugal*; *Modern Switzerland*; *The New Switzerland*; *One Day in Belgium*; *Pigeon Holes of Memory, The Life and Times of Dr. John Mackenzie*; *Poetics and Culture*; *Population Pressures*; *Poverty, Migration, and Settlement in the Industrial Revolution*; and *Tradition and Innovation*.[4]

REVIEWING AND ABSTRACTING IN GENERAL

Royal Society Scientific Information Conference

In the 1940s much interest concerning the processing of scientific information was evident through various conferences at the national and international levels. At these conferences on documentation, storage, and retrieval of information, it was quite the thing to point to the rising flood of science papers and bemoan the gaps in our abstracting services. Crash programs to attain a total coverage in abstracting were proposed by some. I recall also a proposal at an international conference, by an expert on snails, that we busy ourselves in abstracting papers published anywhere at any time in journals that have perished the defunct literature of science.

In 1948 a conference was held in London under the auspices of the Royal Society. There were those who apparently believed that I was somewhat of an

[4]Current listing as of Fall 1999 (Editors).

authority on the reviewing and abstracting of scientific literature. I knew otherwise but, be that as it may, I was asked to represent the National Academy of Sciences, though not a member, at this meeting, the Royal Society Scientific Information Conference, in London (June 21 to July 2, 1948).

The Conference was an outgrowth of the Royal Society Empire Scientific Conference of 1946 and the British Commonwealth Scientific Official Conference of 1946. It was called by the Royal Society for the purpose of reviewing intensively the present systems of publication of scientific literature and to consider many ancillary problems: abstracting services; classification; library services; mechanical aids in reproduction, storage, and selection of documentary material; translations; reviews and annual reports. It was to be limited to a consideration of the subjects from the point of view of use and service to the scientific community. It was to embrace all scientific subjects, including agricultural sciences, engineering sciences, and medical sciences, but excluding social sciences.

ORGANIZATION As of May 31, 1948, the number of delegates to the Conference was 152, consisting of 146 representatives from the United Kingdom and British Commonwealth, three from the United States of America, and three from UNESCO. Additional delegates appear to have been appointed as the time for the Conference drew near. Many observers were also in attendance (119 tickets issued as of May 4, 1948).

A Conference Organization Committee of 16 members held preliminary meetings on March 3, May 5, and May 31. Four sections were established to study specific problems within the scope of the Conference at large: Section I, "Publication and Distribution of Papers Reporting Original Work"; Section II, "Abstracting Services"; Section III, "Indexing and Other Library Services"; Section IV, "Reviews and Annual Reports." The work of each of the sections was planned by a steering committee and directed by a Chairman and an Editor who were, respectively: Sir Alfred Egerton and Professor J. D. Bernal for Section I; Dr. C. H. Desch and Sir David Chadwick for Section II; Mr. J. E. Cummins and Dr. J. E. Holmstrom for Section III; and Sir Edward Salisbury and Professor Munro Fox for Section IV.

The first three days (June 21 23) were given over to Plenary Sessions on the terms of reference and composition of working parties of the several sections. The 16 working parties met on June 24, 25, and 28. Plenary sessions were held on June 29, June 30, and July 1 to consider the recommendations of the working parties within the respective sections. Final sessions of the Conference were held on July 2 to approve the final form of the recommendations to the Council of the Royal Society.

CONFERENCE LITERATURE Preparatory study of the problems before the Conference was much facilitated by a wide distribution of 46 printed papers

which were available to delegates by the opening of the conference. The titles of these papers, all closely pertinent to the problems before the Conference are listed below. In addition, at least 173 mimeographed papers were prepared before and during the conference for the guidance of the working parties.

LIST OF PRINTED PAPERS

Paper No. 1: Editor's Preliminary Notes.

Paper No. 2: Provisional Scheme for Central Distribution of Scientific Publications, J. D. Bernal, F.R.S.

Paper No. 3: Indexing and Other Library Services, Notes by the Editor, J. E. Holmstrom.

Paper No. 4: Publication and Distribution of Papers Reporting Original Work.

Paper No. 5: Notes on Royal Society Publications, Sir Alfred Egerton, Sec.R.S., and Sir Edward Salisbury, Sec.R.S.

Paper No. 6: A Note on American Physical Journals, R. C. Evans.

Paper No. 7: Suggestion for a British Applied Physics Journal. Memorandum submitted by the Institute of Physics.

Paper No. 8: A List of Abstract Journals published in the British Commonwealth.

Paper No. 9: Note on Abstracts, Sir Alfred Egerton, Sec.R.S.

Paper No. 10: Discussion of measures for improving scientific information services within the Empire.

Paper No. 11: The Problem of the Optimum Format for Scientific Journals: Suggestions and Points for Further Investigation, M. D. Vernon, M.A.

Paper No. 12: A Subject Index of Scientists, K. O. Michaelis.

Paper No. 13: Memorandum from Canada, Hugh H. Saunderson.

Paper No. 14: A note on botanical periodicals, Prepared by the Royal Botanic Gardens, Kew.

Paper No. 15: The organization of British documentary activities, A. F. C. Pollard

Paper No. 16: Preliminary Survey of British and Commonwealth Journals Publishing Original Scientific Work.

Paper No. 17: Decimal Classification Mechanised by Microphotography and Keyed by a Special Alphabetical System, J. E. Holmstrom.

Paper No. 18: The Make-Up of Periodicals, The effect of format on efficiency, Prepared by the ASLIB Committee on Format.

Paper No. 19: Co-ordination of information, A survey of schemes put forward in the last fifty years, E. M. R. Ditmas.

Paper No. 20: The distribution and use of scientific and technical information, D. J. Urquhart.

Paper No. 21: Note on the Simultaneous Publication of Papers at Two Different Levels of Completeness, N. W. Pirie.

Paper No. 22: The Scientific Approach to Documentation, Jason Farradane.

Paper No. 23: The Mechanized Distribution of Information, Note Prepared by the ASLIB Committee on the Mechanized Distribution of Information.

Paper No. 24: Report on the Publication of Scientific Research in the United Kingdom, Royal Society Report issued in July 1947.

Paper No. 25: The Processing and Dissemination of Technical Information, L. R. Poole.

Paper No. 26: A proposed plan for the mobilisation of bibliographical references, A. F. C. Pollard

Paper No. 27: Divisions of Natural Science and Technology, H. J. T. Ellingham.

Paper No. 28: The Panel on Technical Information Services of the Committee on Industrial Productivity, D. J. Urquhart, Joint Secretary.

Paper No. 29: A Note on Scientific Journals, Sir Alfred Egerton, Sec.R.S.

Paper No. 30: The Methods of Reproduction of Scientific Papers, J. A. S. Morrison.

Paper No. 31: The Colonial view-point with special reference to East Africa, Note by E. B. Worthington.

Paper No. 32: Note on the Presentation of Research Results in Departmental Annual Reports, A. G. G. Hill.

Paper No. 33: A Classification of Classifications, J. E. Holmstrom.

Paper No. 34: Memorandum on Section I dealing with the central distribution of scientific publications.

Paper No. 35: Notes on Papers 34, 37, and 39, J. D. Bernal, F.R.S.

Paper No. 36: The Organization of the Distribution of Scientific and Technical Information, D. J. Urquhart.

Paper No. 37: Comments on the Preliminary Notes, C. F. A. Pantin, F.R.S.

Paper No. 38: The Length of Scientific Papers, D. R. Read.

Paper No. 39: Comments from various sources on the proposals in Section I of the Editors' Notes and on Paper 2.

Paper No. 40: Microfilms and Copyright, Bristows, Cooke Carpmael.

Paper No. 41: Additional Notes on Reviews and Annual Reports.

Paper No. 42: Scientific Documentation, J. Wyart.

Paper No. 43: Scientific and Technical Periodicals Published in Canada.

Paper No. 44: Metallurgical Abstracts, Hume-Rothery, F.R.S.

Paper No. 45: Summary of Information Supplied by Certain Abstracting Agencies, Sir David Chadwick.

Paper No. 46: Preliminary Analysis of Pilot uestionnaire on the Use of Scientific Literature, J. D. Bernal, F.R.S.

E HIBITIONS An interesting exhibition devoted to Scientific Journals, Abstracts, and Reviews; to Printing and Methods of Reproduction; to Classification, Mechanical Indexing, and Sorting; and to Microphotography and Microfilm Readers was arranged in Burlington House for the duration of the Conference. The subjects of the various exhibits are as follows.

E HIBITS

1. VARIATIONS IN PERIODICALS REPORTING ORIGINAL WORK.
2. T PES OF ABSTRACTS AND FORMS OF ISSUE.
   (a) Periodical collections in journal form.
   (b) Bound Volumes, the abstracts arranged in order of subject, usually alphabetically.
   (c) Printed on one side of paper only and prepared for cutting up and mounting on cards.
   (d) Printed on index cards for filing in cabinet.
3. REVIEWS IN SCIENCE.
   (a) Reviews for the specialist in his own field.
   (b) Descriptions enabling a specialist to keep up to date in fields adjacent to his own
   (c) Reviews for general reading by scientists.
4. LETTERPRESS COMPOSITION.
5. PRINTING AND BINDING.
6. SEPARATES.
7. STEREOT PE AND COLOUR PRINTING.
8. LITHOGRAPH .
9. DUPLICATING PROCESSES FOR THE PRODUCTION OF SCIENTIFIC REPORTS.
   (a) The stencil process.
   (b) The lithographic process.
   (c) The “Ormig” process.
   (d) Photostatic processes.
10. VARIT PER T PEWRITERS.
11. RETOCEE DOCUMENT COP ING E UIPMENT.
12. THE COMPILATION OF COMPENDIA.

13. THE ARRANGEMENT OF COMPENDIUM DATA.
14. CHEMICAL DATA ON NOTCHED CARDS.
15. UNIVERSAL DECIMAL CLASSIFICATION (UDC).
16. KAISER INDE .
17. A PUNCHED CARD CODING S STEM UNDER TRIAL.
18. A DEVELOPMENT OF PUNCHED CARD TECHNI UE.
19. AUTOMATIC SELECTION B MEANS OF HOLLERITH PUNCHED CARDS.
20. UDC MECHANIZED B MICROPHOTOGRAPH .
21. A CINESTAT PHOTOMATIC TABULATOR.
22. MICROFILMS AND MICROFILM READERS.

GENERAL OBSERVATIONS The problems before the Conference were very ably considered within the working parties. Joint sessions of working parties were held on topics of common interest. Recommendations of the working parties tended to be more courageous and venturesome than those of the Sections. The recommendations of the Sections, in turn, were in many instances severely amended, if not even enfeebled, when acted upon by the entire conference. This, however, is fully understandable; the Conference was empowered only to recommend to the Council of the Royal Society and the Royal Society, in turn, could only be expected to pass on its considered recommendations to learned societies, publishing bodies, agencies of the Government, etc. At the same time the working parties were instructed to consider the problems before them "only from the point of view of use and service to the scientific community" and could not be expected to modify their own studies by any assumptions of conservatism, temerity, or respect for tradition by the Conference at large.

Many of the items before the Conference were treated as Commonwealth problems. Or, in some cases, in the search for an immediate solution, the recommendations were directed toward Government or other institutions within the United Kingdom and the Commonwealth. The proposal of Professor Bernal that a centralized system be established for the publication of original work as separates and for the distribution of these separates through block orders to subscribing members was withdrawn by Professor Bernal early in the Conference. The recommendations of the Conference were many: the following may be considered as a summary only and represents the exercise of much discrimination on the part of the writer; it is not to be regarded as a complete synopsis of the Conference document.

RECOMMENDATIONS OF THE CONFERENCE The Conference made the following recommendations:

1. Ways and means of improving the quality of papers and of reducing delays in publication to be sought.

2. The publications of candidates for professional appointments and awards to be evaluated only on the basis of their intrinsic merit and not on their number or length.
3. Greater uniformity and standardization in the format and make-up of scientific periodicals, especially in page size, to be sought.
4. The value of precise journals (summaries of original papers, of about one-tenth the length of the original) to be investigated.
5. Extension of more adequate assistance to editors to be sought.
6. Payment by authors of publication costs to be discouraged.
7. Consultative committees of editors to be set up and a more rational grouping of papers within existing scientific periodicals to be sought.
8. Facilities for the collection and distribution of separates to be explored.
9. In journals, the commencement of each paper on the right-hand page to be recommended for adoption as a standard practice.
10. Enlargement and increased support by Government of central scientific library and information services to be encouraged.
11. Greater cooperation between libraries to be sought:
    (a) to minimize any undesirable duplication in services.
    (b) To render increasingly accessible the world's literature in science.
12. Expansion of information and bibliographic services to be sought in order to render increasing assistance to research workers.
13. A permanent liaison to be set up between printing organizations and the publication committees of learned societies.
14. More detailed abstracts of papers in foreign languages to be prepared.
15. Abstracting agencies to be asked to indicate the language of an original article and of summaries thereof, and to give the address of the author where it is practicable to do so.
16. Titles of articles when abbreviated, to be abbreviated in accordance with the rules of the World List of Scientific Periodicals.
17. The subject indexes of abstract journals to be improved.
18. The preparation of abstracts to be facilitated by procurement, whenever practicable, of advance copies of papers as preprints, page proofs, etc.
19. Regional lists of papers in journals published in the Dominions and Colonies to be issued from time to time to facilitate exchange of information within the Commonwealth. Regional abstracting, as an outgrowth of the issuance of such lists, to be facilitated.
20. The issuance of pre-publication lists of papers accepted for publication to be encouraged; so also lists of new and forthcoming books, theses, and government publications.
21. The organization of a Standing Consultative Committee of abstracting agencies to be considered this Committee to arrange for continuing

cooperation between the abstracting agencies, to promote increased collaboration, and to encourage further rationalization of their services, specifically in systems of bibliographical citation, in systems of indexing, in increasing the coverage of original papers, and in maintenance of a panel of abstracters with special linguistic knowledge.

22. Appropriate steps to be taken to improve the quality of authors' summaries with the possibility in mind of their eventual use as abstracts.

23. Extension of the UDC, despite its manifest limitations, to be encouraged.

24. The organization of a Standing Committee on Subject Classification in Science, provided with a permanent staff, to be sought.

25. Improved processes for the interconversion of cumulative card indexes and non-cumulative volume bound indexes to be sought.

26. Systems of alphabetical indexing to be further studied and improved.

27. Unit catalogue cards to be issued by the publishers of all British scientific and technological books.

28. Encouragement to be given to the further development of reflex, dry process, diazo printing.

29. Specific techniques and processes in photography and printing, known to be of great potential value, to be submitted to scientists for their consideration.

30. Special attention to be drawn to the values and respective limitations of diazo printing, silver salt photography, photo-offset, and letterpress printing.

31. The values and limitations in reproduction of books and manuscripts in microflats or in continuous strips of microfilm to be considered by the British Standards Institution.

32. Recognition to be given to the potential value of ultramicrophotography in scientific information services although specific applications are not presently in evidence.

33. The British National Committee on Documentation to be invited to set up an Advisory Committee on Documentary Reproduction.

34. The restrictions imposed by copyright laws on the free flow of scientific information to be brought to the attention of publishing bodies in the hope that difficulties now extant in the making of single copies of extracts from books and periodicals may be removed.

35. A full-scale experiment on mechanical methods of indexing and selection to be brought to the attention of the Panel on Technical Information Services, Committee on Industrial Productivity, for possible initiation.

36. The work of the ASLIB Committee on Mechanized Distribution of Information to be encouraged.

37. The various systems proposed for chemical notation to be brought to the attention of the National Committee for Chemistry of the Royal Society and the Chemical Council for exhaustive study.

38. Improvement in the training, qualifications, and status of special librarians and information officers to be sought.

39. Training of undergraduate and graduate students in library services, principles of classification of knowledge, indexing and the use of abstracts, bibliographies, and reference books to be encouraged.

40. The preparation of Directories to Information Services to be encouraged.

41. Special grants to be recommended for completion of the ASLIB Directory of Specialized Information and the D.S.I.R. Directory.

42. Early publication of the new edition, World List of Scientific Periodicals, to be sought.

43. Universal adoption of the World List system of abbreviations to be sought and a continuing scheme for extension of the system to new publications to be worked out.

44. The preparation of a subject index of the research activities and specialized knowledge of individual scientists to be arranged along the lines of a similar American index.

45. The preparation and continued maintenance of scientific compendia in all fields of science and the indexing of all new data of science to be encouraged.

46. Increased publicity to be given to the ASLIB Register of Translators and the Register to be extended as much as possible.

47. Recognition to be given to the need of dual qualifications by translators in both languages and science.

48. The preparation of a Central Location Index of Translations to be encouraged.

49. Modification of the Berne Convention and amendment of the copyright law to be sought in order to make such translations readily available on demand.

50. An inquiry into the need for improved special dictionaries to be encouraged.

51. Extension of the ASLIB Register of Special Translators to include those specially qualified as interpreters to be recommended.

52. The value of critical and constructive reviews written by leading specialists in particular fields to be recognized and the preparation of such reviews to be regarded as an important ancillary to the pursuit of new knowledge.

53. The importance of reviews written by specialists for workers in other fields of science to be recognized.

54. Encouragement to be given to the production of annual reviews, progress reports, and books on recent advances which cover limited fields in a comprehensive but critical manner.

55. The publication in full of important review lectures to be encouraged and their distribution to the chief centers throughout the Commonwealth to be facilitated.

56. The importance of providing reviews in the applied sciences to be brought to the attention of the relevant societies, institutions, and Government organizations.

57. Societies planning new series of reviews to be encouraged to advise sister societies and institutions of their intentions.

In 1948, the Royal Society published a volume of 723 pages descriptive in great detail of all aspects of the Conference. The book is entitled *The Royal Society Scientific Information Conference, June July Report and Papers Submitted* (London, the Royal Society, Burlington House, 1948). As a representative of the National Academy of Sciences, I was enabled to present a brief paper pertaining to reviews in a program in which L. Lord, T. M. Colebrook, A. L. Bacharach, J. D. Bernal, and T. A. Vahidy were the other participants (see pp. 98 100 of the volume).

International Conference on Scientific Abstracting

The Royal Society Scientific Information Conference was followed in 1949 by an International Conference on Scientific Abstracting convened in Paris in June under the auspices of UNESCO. Along with two others I again represented the Academy. My report of the proceedings was as follows.

> UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
> International Conference on Scientific Abstracting
>
> Summary Record of the First Meeting held at Unesco House, 19 Avenue Kleber, Paris 16e, on Monday, 20 June 1949, at 10:30 a.m.
> President: Professor Pierre AUGER, (later) Dr. Alexander KING (United Kingdom)
>
> Secretary: Mr. J. B. REID, Department of Natural Sciences, UNESCO.
>
> The PRESIDENT welcomed the members of the Conference, on behalf of the Director-General, who was prevented from being present. He said that the present meeting was part of a long-term effort to adapt the methods of publishing, tabulating, and analysing scientific work to the present situation, which was yearly becoming more difficult. The progress of science and technology was so rapid that the wealth of different documents and publications

which it created threatened to paralyze documentation itself. At present, more than 50,000 scientific or technical periodicals, containing between one and two million articles, were published. While all these articles did not always describe original results of importance, they were all written in pursuit of a definite ideal, namely that of being of use to the scientific and technical world; and in order for this immense amount of scientific literature to achieve its purpose, the expert must be aware of the articles and reviews dealing with subjects of interest to him. He must know where to find them and, before reading them, must also know whether they in fact contained matter of value to him. At the present stage of development, it would be intolerable that important contributions to scientific knowledge in general should be lost or forgotten for decades, as was the case with Mendel's discoveries on heredity.

One of the most important vehicles for this purpose was the abstracting services and papers an essential link in the chain connecting the laboratory, where the work was done, with the office (often very far away) of the person closely concerned with the results of the work. Abstracts were, therefore, a very effective means of disseminating scientific and technical knowledge, and thus of reaching establishments or research workers in parts of the world where the development of science had been retarded; they helped to eliminate the danger of that excessive specialization which always lay in wait for the modern scientist, by placing before him, in a digestible form, the important results obtained in fields other than his own. In this way the non-specialist and technician in a word, the man who wished to acquire the requisite knowledge would find, in abstracts, a valuable means of doing so.

The importance of this problem was well realized at the First Session of the General Conference of UNESCO in 1946, which issued instructions to the Secretariat to prepare for a World Congress that should deal with the rationalization of scientific publications and abstracts. The Second Conference defined these instructions more precisely and enjoined upon the Director-General to convoke, in 1948, an expert committee on scientific abstracting, with a view to preparing the ground for a General Conference on that subject. The Expert Committee met at UNESCO House in April 1948. It comprised nine experts from six different countries. As a result of their recommendations, the Secretariat took certain steps which culminated in the present Conference; an expert was entrusted with the task of preparing a report on the present state of the abstracting question; this report was supplemented by an enquiry, carried out by the International Federation of Documentation; and the report, with the results of the enquiry, is now submitted to the Conference.

The President said that, without wishing in any way to prejudice the discussions and decisions of the Conference, he thought that one of the subjects to be dealt with should be the place assigned to abstracts among the other bibliographical services linking the original publication with its eventual reader. The relationships between libraries, bibliographical index cards, annual reviews, title indexes, various forms of classification and the abstracts themselves should be the subject of detailed consideration.

The present Conference should discuss the actual technique of the preparation and publication of these abstracts, the problems arising as regarded the language question, and finally, the work to be carried out in the interests of uniformity and rationalization.

The President reminded the meeting that in this field, as in all others, they must not hesitate to adopt modern standards, so as to make the work more effective and less expensive, and that new methods of publishing, reproducing and classifying documents were continually making their appearance.

A Co-ordinating Committee on Medical and Biological Abstracting had met several times in recent years, and more recently at the beginning of the present month. Its pioneer work might well assist the discussions, especially by reason of the report which Mrs. Cunningham, a member of that Committee, would be presenting to the Conference.

The President concluded by expressing the hope that the discussions would produce at least the elements of a solution to the very serious problem with which the Conference had to deal. Its proceedings would possibly result in the setting up of specialized committees (similar to the committees for the biological and medical sciences) which might cover the fields of pure and applied physics, chemistry, agriculture, mathematics and related sciences. It would be for such committees to continue the work begun at the present Conference, which could not be really satisfactorily completed at a single session. They could meet in plenary session at fairly lengthy intervals, a small executive committee being responsible for continuing the work between the plenary sessions. UNESCO, for its part, would do all in its power to supply material assistance and to see that the resolutions of the Conference were, so far as possible, carried out.

Whatever the form with which the Conference would wish to invest an organization that should be sufficiently permanent to guide the Secretariat in its completion of its difficult tasks, the President assured the meeting that UNESCO would support that organization and make the best use of its services and opinions. He concluded by wishing the delegates the best of success in their work.

A SUMMAR OF SOME OF THE CONCLUSIONS OF THE CONFERENCE

Establishment and Report of the Credentials Committee

The PRESIDENT proposed the following names:

Professor von Muralt (Switzerland)
M. Julien Cain (France)
Mr. Bhagwantan (India)
Dr. El Diwany (Egypt)
Professor Solberg (Norway)

This proposal was adopted.

The members of the Credentials Committee withdrew to prepare their report.

(The meeting was adjourned at 11:15 a.m. and resumed at 11:45 a.m.)

Professor von MURALT (Chairman of the Credentials Committee) presented the Committee's report. The list of participants given in document UNESCO NS SAC 10 was correct except for the following points:

1. Denmark had an additional delegate (M. H. Lemcke);

2. The United States of America had six additional observers or advisers;

3. France had three additional technical advisers (MM. Kersaint and Roger, and Mme. Briet);

4. Sweden had an additional delegate (M. Erwin Engel);

5. The representative of the International Federation of Documentation was M. Lorphevre, replacing M. F. Donker Duyvis;

6. The World Federation of Scientific Workers was represented by Professor J. D. Bernal;

7. Dr. A. Danjon would be observer (not acting delegate) on behalf of the International Astronomical Union;

8. Dr. P. Groen would be observer (not acting delegate) on behalf of the International Union of Geodesy and Geophysics;

9. Dr. V. Le Lorier and Mlle. M. Troue would continue to be acting delegates of the International Union against Cancer;

10. Out of the eight observers from the International Union of Pure and Applied Physics, it was suggested that those concerned should appoint two or three acting delegates.

11. Two delegates were representing a State and an international organization at the same time. It was proposed that they should have one vote as representing a State, and one vote as representing an international organization.

Professor SEVERI said that Professor Domenico Marotta had been detained at Rome by the WHO Conference.

The report of the Credentials Committee was adopted.

Adoption of the Agenda

Professor BERNAL asked that Item 8 of the Agenda should provide for the establishment of a fifth Committee to consider suggestions for the setting up of a permanent organization to continue the work of the present Conference, in the manner suggested by Professor Auger. Such a Committee, consisting of not more than eight persons, would present its conclusions to the plenary meeting on Friday. Professor Bernal then suggested the names of certain persons who might sit on this Committee: Dr. L. H. Lampitt (United Kingdom); Professor Wyart (France); Professor M. W. Woerdeman (Netherlands); Mr. J. E. Cummins (Australia); Mr. H. H. Goldsmith (United Nations); Professor von Muralt (Switzerland); Mr. Verner W. Clapp (United States of America). It was agreed in principle, without opposition, to set up such a Committee.

M. LORPHEVRE reminded the meeting that certain organizations which had taken part in the work preparatory to the present Conference (the International Organization for Standardization, the International Federation of Documentation, and the International Federation of Library Associations) could usefully be members of the fifth Committee, whose establishment had just been agreed to in principle.

The PRESIDENT thought it would be better to await the consideration of Item 8 of the Agenda before specifying who were to be members of the fifth Committee.

It was decided accordingly.

Mr. J. B. REID said that it might be well to add to the Agenda an Item 7(a): Consideration of the Resolutions and Recommendations adopted by the Interim Co-ordinating Committee on Medical and Biological Abstracting at its Second Session, held from 1 to 4 June 1949. Moreover, the excellent work that had been done by that Interim Co-ordinating Committee appeared to render superfluous the Biology and Medicine Committee referred to under Item 10 of the Agenda; it might therefore be suppressed.

Professor LEIPER proposed that the eighth Committee should be called "Agriculture and Applied Biology."

With the amendments suggested by Mr. Reid and Mr. Leiper, the Provisional Agenda was adopted.

Adoption of the Rules of Procedure of the Conference

Professor SEVERI drew attention to the danger inherent in the application of Rule 2 together with Rules 30 and 31; the members actually voting might be a very small minority of those present. In order to lend sufficient authority to any decision taken, could not the President be given discretion, when he thought there had been too many abstentions, to defer the final decision to a later meeting

The PRESIDENT thought the matter was a very delicate one. The formula suggested members present and voting was that adopted, for instance, by the General Conference of UNESCO, and was the only one which did not admit any obscurity of interpretation. If the meeting wished, there might be an additional provision in the Rules of Procedure (or it might simply be tacitly agreed) that, if those voting represented only a small fraction of those present, the President might regard the vote as meaningless and defer it to a later meeting, which would enable those who had abstained to obtain the further information they required and so vote with a full knowledge of the facts. Under this procedure, the second vote would be valid, whatever the number of persons voting.

Professor ZEREGA-GOMBONA seconded the amendment proposed by Professor Severi.

Dr. El DIWAN said he preferred the original text. A conference could necessarily last only a short time, and the proceedings might be unduly prolonged if they had to wait until there was a sufficient number of actual voters.

Dr. CRANE said he would be opposed to the amendment suggested by Professor Severi, unless the latter suggested a definite figure (1 4 or 1 3 of those present), which would avoid all recrimination or challenging of the President's decision.

The amendment proposed by Professor Severi was rejected by 20 votes to 8. Professor ZEREGA-FOMBONA pointed out that Rule 29 provided for one vote per delegate. The practice of the United Nations and UNESCO required that there should be one vote per delegation.

At the request of M. Julien CAIN, the PRESIDENT read out circular letter CL 131, which referred to Rule 29 of the Rules of Procedure.

Dr. LAMPITT represented that Rule 29 should remain unchanged, as it was quite by chance that delegates were asked to represent States; in actual fact they represented science, and should therefore vote as individuals.

As Professor Zerega-Fombona's proposal was not seconded, it could not be put to the vote.

The whole of the Rules of Procedure was adopted without amendment.

Election of the President, Vice-Presidents, and General Committee of the Conference
For the presidency, Dr. CRANE, seconded by M. Julien CAIN, proposed the name of Dr. Alexander King, who had presided so tactfully and efficiently over the Expert Committee whose work had led to the present Conference.

Dr. Alexander King was elected unanimously and took his place in the presidential chair.

For the two posts of Vice-President, Mr. CAIRNS proposed the name of Mr. Clapp (United States of America), and M. von MURALT that of Professor Lindblad (Sweden). Mr. CLAPP proposed the name of Professor von Muralt (Switzerland) and Dr. El DIWAN that of M. Julien Cain (France).

M. Julien CAIN having declined to stand, the PRESIDENT took a vote.

Results: Professor Bortil Lindblad: 36 votes (elected); Mr. Vernor W. Clapp: 29 votes (elected); Professor von Muralt: 15 votes.

For the four members of the General Committee of the Conference, the PRESIDENT proposed the name of Professor von Muralt (Switzerland), and Professor BERNAL that of Professor Wyart (France). Dr. LUCK proposed the name of Mr. J. E. Cummins (Australia) and Dr. El DIWAN that of Dr. S. Bhagwantan (India).

These four persons were elected.

(The meeting closed at 12:45 p.m.)

Senator Humphrey's Proposal

In 1960 Dr. Keith Cannan (Chairman of the Division of Medical Sciences at the National Academy of Sciences, National Research Council) invited me to join with Maurice Visscher, William Bean, Chauncey Leake, and Wallace Fenn to participate in a meeting held in Washington, D.C. in November 1961 to discuss the problem of information services. My own concern in this matter

stemmed from a proposal by Senator Hubert Humphrey, Chairman of a subcommittee on Reorganization and International Organizations, US Senate Committee on Government Operations.

Hubert Humphrey, in 1961, as Chairman of a Senatorial subcommittee concerned with government operations, reported that an estimated 160,000 projects in research and development in the United States cost about 12 billion, of which the Federal Government's share approximated 8.1 billion. He stated that the various agency information systems were a "hodge-podge"…"overlapping, underplanned, undernourished and under-used."

His subcommittee had recommended a total view of the information program, commencing with the very conception of a project. Publication of the ideas and research plans of scientists prior to initiation of a contemplated investigation would be a beginning. Negative results from projects that turned sour should be published. Papers delivered orally at scientific meetings should be drawn within the compass of the overall government-managed information service the argument, among others, being that "if they had not been registered, abstracted, and indexed on a prepublication basis, they may disappear: except within the circle which will have heard the oral presentation." Also to be included would be the squeezings from progress reports and from projects cancelled without reaching formal publication; …"unless this is done, the chances are 'pretty high' that in later years scientists may needlessly and unwittingly repeat the earlier work of cancelled projects."

I was horrified by the recommendations, which would generate, if implemented, a flood of information of dubious value and at an outrageous cost. Having little trust in the ability of government to manage anything, and believing that government should do nothing for people that people can do for themselves, I made a very negative contribution to the conference, as will be concluded from my letter to Senator Humphrey, reproduced here. Additional comments on the problem are set forth in a letter from Dr. Cannan following the Humphrey letter.

December 6, 1961
Senator Hubert H. Humphrey
United States Senate Committee on Government Operations
Room 162, Old Senate Building
Washington, D.C.

Dear Senator Humphrey:

I have read, with a good deal of interest and some concern, one of the most recent publications of your Committee, namely, that issued on September 20, 1961, as a report on the information problem as it applies to the electronics industries. My interest in these problems stems from the fact that for many years I have been Editor-in-Chief of Annual Reviews Inc., and in 1948 and 1949 participated in the Royal Society Scientific Information Confer-

ence and the International Conference on Scientific Abstracting, respectively. For a number of years, I was also close to the *Journal of Biological Chemistry,* partly as a member of the Council, a member of the Editorial Committee of the Society, and its President in 1956 1957. I have also had an opportunity to view certain aspects of the problem of dissemination of information through membership on various fund-raising agencies (US Public Health Service, American Cancer Society, etc.)

1. our proposal to expand the services rendered by the present Science Information Exchange of the Smithsonian Institution, such that the fund-granting agencies will have access to the 200-word summaries of research and development projects submitted for support by government agencies, seems to me to be deserving of support. It is extremely helpful at the administrative level to be acquainted fully with the research and development projects which it is proposed will be carried on throughout the sciences and throughout the country. It is very helpful in the allocation of funds to be informed adequately of the various centers in which research is being pursued or about to be pursued on a stated subject and, likewise, to know the resources, magnitude, and diversity of support being received by stated individuals, agencies, institutes, etc.

2. My own considered judgment is that the working scientist should be provided with efficient services, sufficient in depth and in breadth, to cover at the primary and secondary levels of publication the particular aspects of science in which his researches are centered. This coverage should be worldwide and should include the papers and reports that originate within any and all countries and, in their coverage, should rise above such unessential information as the sources of financial support, the agency under whose auspices the work was done, and whether it was governmental or non-governmental. While this coverage should be complete and thorough, and as such would probably present the scientist with even more than he can encompass, he should be spared the labor of having to evaluate a great deal of information of dubious value that would come to him if there were to be a broad dissemination of information at the prepublication level. It would, I believe, be most unfortunate to draw into the general information mill for processing, evaluation, and dissemination the enormous amount of material that presumably could be extracted from progress reports, from reports on projects that were terminated or cancelled without reaching the publication stage, or from the papers given at many conferences, symposia, and meetings of professional societies. Much of this information proves, in the course of time, to be very rich in errors, quite misleading in content, and frequently devoid of value. In fact, I would suggest most respectfully that while one can appreciate to the full the desire of your Committee to achieve economy and efficiency in government operations, I feel certain that the solution proposed in your report of September 20 will defeat the very laudable end which you seek to achieve. In short, the false and erroneous “leads” which will emerge from information dissemination at the prepublication level will lead to wasted efforts far more costly than that which now arises from the unwitting and needless duplication of effort which has been brought to the attention of your Committee. May I repeat, that while I agree fully with your proposal to broaden the services of the Science Information Exchange, I can agree with it only insofar as

the distribution of the summaries mentioned is very carefully restricted to management only. The working scientist and engineer should, I believe, be spared all of this material as well as anything else that originates at the prepublication level. As far as he is concerned, I would suggest that your approach to the problem should be to improve, insofar as it is realistically feasible, the distribution to him of information already published that is pertinent to his research.

3. I realize fully that your report is intended to be applicable only to research pursued by tax-supported agencies, but with supplementary information drawn in from nongovernmental sources. I realize also that it is intended to cover only applied research, that is to say, research and development, testing, and evaluation. I sincerely trust that if the government should move in the directions outlined in your report that the greatest care will be exercised not to expand the compass of the information problem by drawing in the basic sciences as well. To the pure scientist, the problem in some respects is more difficult than it is to those engaged in research and development. I am sure that if my colleagues in the basic sciences were asked to contribute to the information mill the contents of progress reports and the ideas that come to them in the course of their work, and which, in turn, are expressed in all sorts of formal and informal ways, his cooperation would be very difficult to gain. By the same token, he should certainly be spared the anguish of having the published papers that now come to his attention diluted by a much greater volume of unbaked information that would come from many sources at the prepublication level.

As a final point, I sincerely trust that in your studies you are seeking the collaboration of the professional societies in science and engineering. These societies can be effectively reached through the intermediation of the National Academy National Research Council. The professional societies are, I believe, far closer than many government agencies to our scientists and engineers in all of the matters that pertain to the problems under discussion. I hope that you will explore to the full the possibility of cooperating with and seeking advice from our professional societies in the very important studies that your Committee is pursuing in the dissemination of science information.

ours very sincerely,
J. Murray Luck

8 December 1961

Dr. J. Murray Luck
Annual Reviews Inc.
231 Grant Avenue
Palo Alto, California

Dear Murray:

Thanks for your letter.

ou certainly did not let us down with your remarks at the recent meeting of the Division. The subject which you presented so cogently is one that

has exercised me a good deal. Several of us in Washington have attempted to persuade Julius Cahn (Senator Humphrey's indefatigable right-hand man) that his pet project of the dissemination of prepublication information will sit ill with the scientist and will not contribute to the orderly progress of knowledge. It is purely an administrative instrument and should be designed and limited to this purpose. The trouble is that the management and legal boys feel that scientists, though they may be intellectual giants, are no good at the management of their own affairs and must be shown what "efficiency" is. These people are good friends of science. They wish to help but have only management practice to offer.

We did appreciate the thought and time you gave to coming to our meeting and stimulating thought. Discussion at the time was disappointing but delayed reactions of interest are beginning to come in by mail.

Seasonal Greetings.

Sincerely yours,
R. Keith Cannan
Chairman of Division

Council of Biology Editors Conference

In May 1980 a Council of Biology Editors held a conference in San Francisco to permit and encourage the participants to describe from their experience in publication anything that might be of interest to their fellow editors in attendance. I was asked to participate, presumably to discuss matters of interest regarding the *Annual Review of Biochemistry.* My contribution to the conference follows.

Council of Biology Editors

San Francisco, May 20, 1980

Mr. Chairman and other gentle persons,

Were I to confine my remarks to the publications of Annual Reviews Inc., and more specifically, the *Annual Review of Biochemistry,* I would probably be attempting that which our chairman expects of me. But since I am inclined towards disorder and scrambled thoughts, please forgive me if I ramble along without strict adherence to the assigned topics of "Reviews."

The *Annual Review of Biochemistry* was conceived some 50 years ago with the first volume of the series appearing in July 1932. It was 724 pages in length and sold for 5 a copy a price which, incidentally, was maintained for the next 16 years when, trying to recover from World War II, we increased prices of the three series then being published to 6 per copy.

I remember well that other Reviews in the early 1930s were doing their bit to relieve the agonies of those in the biomedical sciences who were trying valiantly to keep up with a distressing expansion in the original literature. The *Ergebnisse der Physiologie* had been around for years. The *Annual Reports of the Chemical Society* were excellent and the 30 or 40 pages given to biochemistry were competently done but too much was omitted.

I came to Stanford in 1926, and as a brash young fellow who was unaware of his inadequacies, I tried to give a course a seminar sort of thing to a dozen or so graduate students in the department who were presumed to thirst after the last word in the state of biochemical research. I was soon in trouble up to my eyebrows because, of the 20 or 30 subject areas into which biochemistry could be logically divided, there were only two or three wherein I felt at ease before these eager-beaver graduates. I could find only a shadow of consolation in the suspicion that other brash young fellows, and even many oldsters, including a sprinkling of Olympians, were suffering similar agonies for the same reason. Which proved to be the case. Out of this emerged the *Annual Review of Biochemistry* as a cooperative effort on the part of biochemists with different areas of expertise, to pool their knowledge. Apparently it satisfied a need, for the ARB caught on and has managed to survive for almost 50 years. By 1981 over 1,900 biochemists will have done their bit as authors of the first 50 volumes.

What constitutes a good review ou will agree, I hope, that it must be well written, clear, unambiguous, free of dangling particples, of split infinitives, and of long strings of adjectives all trying desperately to qualify each other as well as the noun at the end of this long freight-train construction. As a personal opinion, I would prefer that the review be critically written by a courageous author who would evaluate the subject matter and in so doing would sift out the pearls of wisdom and omit the mediocre and the vast amount of dribble and superficial stuff that manages somehow or other to get published. Of course, it would be biased, opinionated, and colored by the whims, the prejudices, and the selection criteria of the author. Hopefully, his successor would be cast from a different mold and would undo any damage that may have been done before he in turn inflicted his own unique kind of damage.

A bad review, in my opinion, is not only badly written but is one in which the author attempts to be fully comprehensive. He ends up by grinding out a catalogue or a mere listing of every paper that comes to his attention. Each will have his checkmark in *Chemical Abstracts* and his toiling secretary will provide him regularly with stacks of cards each being a copy of an abstract from something or other. The final result is a mere catalogue, not a review. I have seen many such horrors, for example, 10 pages of text and 20 pages of bibliographic references (700 or so in number). Imagine if you will a chapter on renal physiology in which the author endeavors to cite every paper on the kidney published in the past year or biennium. And, of course, there is all too frequently a travesty, for example, Brown did this, White did that, Black did this, and so on for many sentences without even an occasional change in verb or sentence structure.

I must show you something of an ancient vintage which defines good writing. I selected it from the reviews appearing in a 17th century volume entitled *Weekly Memorials for the Ingenious etc.* I used it in the preface I wrote for Volume 24 of the *Annual Review of Biochemistry.* Note the language, beautiful in the richness of vocabulary, and enviable in its precision.

> "He thinks the world cloy'd with many trivial and useless writers, but gives this as a rule: If men would take care that ill Books be not

written, and that good Books be not ill written; but that in their composing a due regard be always had of *Prudence, Solidity, Perspicuity,* and *Brevity* there would be no cause left for us to complain of the too great number of Books.

Prudence chiefly consists in this, that a man never apply himself too rashly or inconsiderately to write, but that he first learn and well imbibe what he purposes to teach others….

So he says men should be no less studious of *Solidity* (he means in Subjects that will bear it, not in things written more for the diversion of the Mind than for correctness) that is, men must take care that what they write be not weak, frivolous, doubtful, carrying little shews of truth; but things that are true indeed, firm, and beyond all exception; and so fortified and confirmed with stress of Argument, that they manifestly shew labour, and readily force the assent of *Readers.* Not that this *Solidity* can be everywhere observed alike, it being above the infirmity of man so to do; but men should be very wary not to flatter themselves so far, as to think that others are bound to believe their bare say-so's.

He requires also such *Perspicuity,* that he would have the *Book* which is made publick to be the Looking-glass of the Author's mind; clearly presenting the sence of what is written to the *Reader.* As for Authors who use an affected obscurity in their Writings, as though they desired not to be understood, he thinks they might gratifie their own humour and the World much better by being silent.

Lastly, he will not have a man so far indulge *Perspicuity,* as to neglect a due *Brevity*; For as *Obscurity* makes a Book useless, so if drawn out in *Length,* it becomes tedious…."

I wrote many prefaces during the years from 1932 to 1969 and in the one for Volume 25, written with tongue-in-cheek, on April 1, 1955, I expanded upon a *Saturday Review* article. It concerned Kohmar Pehriad (544 493 B.C.), who invented the comma and the small round dot; his son, Apos Trophe, who invented the you-now-what; a second son, Colon, who did his bit; and the half-brother who added the Semicolon. I then tried a paragraph without any punctuation following Don Marquis who did such challenging unpunctuated things about Mehitabel the Cat and Archie the Cockroach. Just think of how the labors of writers and editors would be lightened if we could cease to be enslaved by punctuation. But I have discovered that at least the comma must be saved from destruction. When James W. McBain, the Lord Leverhulme Professor of Chemistry at the University of Bristol, was appointed to a professorship at Stanford, the announcement in the official publication described him as James W. McBain, Lord Leverhulme, Professor of Chemistry at the University of Bristol. Think of the mischief perpetrated by a single comma erroneously inserted after Leverhulme.

Then there are the good and bad uses to which reviews are put. The good news is that in the sciences they are practically indispensable. The number of papers appearing in one year, in some sciences, staggers the imagination. In 1930, *Chemical Abstracts* contained about 6,500 abstracts in what we then

considered to be biochemistry. But, in 1979, with greater coverage of the expanding literature, the number had risen to over 148,000. One has no choice but to depend on reviews, hopefully written by people with the necessary expertise, each providing a well-documented article pertaining to a given segment of the whole subject. If one is giving a course on advances in biochemistry, microbiology, or what not, he has no feasible alternative to the use of reviews. He is probably a dedicated subscriber to the Annual Review of this or that to the tripartite satisfaction of Annual Reviews, the authors, and the readers.

And now the bad news. I used to conduct seminars for graduate students in which, in turn, the participants would inform their fellow students about the real hot stuff on, say, insulin. But did Joe Dokes, the speaker our authority pro tem on insulin read any of the original papers appearing in the *JBC,* the *Biochemical Journal, Hoppe Seyler's eitschrift,* the *Biochemische eitschrift,* or the *JACS* Not on your life He read and carefully copied out paragraph after paragraph from the latest *Annual Review of Biochemistry* articles on insulin.

Is this bad It certainly is for Joe Dokes. If headed for a research career in science, Joe must go through the informative but laborious practice of reading original papers on the subject of his choice, of developing and exercising his own critical abilities and not depend on the pre-digested evaluations by others. Indeed, the best thing he can do is to write a review himself, based on original papers only. Even if he is the sole reader of his review he will have benefitted immensely.

Now that I think of it, were I to be returned to active duty which God forbid I would probably require a student, about to do a Ph.D. thesis on a certain subject, first of all to write a review of a substantial part of the relevant literature appearing in the principal periodicals this to precede his immersion in laboratory research.

And now we come to the finale the role of big brother in Washington who once sought to manage or mismanage information dissemination in science and technology. Senator Hubert Humphrey of blessed memory was then the chairman of a senatorial subcommittee concerned with government operations. In a 1961 report his committee estimated that there were then 160,000 projects in research and development in the USA, costing a total of about 12 billion, of which the federal government's share approximated 8.1 billion. I had participated in several conferences, national and international, from 1946 on concerning reviews, abstracts, documentation, storage and retrieval of information. It was quite the thing in those days to point to the rising flood of papers in the sciences, and to bemoan the gaps in our abstract services. Crash programs were being proposed to obtain a total coverage in abstracting. Others have mentioned, and still do, the "incredible waste in time and money" through duplication of effort. And so we come back to Hubert Humphrey, who stated that the various agency information systems were a "hodge-podge"…overlapping, underplanned, undernourished and under used. His committee recommended a total view of the information problem, commencing with the very concept of a project. Publication of the ideas and research plans of scientists prior to initiation of a contemplated investigation would be a beginning. Negative results from projects that turned

sour should be published. Papers delivered orally at scientific meetings should be drawn within the compass of the overall government-managed information service, the argument, among others, being that "if they had not been registered, abstracted and indexed on a pre-publication basis, they may 'disappear' except within the circle which will have heard the oral presentation." Also to be included would be the squeezings from progress reports and from projects cancelled without reaching formal publication "unless this is done, the chances are pretty high that in later years scientists may needlessly repeat the earlier work of cancelled projects."

If implemented, just imagine the flood of information of dubious value possibly rehashed in reviews, which would assail the science community at an outrageous cost to the bedevilled taxpayer. ou will have to conclude that I have little faith in the ability of government to manage anything let alone in the world of learning. At about the same time someone from Washington came to Palo Alto to learn in detail the operations of Annual Reviews. He broke the news to me that serious consideration was being given to a government-managed and government-financed family of reviews which would encompass the whole of science and technology. Apparently it died in gestation: I never heard of it again.

III. COOPERATIVES

Introduction

I suppose the ways in which groups of people may cooperate for economic purposes are legion. I intend to discuss several of these types. First of all, there are consumer cooperative societies that have as their purpose the procurement of goods and services of acceptable quality for sale at prices which are as low as is prudent and which require that operating surpluses be returned to members as a stated percentage of their expenditures on goods and services during the accounting period.

A second form of cooperation is found in cooperative housing, described below.

A third type of cooperation is agricultural. Witness the large group of agricultural cooperatives in which the members seek to sell their products at prices as high as the market permits and to purchase their requirements as cheaply as possible.

There are also industrial cooperatives, sometimes owned by consumer cooperatives and sometimes by agricultural cooperatives. In Great Britain, where consumer cooperatives are numerous and possessed of much economic strength, factories for soap manufacture and production of jams, jellies, and other preserved fruits and vegetables are owned by the Cooperative Wholesale Society. They operate competitively with the usual type of corporation engaged in the manufacture of similar products. The co-op factories have one great advantage in that the many retail cooperatives constitute a solid and dependable market for the products of these factories even though the individual societies are completely free to buy the products that they sell from any source that they may choose.

Finally, there is cooperative banking by organizations better known as credit unions.

Each of these types of cooperatives is described in the following sections.

Cambridge and London Cooperative Societies

I remained at the University of Toronto from 1925 to 1926. During the preceding three-year sojourn in England I had become greatly interested in the Cambridge Cooperative Society. The history of the Consumers' Cooperative Movement appealed to me, and the fundamental concept of ownership of a retail enterprise by the people who patronize it made sense to me. I had never liked the strongly competitive and profit-making characteristics of the usual retail enterprises in which greed by the owners was all too often transparently evident. We joined the Cambridge Society and loyally purchased all of our

groceries at one of the stores. Later, we joined the huge London Cooperative Society with stores in which we purchased bed linens, fine table cloths, woolen blankets, sweaters, and other non-food items.

Also, in the year 1925 1926 in Toronto I met Professor Henri Lasserre, born in Geneva, Switzerland, in 1875. With the degree of Licentiate in Law from the University of Geneva, he practiced law in Geneva for twenty years. He emigrated to Canada in 1921 and taught French and Latin in several institutions in Toronto during 1923 1924. From 1924 to 1926 he was instructor in French at Victoria College. I had the pleasure of becoming acquainted with him through a mutual interest in cooperation. During his years in Geneva he "happened to be charged with the drawing up of constitutions for many cooperative societies of various types" farmers' and workers' associations, consumers' societies, cooperative banks, etc.; he had also to cooperate in the organization and management of some of them. He was struck by the fact that there was implied in the cooperative idea a new conception of human relationship for business and social life based upon solidarity of interest, and that, if brought to its full or integral development, this cooperative idea not only would remedy to a certain extent some of the evils of the competitive system, but might make it possible actually to solve the conflicts existing now between capital and labor, production and consumption, city and country. Lasserre was interested in integral cooperation in which a "limited number of persons would seek to provide for their needs as consumers and in general for their welfare, by means of their own work along cooperative lines."

Several of us at Victoria College were fascinated by Lasserre and by his devotion to the idea of integral cooperation which goes far beyond the scope of ordinary consumers' cooperation. We met in his home one or two evenings a week for many months of the year. Mme. Lasserre generously served tea and cookies on every occasion when her home was invaded by the small group of inquisitive and hungry students. Lasserre provided us with copies of a long document entitled "The Integral Cooperative Form of Association" which we worked over page by page, Article by Article, through its 36 pages and 95 Articles.[1] The document consisted, in part, of the Constitution of the Foundation for the Establishment of Integral Cooperative Societies, incorporated in Basel, Switzerland, in July 1927. Lasserre was one of the three directors. The Foundation was funded by 150,000 Swiss francs (then about 30,000) turned in by Lasserre to the Swiss Union of Consumers' Societies. The Foundation was also empowered to sell bonds, 100 francs each, to be subscribed for in cash, securities, or other properties. I do not know where Lasserre procured such a handsome sum but I suspect that it was part of his personal fortune. I doubt that

[1]This document by Henri Lasserre, along with two Lasserre-Luck letters written in 1928 and an autobiographical sketch by Lasserre, are in the Luck archives, Stanford University Libraries.

an Integral Cooperative Society was ever founded in Canada though Lasserre was patient and persistent in his efforts.

Consumers Cooperative Society of Palo Alto, California

My knowledge of consumers' cooperation through membership in the Cambridge and London societies and the fascinating experiences with Lasserre gave to me an enduring determination to promote the idea of consumers' cooperation in California[2] to which we moved in 1926. In the late 1920s and 1930s, during the severe economic depression at that time, self-help enterprises of many types were organized throughout the country. At Stanford, several students urged me to take the initiative in organizing in Palo Alto a consumers' cooperative society. The Stanford community was fertile ground. The Founding Grant of the University contains the interesting injunction to the trustees "to have taught in the University the right and advantages of association and cooperation." I gave countless addresses on the subject, including credit unions, and participated actively in establishing a consumers' cooperative store in Palo Alto, California. The organization and operation of consumer co-ops in California, described below, brings to mind a number of problems that beset the early co-ops.

In January 1935 a meeting of twelve men and women, presumed to be interested, was held to discuss the advisability of organizing a cooperative. The composition of the group may be of interest: a judge of the International Court of Justice (Jackson Ralston, whose home was in Palo Alto), several housewives, a high school teacher, a deliveryman, a bank clerk, a laborer, an accountant, a local labor leader, a professor, a playwright, a student, and one or two of the unemployed. The time was considered ripe to make the attempt. Five of those in attendance (a housewife, the accountant, the professor, the high school teacher, and the playwright) were authorized to serve as the incorporating committee, with instructions to prepare the Articles of Incorporation and the By-Laws and to secure permission from the Commissioner of Corporations to sell memberships. This proved to be a long and toilsome but illuminating task. There were no laws at the time that applied specifically to consumer cooperatives, and the group wavered between incorporating as a nonprofit corporation and as a membership nonstock corporation under the general corporation law. Since the first alternative would have necessitated a restriction of sales to members only and would have introduced still other difficulties, the group incorporated as a membership nonstock corporation with all requisite safeguards to ensure adherence to the Rochdale standards.

[2]The history of the Palo Alto Cooperative Society during its first eleven years (1935 1945) is to be found in pp. 120 125 from my book, *The War on Malnutrition and Poverty The Role of Consumer Cooperatives,* Harper and Brothers, New ork and London, 1946; 203 pp.).

This was accomplished on March 15, 1935. The permission of the corporation commissioner to sell memberships was issued on June 13, 1935. Then the troubles began. First of all, the commissioner required that all money received from the sale of memberships be impounded until 2,000 was in hand. It followed, obviously, that capital would not be available for commencing a cooperative enterprise until 200 memberships had been sold. The sale of 200 memberships at 10 each in this small community was recognized as a most formidable undertaking unless prospective members could be introduced to a concrete scheme, if not a going concern. The lack of capital was speedily overcome by loans of 400 offered by enthusiastic members whose confidence in the ultimate success of the society more than compensated for the dour misgivings of the corporation commissioner.

Even earlier (since 1933) the proponents of the cause had entertained the thought of opening a cooperative gas station as the initial venture. But the petroleum code within the National Recovery Act and instability in the retail price structure made this undertaking inadvisable. Early in 1934 a local merchant who had once been actively associated in the directorate of a cooperative society in Imperial Russia proposed that when and if the local society be organized it consider the purchase of his grocery and meat market. The plan seemed attractive in that the price was reasonable, a small down payment would be considered acceptable (to be returned if the members within three months indicated their disapproval of the venture), and the purchase could be completed over a period of years through paying in the income received from the sale of memberships and through a guaranteed refund of 5 on sales to members.

The plan was accepted and 300 was paid over as the initial payment, but a fresh crop of difficulties arose. Prospective members were not pleased with the location of the store and they were distressed by the thought that several years would elapse before the store would be really theirs and they would be fully at liberty to administer and manage the store as they saw fit.

The money was soon withdrawn and immediately invested in sufficient grocery items to stock a few shelves in a small store. It was pitifully undercapitalized but economies were instituted from the beginning by subleasing the front half of the store to a group of stenographers (this reduced the rent to 10 per month) and by depending solely upon the voluntary unpaid help of the members who took their turn as clerks. The playwright was the first manager. Members joined gradually and in course of time it became possible to employ an erstwhile masseur as manager. His salary rose slowly from 30 per month to 50 per month but he enjoyed the work immensely.

To expand further the activities of the society, bargaining agreements were next entered into. The first two of these were with a laundry and a gas station. They proved to be highly successful and brought to the society a gradually in-

creasing income in the form of a rebate on members' purchases. The society, in turn, served as a collecting agency for the members' laundry bills and paid the laundry monthly in cash for its services to the members.

The membership slowly increased and the business of the society grew. But for a long time it was embarrassingly short of capital. Members came to the rescue with loans and paid for their groceries monthly in advance. Finally the corporation commissioner, convinced that the society was a going concern, agreed to release the impounded funds but only after the individual assent of each and every member had been secured in writing.

The society went through a series of growing pains that necessitated, first of all, the use of the entire store premises, and finally, removal to much larger premises in the vicinity.

In 1939 a gasoline station was leased and operated with conspicuous success from the very beginning despite the fact that the previous tenant had vanished in bankruptcy. Further bargaining agreements were entered into, of which one concerned with the purchase of milk and another with the cleaning and pressing of clothes were enthusiastically received and supported. The store became unionized in 1937, the first grocery store in Palo Alto to enter into a contract with the retail clerks' union. The relations with the union have been mutually cordial and satisfactory. The society not only adheres to the union scale of wages for grocery and service station employees but originally gave vacation benefits that were beyond the union requirements. In 1936 a credit union was organized. This has operated satisfactorily.

In November 1940, after an exhaustive survey of the members, premises for a second store were purchased, together with adjacent property for a service station and a commodious parking area. The parent store on Florence Street, which was restricted in its operations to groceries and produce, was retained for another eight months and the new property was developed as a complete cooperative unit groceries, produce, meats, delicatessen, and service station. The money required for the purchase and development was received from the members, on loan, within three days in sums that varied from 10 to 1,000. A cleaning and pressing establishment was purchased in the summer of 1942.

In the fall of 1943 the society entered upon another project, uncommon among consumer cooperatives, but one which gave promise of being of great service to the community a refrigerated locker plant. A poll of the membership revealed much interest in the suggestion and well over 300 lockers were rented for one year, rentals prepaid, within one week of the board's decision to go ahead. Some months elapsed before approval of the Farm Credit Administration and the War Production Board was received. By April 1945 all 670 of the lockers had been rented and a waiting list established.

David Faville, then the Professor of Marketing in the Stanford University Graduate School of Business, invited me in the early days of the Palo Alto Co-

op to address his class on cooperatives. Of course I accepted. It was probably the first and only occasion when consumer cooperation penetrated the Graduate School of Business.

One of the early experiences of the society is illuminating. A membership campaign, with much drive behind it, was undertaken in 1936. It was peculiarly unsuccessful. One hundred members were secured within a few months but the campaign was, nonetheless, a failure. The great majority of the members came in under pressure, they knew nothing of the philosophy of cooperation, the resources of the education committee were overtaxed, and the new members thus obtained constituted nothing but dead wood. In the "mopping-up" operation that followed in a later year, some of these were asked to withdraw and others were successfully brought into active participation in the society.

In addition to the minor difficulties referred to above, several other experiences are worthy of note as being indicative of the obstacles that cooperatives have to overcome. In the very beginning many prospective members declined to enter the society because of the unfortunate failure of a number of cooperative societies (including one in Palo Alto) fourteen years earlier. "A singed cat keeps away from the fire," was the common reply of such prospects when invited to join. A number of these are now members. Then there was an interesting experience with a private wholesaler in San Francisco who, after an interminable delay, refused to execute an order for a certain popular brand of English jam and marmalade; reason, he would not do business with a cooperative society. As a result of this an order was placed with the Cooperative Wholesale Society in Manchester for C.W.S. marmalade and tea. Despite high shipping charges, insurance, customs brokerage fees, duty, and a labeling penalty, it was possible to sell the products at the prices of competing merchandise and enjoy a wider operating margin Until the war broke out, increasingly large shipments of marmalade and tea were received from the C.W.S. For this the society owes its thanks to a San Francisco wholesaler.

The most disturbing experience resulted from the activities of two "promoters" who knew nothing about cooperatives but who entered upon a scheme for the immediate organization of chain cooperatives in the peninsula area. They proposed the mass selling of memberships their personal interest in the enterprise being clearly a 20 commission on membership receipts. They were finally dissuaded but not until they had actually incorporated, had held one or two of their high pressure meetings, and had discovered that cooperatives do not flash into existence.

The data in Table 3 describe adequately the business of the early society, of which at least 75 was confined to members.

For some years the Palo Alto Society maintained on its staff a full-time paid education director who was provided with office space and worked in close association with the board of directors and the education committee.

Table Palo Alto Consumers Cooperative, 1935 1945

ear ending Jan. 31	Net members Jan. 31	Sales (dollars)	Earnings (dollars)
1935	26	135.11	7.20
1936	35	1,089.78	35.39
1937	133	12,773.73	317.46
1938	206	23,765.54	412.81
1939	275	31,147.07	751.03
1940	345	74,931.38	2,279.06
1941	421	86,484.03	1,795.67
1942	603	189,350.00	6,899.46
1943	743	272,615.00	11,693.00
1944	733	299,225.00	12,046.75
1945	814	303,648.00	7,759.00

By January 1988, the Society had over 20,000 members of whom about 7,000 were active participants. Until the early 1980s it had as many as five retail outlets. Two of these ultimately had to be sold, or otherwise liquidated, for financial reasons. By the summer of 1988 the plight of the Society was such that two of the three remaining stores were sold to pay off the accumulated debts of the Society exclusive of the residual burden of a little more than one million dollars in promissory notes sold to members of the Society. The moral appears to be that a cooperative society must refrain from establishing an indebtedness that may not be manageable within its financial resources.

In December 1944 the Palo Alto Cooperative Society held a birthday celebration at which I was reminded that I would be expected to make an appropriate address in recognition of the founding of the Palo Alto Cooperative. The text was as follows.

A Birthday Celebration of the Palo Alto Co-op

> There was nothing of expediency or chance in the selection of the 21st day of December for the present meeting. This is a birthday celebration; not of our local society, which is but a lusty infant, but of several memorable incidents in the history of cooperation. We come together, indeed, on one of the most noteworthy days in the history of the Consumers Cooperative Movement.
>
> Holyoake reminds us that it was on this day in 1796 that there was established in London a society which some of us might choose to regard as the temporal and spiritual father of the movement. This Society, known as the Society for Bettering the Condition and Increasing the Comforts of the Poor, was principally interested in the development and public dissemination of methods whereby the poor could solve many of their economic difficulties and by their own efforts wrest themselves from the desperate lot which was theirs. Attention was given to such practical problems as “The Means of Ena-

bling a Villager to Keep a Cow," "Village Commons," "Kitchen Gardens," "The Cost of Cooking," and "Village Shops." Pamphlets were published. Several of the most prominent men of the day contributed liberally to the funds of the Society. Among its founders were two graduates of Harvard: Benjamin Thompson, who is better known as Count Rumford, and Sir Thomas Bernard, an attorney.

Although the Society was benevolently interested in several village shops which represented the labored strugglings of the poor toward a common ownership of their store and the cooperative purchase of food and other necessities, the significance of the Society in the consumers' movement is greater. To me it is the antecedent of the educational activities of the movement. It was a sort of brain-trust. It constituted the first serious effort to educate the common man to solve the problem of poverty and economic injustice by pulling on his own bootstraps and not by looking for the dispensation of alms from above.

The Society as a formal organization did not live for long, but its mission is still before us. It constitutes the cardinal purpose of the Consumers' Cooperative Movement. We are more than an aggregation of stores. Sales, membership records, and dividends do not serve to measure the accomplishments and purpose of the movement. The thing that matters is intangible and immeasurable. It is the growth among men of the spirit of brotherhood, mutual self-help, and cooperative living in the fullest and most ideal sense of the phrase. I cannot help but feel that that Society of 140 years ago had caught this vision and was intent on interpreting it in the practical affairs of life.

It was on this day in 1844 that the shutters were removed from that miserable little shop in Toad Lane, Rochdale, the first of the Consumers' Cooperative shops as we now know them. The struggle of 50 years and the evolution of cooperative ideals and theory had at last culminated in the birth of a system of production and distribution which worked. To us all this date and incident must bring to mind the extraordinary development of the movement as an economic system. It reminds us of the commercial aspects of the movement and permits us with justifiable pride to speak of the Consumers' Cooperative Movement as one of the most sucessful business enterprises in the world.

It was on this day in 1880 that Senator Leland Stanford introduced a bill in the District of Columbia to encourage by appropriate legislation the establishment of cooperative associations. One cannot read this bill without being reminded of the Friendly and Benevolent Society Acts in Great Britain and of the struggle of many years' duration to give proper recognition to the cooperative movement. In 1893, a few days before his death, Stanford dictated his last letter to David Starr Jordan, president of Stanford University: "I think one of the most important things to be taught in the University is cooperation….By Cooperation, society has the benefit of the best capacities, and where there is an organized cooperative society, the strength and best capacity inures to the benefit of each."

At the present time there is a dearth of appropriate legislation for consumer cooperative societies. This is especially true in California. We can rightfully regard this day and the efforts of Leland Stanford as memorable in the history of cooperative legislation.

> The educational, commercial, and legislative aspects of the Movement are brought to a focus and fittingly commemorated by our coming together on this historic day.

Five years later, in November of 1949, the Palo Alto Co-op dedicated a new market on California Avenue which continued until 1987 as the principal market for the Palo Alto Cooperative Society. I was asked to give an address on this occasion, which was published in installments in the *Co-op News* as follows.

> *CO-OP NEWS,* Palo Alto, Calif., Thursday, April 13, 1950, No. 7
>
> Cooperation An Aspect of the Social Philosophy of Leland Stanford
>
> (Editor's Note: Dr. Murray Luck, one of the founders of our Co-op, has kindly consented to our printing his address, given last November at the dedication ceremonies for the new market….Since Stanford University plays a large part in our community affairs, and due to the apparent cooperative leanings of Leland Stanford, the article seems particularly apropos.)
>
> The Consumers Cooperative Society of Palo Alto, today a sturdy adolescent of 15 years, celebrates its growth and accepts its expanded responsibilities to the community in the dedication exercises for which we are assembled.
>
> The Society derives its 1,860 members from Palo Alto and from the Stanford community. Not so many years ago the former was nothing but a wheatfield and the present site of the University constituted the pastures and farmland of Leland Stanford's Palo Alto estate. The University owes its being to the munificence of Leland Stanford, who, in his planning of this great institution of the West, was equally responsible for the birth of Palo Alto, our University town.
>
> It may be of interest to us to reflect upon our community's progenitor and inquire into one aspect of Leland Stanford's social philosophy which is strangely relevant today, his consuming interest in cooperative associations. Here was a man of great wealth, a railroad baron, a person vested with tremendous economic and political power, but interested in helping the common man to fight the monopolies of the rich. The thing is a paradox. I know that many of us, as members of Stanford University, have had our curiosity piqued, to say the least, by part of Section IV of the Founding Grant wherein the rights and duties of the Trustees are set forth. Among these we find (paragraph 15) the interesting injunction: "To have taught in the University the right and advantages of association and cooperation."
>
> The first meeting of the Trustees was held on November 14, 1885, 64 years ago tomorrow, in the Stanford home and was addressed by Leland Stanford. The text of his remarks throws a little more light on his interest in cooperatives.
>
> We find him saying: "Out of these suggestions grows the consideration of the great advantages, especially to the laboring man, of cooperation, by which each individual has the benefit of the intellectual and physical forces of his associates. It is by this intelligent application of these principles, that there will be found the greatest level to elevate the masses of humanity, and

laws should be formed to protect and develop cooperative associations. Laws with this object in view will furnish to the poor man complete protection against the monopoly of the rich, and such a law, properly administered and availed of, will ensure to the workers of the country the full fruits of their industry and enterprise. Hence it is that we have provided for thorough instruction in the principles of cooperation."

Eight years later, in fact just a few days before his death, he dictated his last letter to President David Starr Jordan. From it I quote: "I think one of the most important things to be taught in the University is cooperation….By cooperation society has the benefit of the best capacities and where there is an organized cooperative society the strongest and best capacity inures to the benefit of each."

CO-OP NEWS, Palo Alto, Calif., Thursday, April 27, 1950, No. 8

In the interim Leland Stanford had served in Washington as a United States Senator. On December 20, 1886, he introduced one of his favorite and most publicized bills, S 3022, "a bill to encourage cooperation and to provide for the formation of associations in the District of Columbia for the purpose of conducting any lawful business and dividing the profits among the members thereof."

The bill came up for consideration on February 16, 1887, and was explained by its author as follows. I quote:

> The bill which I have introduced provides for the association and organization of individuals with or without capital. It gives no exclusive privileges and is intended only to aid the natural right of association.
>
> In a large sense civilization itself rests and advances on the great principles of cooperation….
>
> I believe that cooperation will bring out the highest capacities of those engaged in it. It will impart to each individual the stimulus of knowing that he or she may enjoy the full fruits of his or her skill and energy in their calling.
>
> The principle of cooperation of individuals is a most democratic one. It enables the requisite combination of numbers and capital to engage in and develop every enterprise of promise, however large. It is the absolute protection of the people against the possible monopoly of the few, and renders offensive monopoly; and a burdensome one, impossible,….
>
> The moral influences of cooperation are very great. All in the organization are interested in the welfare and good conduct of every other member. All the good influences of the whole are brought to bear in favor of the individual, and all the individual members unite to make the whole most powerful for the accomplishment of results.

CO-OP NEWS, Palo Alto, Calif., Thursday, May 11, 1950, No. 9

I have often wondered how this man acquired an interest in cooperatives and have been curious to know the type of cooperative association that he

visualized. Before the Senate and in his public addresses he indulged in such vast generalities and in such sweeping conclusions that little may be found in answer to these questions. However, the *Evening Star,* a Washington paper, interviewed him on December 21, 1886, and he revealed much.

Leland Stanford described the bill as entirely his own notion. He did not introduce it at the behest of labor advocates or of any organization. The idea had occurred to him years before when he was in business at Michigan Bluff in the heart of Placer County, California, and had learned something of mining operations. He had found that groups of miners very commonly formed loose associations of a cooperative type; a few would pan for gold, others would build a flume, some would divert a stream, and others in the group would tunnel the hills. The profits in these quasi-cooperatives were divided equally or in proportion to the hours of labor contributed by the members. Clearly these associations, if they may be so called, had no existence at law: they were unable to borrow money; they could neither sue or be sued; they could not carry on a business in the accepted sense of the word. Leland Stanford, who had himself practiced law, sensed a remedy, an organized association in which the members through investments of their labor and their capital, could carry on any kind of a productive enterprise to their mutual advantage and profit. The amount of capital invested by each would be of little importance; the number of members, their investment of labor, and their enthusiasm for the success of this, their own enterprise, would be the things that mattered. Even the numbers might be of little consequence. I quote:

> Five or six blacksmiths, equipped with tools, may associate and combine their labor in setting up a business….
>
> There are several girls, one of whom, healthy and strong, can run a sewing machine, another can do fine sewing and another has great taste in trimming and beautifying. These ladies can combine their abilities and build up a profitable business. Singly they can do little but by a system of cooperation they build up a name and a trade. My bill gives them the right to legal association and protects them in the enjoyment of such rights….
>
> Capitalists can easily combine and cooperate but I want a law for those without capital.

Though a man of great dignity and pose, and deliberate in judgment, Leland Stanford entertained extravagant hopes for such cooperative associations. Again I quote, this time from his speech before the Senate: "With a greater intelligence, and with a better understanding of the principles of cooperation, the adoption of them in practice will, in time I imagine, cause most of the industries of the country to be carried on by those cooperative associations."

It is evident that Leland Stanford did not have in mind consumer cooperatives of the Rochdale type, the distributive cooperative with which we in this Society are familiar. The *National Republican* interviewed him on February 17 or 18, 1887, and commented on the fact that the great Rochdale Society was a distributive association but "its success led to the establishment of 'productive' associations, where the labor of the members was the only

capital, and these have proven equally successful." It is not clear from the article whether the conclusion is that of Leland Stanford or the *National Republican.* Although a few productive associations have had a successful experience in Great Britain, they have seldom had more than an ephemeral existence elsewhere (I exclude the agricultural cooperatives of the producer type). This consideration is not germane to Stanford's real understanding and appreciation of the deeper values inherent in a cooperative society.

What really mattered I am sure, for he mentioned these things repeatedly, were the democratic practices inherent in a cooperative association, the protection afforded society against the evils of monopoly, and expression of the high moral values inherent in simple neighborly help. A cooperative is at heart little more than a family of people associated for the homely purpose of helping each other satisfy their economic needs, doing so by a method which is direct and simple, yet characteristically imbued with a spirit of genuine helpfulness and mutual respect.

In respect to many of our economic needs about the only bulwarks that remain as protection against the ever-spreading tentacles of the state or against exploitation by financial and industrial barons are the consumers' cooperative societies. We wish them well.

I congratulate our own Society on the attainment of another milestone and extend to it my most heartfelt wishes for many, many years of service to Palo Alto and the Stanford community.

The Cooperative Movement in California

If the members of a cooperative society are not scrupulous in adhering to the Rochdale principles, still other problems may present themselves. These are illustrated in this section, which deals with the early history of the cooperative movement in California.

The cooperative movement in California has had an extremely chequered history and an inquiry into its past and into its present throws a good deal of light on what should and what should not be done if cooperatives are to contribute effectively to the economic life of the common man.

Consumers' cooperation is not the kind of cooperative activity that has had the most spectacular, durable, or successful results in California. The Epic cooperatives that enjoyed a brief span of life in the "I-Upton Sinclair-Governor-of-California" days[3] were both spectacular and instructive, while the many agricultural cooperatives have known several decades of conspicuous success.

The consumers' cooperative enterprises illustrate the determined endeavor of Californian consumers to exercise control in the purchase of consumers' goods. The Epic cooperatives represent a valiant but ill-directed effort to use cooperatively the surplus labor of the unemployed in harvesting and marketing surplus agricultural commodities for the benefit of those on relief. They were

[3]The acronym Epic comes from Sinclair's "End Poverty in California" program. See Upton Sinclair, *I, Governor of California, and How I Ended Poverty in California.*

to be the principal means to end poverty in California. They constituted, so it would seem, the most direct attack that might reasonably be made on poverty in the midst of plenty. They bore no, or little, relation to consumers' cooperatives of the Rochdale type. The contribution of the latter to a solution of the problem of poverty is more subtle but more fundamental.

The consumers' cooperative movement in California must be described as falling into three periods. The first was the historical and, in some respects, the golden era. It terminated in 1906 at which time "approximately 100 cooperative stores were to be found scattered throughout the state: the Pacific Coast easily had the most successful and strongest cooperative system in the United States."[4] In striking contrast with the present distribution of consumers' cooperative societies it is interesting to observe that next to California came Kansas, Wisconsin, and Massachusetts, in the order named.

The first consumers' cooperative store, established in 1867 in San Francisco, was followed during the next two decades by a number of cooperative societies. They were not numerous but at least two of them proved to be quite enduring. A group of stores, operated on Rochdale principles, was sponsored in the early 1890s by the Farmers' Alliance. Nonetheless, these early efforts were spasmodic, experimental, and, in some cases, almost evangelical. They did not receive the benefit of an informed leadership and failed to adhere rigorously to the fundamental principles of consumers' cooperation. In fact, decades were to pass before the full worth of the Rochdale principles was to be adequately appreciated by the consumers' movement.

The first consumers' cooperative store to give promise of real achievement was that which was organized at Dos Palos in 1896. A truly Rochdale company was established by a group of Easterners, of whom the community was largely constituted. They built their own store, incorporated in 1899, and for several years got along very satisfactorily. By 1900 there were six Rochdale cooperatives in the state and 22 others that could properly be described as consumers' cooperatives. The Rochdale Wholesale Company was organized in that year to serve as a supply house for the growing family of cooperative stores. Despite the fact that its clientele was small and the institution of a wholesale operation was definitely premature, the movement continued to grow. The wholesale company alone succeeded in organizing an average of nine societies per year. Credit was extended fully, accounting methods were poor, and management was frequently incompetent. Nonetheless, the rural communities, in which most of the stores were located, were growing, were prosperous, and were receptive to the idea of economic cooperation. The difficulties in organizing cooperative societies and in raising the capital for stores were few.

[4]Clark Kerr, *Handbook of Consumer Cooperatives in California,* California State Relief Administration. September 1935.

The panic of 1907 and the resultant period of business failure ushered in the second era in the history of California's cooperative movement. It was of fairly brief duration and seems to have terminated in 1930 or thereabouts. By 1910 many cooperative stores had disappeared: some had failed to adhere rigorously to Rochdale principles and others were very badly managed. Only 50 cooperative stores were to be found in 1910 and of these only about half had been in existence for more than five years.

The year 1910 was a crucial one in the history of the wholesale. The preceding decade had been marked by continuous growth, a peak volume of 335,000 being reached in 1910. There is little doubt that the business of the wholesale could have been several times greater had the retail societies made a serious effort to funnel the maximum of purchases through the wholesale. It was probably the recognition of this apparent lack of loyalty that led to a fundamental and unfortunate reorganization of the wholesale in 1910. The California Rochdale Company, as it then came to be called, engaged a general manager to exercise supervision over all of the member retails. These, in turn, were virtually obliged to make all purchases, except local produce, through the wholesale. Twelve stores entered the federation, but, of these, ten passed out of existence by 1912.

An attempt at resuscitation was made through incorporation of the Pacific Cooperative League in 1913. This continued the policy of centralized control. It began with the extension of memberships to individuals and later to stores, clubs, firms, and corporations. To one and all were offered the benefits of wholesale purchasing without the assumption of financial risk or responsibility by the associate (individual) members. The League made two-thirds of its purchases through the Rochdale Wholesale Company to the mutual advantage of both parties. Individual members, where favourably located, were grouped together into buying clubs and into stores. Each store agreed to abide by certain principles, of which one must be emphasized because of its ultimate disastrous consequences: all purchases had to be made through the central wholesale house. All accounting for the local stores was done by the central office and close supervision was exercised over the retail stores. In other respects the type of organization seemed to be democratic and in accordance with cooperative principles.

For some years the policy of centralized control seemed to be a success. By 1921 the League operated some 47 cooperative societies with an aggregate business of 4,000,000. Not all of these stores were in California: several were in adjacent states. The League enjoyed membership in the International Cooperative Alliance and served as a purchasing agent in the western states for several European cooperative wholesales.

By 1921, under the influence of E. O. F. Ames, C. E. Todd, and H. H. Dobbs, the control of the League had become autocratic and arbitrary. In that year, the Pacific Cooperative League Stores, Ltd., was incorporated. The gov-

erning body, though not democratically elected and not responsible to members of the League, induced the various stores to exchange their stock in the old League for stock in the new organization. Contrary to all cooperative principles, Ames, Todd, and Dobbs were given 51 of the stock and voting was changed from one vote per member to one vote per share held. With full control in the hands of three men, the organization quickly lost the patronage of individual cooperators. Within a year it was in bankruptcy and carried all member societies but one into receivership with it.[5] The 47 societies in California in 1920 had dwindled to 12 in 1925 and to 5 in 1930.

The membership figures and business volumes reported in the studies conducted by Florence E. Parker for the Bureau of Labor Statistics are somewhat deceptive and need hardly be mentioned. The Bureau has steadfastly included the large student associations of the University of California and Stanford University. These associations operate bookstores which are not truly cooperative and should not be included in the reports. The low point in the consumers' cooperative movement of California was reached in 1930, a year that can be regarded as the termination of the second or intermediate period.

The contemporary movement, arbitrarily dated from 1933, was ushered in during a period of great economic depression. It developed for a few years in a fervor of evangelical zeal. According to Clark Kerr, there were 56 consumers' cooperative societies in operation in August 1935, with a total membership of 7,000. Most of these mushroomed in growth and developed at a time when Upton Sinclair's slogan "Production for Use" had seized the imagination of the economic reform group. Fifty-two of the stores were less than 10 months old at the time of Kerr's survey. Virtually all of these were initiated with the aid of the many who had served as leaders in Upton Sinclair's "End Poverty" campaign and who now turned to the cooperative movement as an outlet for their energy and zeal. Twenty-five other cooperative grocery stores which had started operations in 1934 or 1935 had closed by August and, of many others that were in process of organization at that time, few indeed were heard of again.

And so, while the history of the Pacific Cooperative League illustrates the dangers inherent in centralized control and ownership, the history of the cooperatives of 1934 and 1935 illustrates equally effectively the futility of attempting a mass development of consumers' cooperation.

Despite these various setbacks the cooperative movement in California has enjoyed sufficient resilience to rise again and again from its own ashes. There were many who never lost faith in the possibilities of consumers' cooperation. The initial successes of a few good societies added new adherents rapidly.

[5]The San Diego Society fought its case in the courts and won: it was not required to turn over its property to the receiver of the Pacific Cooperative League.

As of January 1, 1943, there were at least 91 consumers' cooperative societies in operation in California.[6] The self-help cooperatives, also known in California as the Epic cooperatives, were in flood tide in 1933 and at ebb tide three years later, virtually engulfed in the rapidly changing economy of those years. However, no apology is needed for including in this treatment of Californian cooperation a movement of so ephemeral a character. The self-help cooperatives constituted an extremely direct attack upon the problem of poverty and to the uncritical presented a plausible means of exchanging the labor of the unemployed for the surplus commodities of agriculture. The scheme also provided for the cooperative use of special skills without their application to commodity production and distribution: unemployed barbers, music teachers, shoe repairmen, auto mechanics, tailors, etc., were able to serve themselves cooperatively insofar as the exchange of their respective skills was concerned.

In their most ambitious formulation, however, the self-help cooperatives planned that the labor of the unemployed would be used in the harvesting of "surplus" fruits and vegetables, in the canning or drying of these foodstuffs, in the cutting of firewood, and in similar pursuits. Provision was also made for the cooperative purchase of consumer goods by members of the exchange. In a few instances such cooperative buying associations developed into consumers' cooperative stores of the traditional type. In all cases where the cooperative was the recipient of federal aid, the benefits of the organization were restricted to the unemployed, including those on relief: the gainfully employed were deliberately excluded. The immediate economic background is, doubtless, a population of 700,000 unemployed in immediate proximity to rich agricultural areas in which many thousand tons of fruits and vegetables remained unharvested: prices were too low to afford the producer a satisfactory return on his investment.

The first self-help cooperative of the period in question is believed to have been organized in Compton, California, in March 1932. Largely because of the crusading zeal of Upton Sinclair and his associates, the movement spread rapidly. Within a year there were over 37,000 active members in 172 units in nearly 100 cities and towns.[7] It was not confined to California, although in 1935, 60 of all self-help cooperatives in the United States were in California. The number was reported to be 183 but the active membership had dwindled to 6,200. In 1933 the corresponding numbers were 172 and 37,000 respectively. The movement was definitely on the decline. Nonetheless, in 1935, we managed to organize the Palo Alto Consumers' Cooperative Society, which for fifty years or more operated successfully as a truly Rochdale-type cooperative (see page 59).

[6]Exclusive of seven student cooperative housing associations and of four pseudo-cooperative University bookstores.

[7]Clark Kerr, *Self Help A Study of the Cooperative Barter Movement of the Unemployed in California,* (thesis). Stanford University, 1933.

Peninsula Housing Association

My happy and memorable experiences in founding the Consumers' Cooperative Society in Palo Alto and in learning about integral cooperation from Henri Lasserre were described in some detail above. They were not the last of my co-op activities. In 1942 or 1943 I was invited by the Stanford MCA and WCA to lead a Christmas vacation workshop at Asilomar, California, on consumers' cooperatives. Also invited was Sumner Spaulding, a city planner from Los Angeles. He was asked to conduct another workshop on city planning. Sumner and I had many discussions between ourselves and with the students on the possibility of joint acquisition of a piece of land by a group of people with common interests in the economies that could be realized through the group purchase of a suitable piece of land, and joint planning of development of the property for housing and community facilities (school, church, entertainment center, etc.). In general, economic and social benefits would be available to the residents of a community if they were to be its owners and, thereby, could control its development.

I found enthusiastic support for this concept of cooperative housing in Dr. Erik Heegard, one of my research associates in biochemistry; in Dr. David Bonner, a Stanford biologist; and in Ralph Evans, at that time the Palo Alto postmaster and also a member of the Palo Alto Co-op. We organized the Peninsula Housing Association (PHA) and arranged for its incorporation in April 1944. One year later the Commissioner of Corporations granted us permission to sell memberships and to issue certificates of interest. The incorporating committee also included Frederick Anderson, Professor of Romanic Languages at Stanford, Rebecca Anderson (his wife) and Mrs. Aletha Baker. Each of us advanced 200 to cover the legal costs we had incurred. The Association grew rapidly and, in the words of Wallace Stegner, an active member, it "had the spirit that used to animate barn raisings when democracy was younger and simpler." By 1946 there were 150 members, each of whom paid an entrance fee of 200, of which 150 was refundable if one withdrew from the Association. Each member purchased a certificate of interest, initially 500, bearing an interest return of 5 per annum, later 2,000 when purchase of the land was assured. We contemplated a membership of 400 and confidently issued a biweekly publication called "The 400."

After an exhaustive search for a suitable piece of land, we ultimately acquired, at public auction, a magnificent parcel of 260 acres for 155,000 inclusive of 34,000 for a water line to the property. Our legal counselor, Willard Johnston, and I were authorized to open the bidding at 112,000 but not to exceed 131,000. As bidding progressed, a San Francisco syndicate countered our initial bid with one of 123,000, which quickly rose to 131,000. At this point, because of a legal nicety, we persuaded the judge to grant a two-day ad-

journment. The association then authorized me to raise our bid to a maximum of 156,000. When bidding resumed, the San Francisco syndicate stopped at 155,000, at which price PHA acquired the property. It was only four miles from downtown Palo Alto and was partially bordered by Stanford University property. I am convinced that a better piece of land could not have been acquired at even double the price. The location was excellent and the view was unsurpassed.

Of course, the community had to have a name. A Names Committee, including Heegard, Bonner, and Stegner, received many suggestions from the members. The three most popular suggestions were Lark Hill, Ladera, and New Rochdale. The Spanish name, Ladera, was finally recommended to the Board of Directors and was accepted by the members. The Names Committee also proposed acceptable names for the streets. In keeping with the Spanish name for the community, the streets were likewise named in Spanish.

I do not propose to describe this venture into cooperative housing in needless detail except to emphasize that we soon found ourselves on a very rocky road. Selection of a manager was an unending source of dissension. Several architects addressed the members and presented their views on development of the property, on construction of the houses, and on the community facilities. Plans were prepared for houses of 13 different designs and sizes. Whether or not the manager should also be in charge of general contracting proved to be a thorny and very divisive issue. I resigned from the Board of Directors and Evans resigned also from the Association. The Federal Housing Authority was repeatedly demanding this and that revision of the plans for laying out the roads, the building lots, and construction of the houses and community facilities. Otherwise, the FHA refused to guarantee the loans requested by the members. Without such a guarantee Evans was convinced that the whole venture was destined to fail.

On December 31, 1948, bids were received for construction of the first 31 houses, at prices of 12,125 to 17,793 plus about 5 for various fees. In April 1949, 150 members gathered at the site of one of the first homes. Only the foundations were in. I was asked to dedicate the prospective house. Two members, Frank Skillman and Herbert Hunter, joined me in greeting this evidence of progress. Curbs, gutters, and sidewalks were under construction for the whole of Section 1.

Financing difficulties, largely because of the stubborn position of the FHA, quickly escalated into a most embarrassing and heartbreaking problem that defied a desirable solution. In March 1950 the sale of Ladera to the Portola Development Company, a subsidiary of Hare, Brewer, and Kelley, Inc. was approved. However, a restrictive clause had to be imposed on insistence of the purchaser. This required the withdrawal of colored families from membership. The right of occupancy could not be denied, but ownership plus occupancy was the crux of the problem. I remember that the members involved withdrew

gracefully and with complete understanding that many of their friends might lose their investment if they failed to withdraw. A few days later, by a remarkable coincidence in timing, the FHA was required to refuse loan guarantees in all cases wherein such a restrictive clause was included in purchase contracts.

The PHA sold all of its assets to the Portola Development Company for 392,327.95. This sum constituted the entire amount invested by members (then-present or withdrawn). Portola Development Company also assumed all of PHA's other liabilities, which totaled about 141,530. Payment by the Company was secured by a 15-year interest-free promissory note. As far as I know, all the members (then-present or withdrawn), 262 in number, received, in 1963 or so, a return of their total investment, averaging 2500. Sale of the assets of the PHA to Portola Development Company led, in May 1951, to a change in the name of the Association to the Ladera Community Association (LCA). Of the four officers and five directors of the LCA, all but one were members of the original cooperative.

It is surely obvious that the highly motivated program of the original cooperative failed. Ladera continues as a very desirable place in which to live. In terms of people resident in Ladera, the number had more than doubled within a few years of changing the name of the Association to LCA. Serious efforts are made to see that all decisions of any consequence are arrived at by the collective voice of the entire community. However, the original cooperative, recognized as the Peninsula Housing Association, failed.

Several reasons can be advanced for the failure. The plan for total development was too ambitious, especially in view of the slow growth in membership. Troublesome local ordinances, the FHA, and internal dissent on a variety of issues combined to cause failure. In its later stages, the refusal of the FHA to guarantee construction loans required by the members was "the last straw that broke the camel's back." Had the PHA limited itself to the cooperative acquisition of the land and installation of the road, utilities, and building sites, the project might have succeeded. The lots would then have been sold to the members, who would each be free to contract for construction of his own home. Perhaps the PHA spent beyond its means; the land cost was higher than anticipated; administrative and management expenses were high, so also were the development of utilities and costs of services of paid employees. But for those of us who participated in the growth pains of the infant cooperative and in working together to build a better community for better living, it was one of the greatest experiences of our lives.[8]

[8]In describing the Ladera story I have drawn heavily upon a well-written and authoritative booklet of 50 pages, "Ladera Lore," by Hallis Friend and Nancy Lund (April 1974). Copies are to be found in the Portola Valley Library (765 Portola Rd., Portola Valley, CA 94025) and in the Menlo Park Library (800 Alma St., Menlo Park, CA 94025).

Stanford Cooperative Housing

My description of cooperative housing in the Stanford area (see the preceding section) would be quite incomplete unless a brief reference to the Stanford Housing Cooperative were included. The Co-op was commonly known as the Walter Thompson Cooperative House. It was located at 714 Santa nez and was also referred to as Tamarack Lodge. For at least twenty years prior to 1942, the house, owned by Stanford University, had been leased to a club of Japanese Japanese-American students. . Okumoto, a research assistant in anatomy, served for twenty years as the secretary of the club. He collected the rents (300 per month) for transmittal to the university, paid the taxes, and exercised other functions as a sort of *de facto* owner.

The Japanese were obliged to evacuate the house in early 1942. Shortly thereafter, other students, members of the Stanford University Student Cooperative, took over the lease and occupied the premises. Occupancy continued during the remaining years of the war. The Cooperative was in excellent financial condition throughout its occupancy of the house. In June 1945 the group was informed by the university that the lease was to be cancelled and would terminate in the following August September. Termination of the lease was part of a major reconversion project of student housing, dictated by the closing of fraternities in 1943 and by the demands of the Army and Navy to use all available housing for occupancy by the Civil Affairs Training Officers, the Civil Communications School, and a number of female officers. Several fraternity houses, Encina Hall, Branner Hall, and Toyon Hall, were occupied by units of the Army and Navy. Sequoia Hall remained as the only university residence for male students.

On June 21, 1944, the Student Housing Cooperative conveyed its assets to a Trust of which the Trustees were Paul Kirkpatrick, Murray Luck, Otway Pardee, and Robert G. Randolph. The document of conveyance was signed by the three officers of the Student Housing Cooperative and by thirty of its members, 12 of whom were occupants of the house. The sum of 1,000 was received from the Cooperative for investment on its behalf and to be used to aid in the re-establishment of a student-sponsored cooperative living association when this was deemed advisable and possible.

As of June 1, 1953, the assets of the Trust totalled 1,272.65, distributed as follows:

(a) 500.00 invested as a three percent, 30-day demand note in the Palo Alto Consumers' Cooperative Society.

(b) 705.53 in the form of a five percent, 90-day demand note in the University of California Students' Cooperative Association.

(c) 67.12 deposited in the American Trust Company, Palo Alto.

Throughout the 1960s the Trustees moved steadily toward the conclusion that the monies committed to their care should be used in the immediate future for the purposes spelled out in the conveyance document. In 1969 the Trustees agreed that the Trust should be terminated and the funds in its custody should be given to Stanford University for the Stanford Student Loan Fund. The funds had increased through interest accumulation to 2,393.55. On March 6, 1969, President Pitzer gratefully accepted the gift and assured the Trustees that the money would be added to the Student Loan Fund and used to assist the university's students in financial need. This transmittal of the entire assets of the Trust to the university led thereby to termination of the functions and responsibilities of the Trust and hence to its immediate dissolution.

Please refer to the following extract, "An Obituary" on cooperative housing, for further information, including several statements by Leland Stanford, who was a firm believer in, and a dedicated advocate of, cooperative organizations. Leland Stanford's advocacy of cooperative organizations is also described in much detail by Lee Altenberg in *Sandstone and Tile*, Vol. 14, No. 1, Winter 1990, pp. 8 to 19, a publication of the Stanford Historical Society. The Altenberg article, which I heartily recommend, is entitled "An End to Capitalism: Leland Stanford's Forgotten Vision."

August 25, 1945
Stanford Daily Editorials Features

An Obituary

"THE FEW VER RICH can get their education anywhere," said Senator Stanford in his last letter to David Starr Jordan (the first president of the University). "They will be welcome to this institution if they come, but the object is more particularly to reach the multitude those people who have to consider the expenditure of every dollar."

But over the years the Stanford Family has winced to see this University become, perhaps partly out of necessity, a rich man's school. And for whatever reasons and however justifiable, the hard fact is still that Stanford has failed a fundamental aim of its founders.

With us they would watch sadly next month the death of the only active adherence to the original ideal still remaining at Stanford, when the University administration terminates the Walter Thompson Co-op House.

In spite of the vicissitudes of its establishment, the lack of University encouragement, and all the years of the war, the Co-op has operated continuously, has served superior meals, has kept low prices, and still shows a surplus of one thousand dollars. (At one time, it not only provided meals for its own members, but also for the graduate women of Hilltop House.)

During the same period, the fraternities and eating clubs were forced to close entirely, and the University lost money on men's halls under its management while keeping them less clean, serving inferior meals, and charging prices twice as high. The meals served at the Co-op are the best available to men, army or civilian, on campus, and the cost of both room and board is the lowest of any campus living group, men's or women's.

The Co-op has been successful. It has also made a definite contribution to student life….

Among its members have been counted Jews, blacks, and nationals of twenty foreign countries. And from the beginning, the operation of the house on cooperative and democratic principles has been for the most part effective and congenial, and for many members, a godsend.

For two successive years the Co-op ranked first among all living groups in scholarship. Numbers of its members have served on Excom and Men's Council, and other offices of student government, and have participated in every activity from the choir to intramurals to theatricals. Members have held scholarships, worked as instructors and as teaching and resident assistants. And no Co-op member has ever been brought before Men's Council on a moral charge or violation of the honor code.

Far from deserving termination, the Co-op more than any single living group deserves official backing by the University.

Leland Stanford took frequent occasion to further the cause of cooperation and cooperative groups. He even introduced a bill in the US Senate to encourage and provide for the formation of cooperatives in the District of Columbia. And in support of it he delivered two months later one of his rare speeches on the floor of the Senate.

In the exercises of the opening day of the University he was careful to point out that provision had been made for freely teaching the benefits of cooperation, through which modern progress had been mostly achieved. "Cooperative societies," he said, "bring forth the best capacities, the best influences of the individual for the benefit of the whole."

The doubtful venture of the founding of the Walter Thompson Co-op was underwritten by eighteen of the Stanford faculty, and approved in writing by twenty-two more. The name was in honor of the late Walter Thompson, a kindly professor of political science, who had actively furthered the Cooperative Movement. And among scores of contributors, Mrs. David Starr Jordan herself gave a table, chairs, and wicker furniture toward the establishment of the house.

With the passing of the Co-op, and with the imminent commencement of direct supervision of the fraternities and other residences by the University, and its published intention of raising room rent yet again for next quarter, our regrets are deepened that the winds of freedom will blow henceforth less briskly.

Drafted by Cyclone Covey (one of the student residents of the Walter Thompson Cooperative House)

Credit Unions

Shortly after the Consumers' Cooperative Society of Palo Alto came into being, the Board of Directors set up a Committee on New Projects which was instrumental in arranging bargaining agreements with other consumer-oriented services. In early January 1937 the Committee on New Projects approved a proposal to organize a credit union. The Board of Directors of the Co-

op approved the idea and took the initial steps toward setting up a credit union. The incorporating Board of Directors of the Credit Union consisted of Mrs. M. S. Alderton, Mr. Hugh Anderson, Mrs. S. F. Bryant, Dr. Vern James, Mr. C. F. G. Orton, Prof. Harry Rathbun, and Mr. John Way. The group met in my home on Wednesday, January 20, 1937, to sign the Articles of Incorporation, to complete the necessary application papers, and to appoint any pro-tem committees that might be required. This was preceded by much earlier correspondence (October 1936) with John L. Moore, managing director of the California Credit Union League. We had the option of organizing as a California-administered credit union or as a Federal credit union operating under the terms of the Credit Union Act which became effective on July 29, 1937. The Act itself, although obviously relevant, is much too long for inclusion here. It consists of 25 sections covering 10 single-spaced pages. The Directors of the credit union decided to organize under the Federal Credit Union Act.

A chapter on cooperative banking appears on pages 143 172 of my book, *The War on Malnutrition and Poverty,*[9] describing the credit union movement in considerable detail. The Palo Alto Credit Union during its early years is described on pages 159 164 of the cited book. I have had many occasions to describe publicly various aspects of the credit union movement. A Russian-American in San Francisco, interested with a few of his friends in organizing a credit union, asked me to address a meeting in San Francisco to explore the contemplated project. I am including my remarks because they describe in adequate detail what credit unions are as well as what they are not.

> A credit union is a very simple sort of cooperative organization for banking purposes. A typical credit union may consist of 50 or 100 or more people who have some interests in common. Perhaps they all work in the same factory. Perhaps they are employed in the same office. Perhaps they are members of the same lodge or the same church. In general they constitute and should constitute a homogeneous group, preferably a small group because it is rather important that they know one another. There are times when within such a group of say 100 people some, at least, have a little money to save. Such savings will be deposited regularly if possible with the treasurer of the union, but otherwise just when one happens to have a few dollars to save.
>
> There are other times when some of us need 50 or 100 or 200 for some useful purpose but the amount required is such that we cannot take it out of our paycheck and we must borrow it. Perhaps it is needed for the purchase of furniture. Perhaps we need it to pay an insurance premium. Perhaps it is needed for doctor bills. In any event, as we all know, there are times when all of us feel that we must borrow a sum of money for some purpose. If the amount required is very large, we would probably have to go to a bank or some other lending institution and we would have to place a mortgage on our

[9]Luck, J. Murray, *The War on Malnutrition and Poverty, The Role of Consumer Cooperatives* (Harper and Brothers, New ork and London, 1946, 203 pp.)

house or on our car or other assets in order to secure the loan. Credit unions seldom make large loans. In fact, in California they are not permitted by law to make a loan in excess of 10,000. This would obviously be considered a large loan and would have to be secured like a loan from a bank. But if we need a small sum of up to 300 we are permitted by the credit union law to approach the treasurer of the union and indicate that we would like to borrow this for a certain useful purpose. The treasurer will refer the request to a credit committee which consists of five members who have been elected to serve on this committee. If they feel that I am a good risk, that I am an honest person, that I can be depended upon to repay the loan by the agreed date, they will recommend that the loan be made. I, in turn, will be obliged to repay the loan at so many dollars per month and shall have to pay interest at the rate of one-half percent per month on the unpaid balance.

And so in effect all of us who are members of the credit union save money when we can and deposit it in the union where it will draw interest as in a bank or usually at a higher rate. In turn, when some of us need to borrow sums of money up to 300 we may now borrow through our credit union the money that is thus deposited and accumulated. Loans up to 300 would be character loans. Loans in excess of that amount would have to be secured. And so a credit union is in part a bank in which people can deposit money and from which people can borrow money. But those who may deposit and those who may borrow must be members, not anyone who happens to walk in, as in a bank. There is no annual membership fee. There is only a payment of .50 at the time of admission as a member. A credit union is a cooperative organization because all the work that is involved is done by the members. Also, voting for the election of officers and for the election of the several committees that are required by law is on the basis of only one vote per member.

I must also indicate what a credit union is not. While I referred to a credit union as being a sort of cooperative banking facility, it is certainly not a bank if by that we mean a fine building of stone and marble and with the large staff of employees and the kind of physical facilities that we associate with a bank. It is not a place in which anyone can walk in, open an account, and deposit money or make loans. The membership feature is important and the homogeneity of the group is important. It is not the usual type of small loan company. It is not like the Household Finance Company, the Seaboard Finance Company, the Beneficial Loan Company, etc. These well-known and efficient small loan companies operate essentially like banks but they operate definitely in the small loan field. In consequence they have to charge high rates of interest which at the present time in California and many other states are permitted by law to be as high as 2.5 interest per month. If the Bank of America were to make small loans (which indeed it does), it likewise would have to charge pretty high rates of interest (which it does) on small loans because of the fact that the cost of servicing a 50 loan is just about as much as servicing a 5,000 loan. A credit union is not a pawn broker's establishment. ou do not bring in your jewels, your clothing, or your musical instruments, etc. and leave them with the treasurer as security for repayment of the loan. They are small loans but they are character loans rather than secured loans.

I was asked to relate my experiences with the Palo Alto Credit Union. This institution was organized in 1936 at a time when an open charter credit union was permissible. In other words, anyone in Palo Alto is legally eligible for membership. Initially the credit union admitted to membership only those who were already members of the Palo Alto Cooperative Society. The purpose of this is to preserve the principle of homogeneity, and to make reasonably sure that the members of the credit committee will know the people who apply for loans.

A very fair question, which, in fact, I have often asked myself, is why the credit union was organized. The answer is to be found in the fact that it was very urgently needed. The years from 1930 to 1940 were extremely difficult in the economic sense. Some of you will remember the nationwide closing of the banks in 1932. And you will remember the great number of bank failures that were reported in 1933. Unemployment was severe. The need of people for borrowed money was very great but the willingness and the ability of the banks to make character loans were at a minimum. The banks themselves were having a hard time and could not afford to lend money to people who were temporarily unemployed or were living on marginal incomes and where, according to the strict practices of banks, a loan would not be considered safe. Even in Palo Alto, which is usually regarded as a fairly solid sort of community with little unemployment, there was a good deal of economic distress in the 1930s.

At the time the credit union was organized, cases had come to light of people who, being obliged to make small loans, had necessarily to turn to personal finance companies and had found that the cost of borrowing money was excessive. One of our early members moved to Palo Alto from Santa Barbara. There he was a dairyman. In 1937 he borrowed 195 from a personal finance company but was obliged to sign a note for 227 to include 3 for initial charges on the loan. His contract required that he pay off the loan by paying 11 per month on the principal and 20 per month in interest. I will abbreviate the story by merely stating that after one year he found it necessary to renew the loan and by the time he came to Palo Alto in 1939 he had paid a total of 162 in interest and service charges alone. He then borrowed from the Palo Alto Credit Union enough to pay off his indebtedness to the personal finance company and, in the course of time, was able to pay off his debt to the Credit Union. On this loan there was, of course, no service charge and the interest was one percent per month on unpaid balances. In another case a woman member on a small loan of 100 paid 33 in interest and service charges during the ten months required to pay off the debt. Had she borrowed from the Credit Union the total cost would have been 5.50. These are merely two of many dramatic instances where members of the Palo Alto Credit Union had previously turned to personal finance companies and paid heavily for the money that they had borrowed.

At the present time the California Small Loan Law does not permit service charges on loans, but the interest rate is fairly uniformly fixed at 2.5 per month on unpaid balances. The only reason, of course, that credit unions can operate so inexpensively is that they have no salaried employees, at least at the beginning, and the premises in which they do their business are usually provided rent-free by the organization in which the members are employed.

This is usually true, for example, of all industrial credit unions and postal credit unions as well as credit unions that, strangely enough, have been organized and operate among the employees of some of our banks.

The Palo Alto Credit Union does have three salaried employees and it does pay a modest rental to the Palo Alto Cooperative Society for use of office space in the store on California Avenue. But in general it is correct to say that operating expenses are very low, losses due to failure to repay loans are negligible, and failures among credit unions are almost nonexistent. They are, of course, rigidly controlled by law and are subject to the same kind of auditing procedure as other finance companies. I should also have pointed out that at the time we organized the credit union in Palo Alto we were well aware of the fact that, in some states, notably in Texas, the charges that people paid for borrowing money were plainly extortionate. In Texas, but in certain other states, there used to be and, to some extent there still is, little if any control over usury. One common device in the case of small loans was to execute, instead of one note for say 50, ten notes for 5 each. On each of these a legally permissible service charge could be superimposed. In a study made in Dallas in 1936 or thereabouts the records of 2,554 loans showed that the borrowers paid more than 85,000 in interest and charges on loans totalling 55,000. A public committee in Dallas estimated in 1940 that citizens of Dallas were paying illegal interest in the amount of one and one-quarter million dollars per year.

When the Palo Alto Credit Union was organized in 1936 it drew its members from the Palo Alto Cooperative Society. By April 1937 the credit union had 34 members and had made two loans totalling 232. One year later it had 90 members and had made 7,000 in loans. By February 1954 it had 249 members and with assets of 14,700 had made total loans to date of 89,000. By February 1955 the membership had risen to 1,471. The assets had increased to 334,000 and the total loans since organization amounted to 1,500,000. There are at present 652 active loans totalling 316,000.

The Palo Alto Credit Union and a number of other credit unions have an interesting insurance feature which amounts to this: I borrow from the credit union 1,000, stating that this is to be used to pay for a life insurance policy. The 1,000 is loaned to me under a contract which requires me to pay 7 per month in principal and six percent per annum in interest on the unpaid balance. In other words, it is a 12-year loan. I then explain that I wish the credit union to buy the insurance policy for me. The 1,000 is now paid back to the credit union and it in turn assumes the obligation to pay the interest premiums. In so doing I automatically become the holder of a 1,000 share in the credit union on which I receive three percent interest per year and which in turn reduces somewhat the cost of the money which I borrowed in the first place. Like many other loans these days this is an insured loan with a double indemnity feature. If I borrow the 1,000 today and a few months later I die, the balance of the loan will automatically be paid off and my widow or estate will receive not 1,000 in life insurance, but double this, namely 2,000. This is the most inexpensive form of life insurance that I know of, especially so if one is lucky enough to be fairly old when he takes out the policy.

This has been an extremely sketchy account of credit unions and, in fact, deals with the Palo Alto Credit Union alone. I am not urging you to or-

ganize a credit union. I was asked only to tell you about the Palo Alto Society and it is, of course, for you to decide whether or not you wish to organize one. Frankly, I do not know whether you would qualify legally. Possibly since you were all born in Russia or your parents were born there you may be regarded as sufficiently homogeneous to come within the law. Perhaps as members of the Russian church you would be permitted to organize such a credit union. These are questions to which I do not know the answer. But, in principle, what you have to decide is whether you are interested in a cooperative plan such as this for small savings and for small loans at small expense.

If you study credit unions further you will, of course, find that there are thousands of them in this country and in Europe. They actually had their birth in Germany in 1840 or thereabouts. ou will also find that they are surprisingly safe. And the operational failures are negligible. This to me is a remarkable testimony to the honesty and integrity of ordinary men and women who, having contracted a debt, recognize that it is their responsibility to repay. Should you wish to go further in this matter and should it turn out that you wanted to organize a credit union, you should then make arrangements to meet with a representative of the California Credit Union league who would come to your meeting with all the necessary papers and would complete the business of organizing surprisingly promptly. ou would find that you would have to have the usual officers and a credit committee and a supervisory committee. This last committee has extraordinary powers and is permitted by law to discharge at once any officer or committee member who fails to observe strictly the duties of his office.

ou would have to have an office in a convenient but inexpensive place. Perhaps it would be open only a few hours a day or a few evenings a week. And you would have to have within your credit union at least 12 or 15 good, dependable people to be officers and committee members and a secretary-treasurer who would have to do most of the work, probably without a salary.

Political Cooperation

There is, of course, another type of cooperation which, to distinguish it from any of the above, will have to be called political cooperation. In recent years I have thought about this a great deal. If we are ever to have international understanding and something that savors of peace and good will, it will have to be by cooperation among the nations of this troubled world rather than by confrontation. For years, many of the Great Powers have thought of other nations as "bad guys" a sort of climate which is certainly not conducive to peaceful understanding among the nations. I recall that President Reagan used to describe the Soviet Union as "that evil empire," while some of the leaders of the USSR were prone to regard the USA as "an instrument of the devil." I do not propose to develop this theme further, emphasizing only the idea that nations must learn to cooperate or international violence expressed by war will continue to plague mankind.

Although I cannot recall any earlier effort than that of Lasserre to introduce integral cooperation in Canada, its practice in a number of communities

elsewhere has been well documented. Among the not-too-distant proponents of integral cooperation was Robert Owen (1771 1858), a liberal-minded English industrialist who sought to replace the competitive system of capitalistic industry by communitarian associations which in essence were full-fledged cooperatives. The movement in American began in 1824 with the foundation of cooperative villages and groups that expressed the grandiose but impractical schemes of Robert Owen. Despite the personal participation of Owen himself, the original settlements failed, as did subsequent colonies that followed in their wake.

The most extensive effort in the USA to apply the principles of integral cooperation in everyday life is to be found among the Mormons (Church of the Latter Day Saints). In the early 1850s the idea of living under a system known as the United Order was being considered by some of the Utah pioneers. They had had some experience in this style of living while still in Missouri and knew that common ownership, founded on spiritual guidance, had been advocated for many years by their leaders. In preparation for the time when this could again be accomplished, there had existed in Utah a period of cooperatively owned herds, farms, factories, and other industries. Groups banded together and bought cattle, sheep, and machinery for the development of the group. Nearly every community had its co-op store, owned and controlled by the people.

In 1872, President Brigham oung called attention to the Order of Enoch and commended some of its qualities. He referred to a city of homes built to suit the individuals who would live in them, but with community kitchens, dining rooms, dairies, laundries, bakeries, etc. He maintained that it would be better for five trained women to cook breakfast for 50 families than 50 mothers doing the same work. It would bring about a time when women would be free to seek greater knowledge. The same would be true for the farmers if land, machinery, etc. were to be owned on a community basis.

The years 1873 1874, at which time prices tumbled and people could not find a satisfactory market for their goods and produce, seemed a logical time for the doctrine of the United Order to be put into operation. President oung had spent the winter of 1873 in St. George, where, on January 11, 1874, he told the people of that city to prepare to enter the United Order. Robert Gardner was elected president of this first Order, with Daniel D. McArthur and James Nixon as vice-presidents. Thus the St. George Mormons were the first to enter this unique system.

Most of the communities that joined the Order adhered to their leaders' systems and requests. The officers were usually the same men who held the Church leadership, and in most cases they were desirous that the Order should be a success. But enthusiasm for the project palled to some degree after the death of Brigham oung in 1877. It has been said that despite the external and internal problems confronting the Order, it is not unlikely that the experiment

would have continued in one form or another for many years had national legislation not interfered.

Enforcement of the Edmunds Act, beginning in February 1885, dealt the Order the *coup de gr ce.* Passed in 1882, the Edmunds Act provided fines and imprisonment for the practice of plural marriage and unlawful cohabitation. When federal deputies began circulating through the territory early in 1885, many Orderville leaders, most of whom had entered into plural marriage, went into hiding to avoid arrest. Some of these men, including the president, Thomas Chamberlain, were eventually apprehended, convicted and sent to the Utah penitentiary.

> In consideration, therefore, of the internal stresses and strains that had rent the basic institution of the Order; the changing economic climate of southern Utah, which had stigmatized the Order as unprogressive; and now, under the prospect of being completely deprived of a functioning leadership by enforcement of the Edmunds Act, the general authorities of the Church counseled the dissolution of the Order in 1885. After listening to the advice of apostles Brigham oung, Jr. and Heber J. Grant, who had gone to Orderville to represent the Church, the members voted somewhat reluctantly, according to diaries and reminiscences to disband.[10]

Conclusion

At sometime during the past decade or so I was asked to contribute a guest editorial on "Consumer Cooperatives." Although I have no information at hand as to the publication in which this editorial appeared, I choose to include it as a concluding item on co-ops. I think it is appropriate because everything in the editorial is as true today as it was at the time of publication. The text of this follows.

> From Another Angle
> "Consumer Cooperatives" A Guest Editorial
>
> By J. MURRA LUCK
>
> EDITOR'S NOTE; J. Murray Luck, who occupies the Guest Editor's chair tonight, is associate professor of biochemistry at Stanford. He has made a study of consumer cooperatives, not only in this country but also in Denmark and Great Britain, and was one of the group of five that organized the Palo Alto Cooperative.
>
> The restoration of peace to a seemingly ever-troubled world and the attainment of individual security in the midst of a fiercely difficult struggle for existence are of concern to many. I think that the Consumers' Co-operative

[10]Daughters of Utah Pioneers, *An Enduring Legacy,* Vol. 9, pp. 28, 29 (1986). For a complete description of the Order, see Kate B. Carter (compiler), *Heart Throbs of the West,* 3rd edition, Vol. 1, pp. 50 71 (1947). See also Kate B. Carter (compiler), *Our Pioneer Heritage,* Vol. 18, pp. 22 26 (1975).

Movement has something to contribute to both. To peace, because it is a movement that belongs to the ordinary people of all countries, people who feel very much as one, people who have no desire to fight their neighbors in other countries, and people who can only be driven to war by incitement and vicious propaganda. It can also contribute to peace because there is something in the movement that takes away the occasion for war. It is built upon an entirely different motive from that which serves as the objective of economic enterprise generally. Business, as we usually know it, is driven forward by the search for profit. Cupidity and the thirst for gain which are synonymous with profit-seeking of the baser sort, when carried far enough bring about economic rivalries which are sufficient to serve as the framework of a first-class war.

I do not propose to simplify the picture to the point of suggesting but one cause of war nor is it my thought that the banks, the large corporations and international cartels must be branded as public enemy number one. I do believe, however, as the whole history of the movement shows, that the change of emphasis expressed by the phrase "Production for use, not for profit" has had a far-reaching effect and gives to Consumers' Co-operative Societies the world over a purity of motive and disinterestedness that are not easily described.

Mr. Gordon Selfridge (*Time,* November 13), unabashed, expresses the philosophy of the entrepreneur in an acquisitive society: "The opportunity to achieve…has been eliminated all over the world…everyone will be on a salary…enterprise will be abandoned." If this point of view represented only childish innocence and naivete it would be fitting to summon up a few arguments to the contrary and to dispose of it as utter tommy-rot. Unhappily, it is worse than simple nonsense. It expresses a point of view which is all too common and is to be found as the very framework of modern business. It is the getting-on-in-the-world-by-getting-rich point of view. It is decidedly anti-social and anti-pacific and I see only one way out that is well tested. It is in the reorganization of much of our economic activities along the lines of the Consumer's Co-operative Movement.

Security. The Consumers' Co-operative Movement was born in poverty. It was started by people of the lowest income groups who eventually learned that much could be done to pull themselves out of the mud by tugging on each other's bootstraps. I believe heartily in the good sense and the innate capabilities of the common man. The history of the co-operative movement is a vigorous testimony to his ability to organize his own retail, wholesale, and productive enterprises and in so doing to give security of tenure to employees; at the same time to give to the economic structure of society the stability that is indispensable to the success of any far-reaching plan for social security.

IV. THE STANFORD EARS AND VARIOUS DIVERSIONS

During my year in Toronto I was offered an assistant professorship by T. P. Nash in the Medical School of the University of Tennessee. We were both interested in the origin of blood ammonia and I liked him as a person. I promptly accepted the offer but, unexpectedly, because of a citizenship problem, the opportunity came to naught. Shortly thereafter, Robert Swain of Stanford University offered me an assistant professorship in the Chemistry Department with responsibility for the teaching of biochemistry. I went to Stanford in September 1926 and remained as an active member of the Department until retirement in 1965.

But there were many interruptions and discontinuities: life was not characterized by total immersion in research and teaching. Like other scientists I was drawn into many extramural committees and organizations during those 40 years: as an administrative officer of the Pacific Division, American Association for the Advancement of Science (AAAS) for about 15 years; as a member of fund-granting committees of the American Cancer Society, the National Institutes of Health, the Medical Fellowship Board, one of the panels of the National Research Council, and the National Science Foundation. For several years I was head of the Section on Biological Chemistry of the International Union for Pure and Applied Chemistry a more time-consuming diversion than I ever expected. But it was a memorable time because the groundwork was already being laid for the International Union of Biochemistry. It was also a difficult time for my two children, who were deprived of much of the paternal association and companionship that they would otherwise have had.

In Pursuit of Justice

THE MOONE -BILLINGS CASE When I was a young fellow, even as old as 30, I was eager to see injustice corrected and the institutions of our country, if not of the world, reshaped into something that savored of heaven on earth. The severe depression of 1929 1933 was a tremendous incentive to the young to single out the misdeeds and mistakes of their elders. I became interested in the Mooney-Billings case which stemmed from a bomb explosion in San Francisco in July 1916. Ten persons were killed and 40 wounded. Mooney was convicted and sentenced to death. Billings was sentenced to life imprisonment. Even before the remaining three defendants were tried, it was established that gross perjury had been committed by the principal witnesses for the prosecution. The three were acquitted but it was too late, because of legal technicalities, to re-

lease Mooney and Billings. They were still in prison in the 1930s. In March 1939 I joined a delegation that waited upon Governor oung, who had the power, but not the inclination, to release the two men. Shortly thereafter, I visited Mooney in San uentin and Billings in Folsom prison. Not until 1939 were the two men released. I wrote a report of the case in the "Friends Intelligencer."

THE FLAG SALUTE CONTROVERS At about the same time, I became interested in a nine-year-old boy in the state of Washington, Russell Tremaine, whose parents were members of the Elijah Voice Society. The parents, in September 1925, withdrew the boy from school because of their objection to compulsory participation of children in flag-salute exercises in the schools. The father served eight days in jail for refusal to send the boy to school. After a succession of court orders, the boy was transferred by order of the court in January 1926 to an orphanage. In June 1926, all intercourse, direct or indirect, with the parents was prohibited. The parents refused to compromise their beliefs and, in June 1927, the court ordered that the boy be held for adoption. In November of that year Judge Hardin, who succeeded Judge Brown in the County Superior Court, ordered that the boy be returned to his parents. I wrote a long account of the case but never submitted it for publication.

THE HENR MILLER CONTROVERS My love of books was not without its problems. In France, in 1949, I tried to purchase two books by my fellow Californian, Henry Miller. The bookstore, finding them temporarily out of stock, offered to send them by mail a few days later. Shortly thereafter I received a polite but peremptory request from an officer of the U.S. Customs: "A package of books by Henry Miller addressed to you is being held by the U.S. Customs. Their importation into the United States is not permitted. Please be good enough to sign the enclosed form to authorize their immediate destruction" (or words to this effect). I replied, "Thank you for your kind letter of recent date. However, I do not choose to sign the enclosed form." Soon a second and similar request arrived. In the meantime I transferred title to the books to Stanford University Libraries, Director Van Patten being happy to add them to the library's collection of Americana. The U.S. Customs disapproved of the pending transfer and again asked permission to consign the books to the flames. I refused to join in this contemplated burning of books a shameful practice which for many centuries impaired the study of history and literature. The American Civil Liberties Union, Western Division, then proposed to the judge of the appropriate court that a committee of 12 or so professors of English literature be appointed to pass upon the alleged obscenity of the books. The judge replied that a professor in one of our West Coast Catholic colleges had already convinced him that the books were obscene. The cost of a legal challenge to the judge's decision would have been prohibitive. This closed the case, but sometimes I doubt if the books were ever destroyed; I hope not.

In 1951 I had occasion to write to the editor of the Palo Alto Times concerning the two books. It turned out that what I would have regarded as a trivial matter led to a modest explosion of public interest. The letter to the editor and her reply are as follows.

The Editor
Palo Alto Times
Palo Alto, California

"The United States vs. Two Books"

Dear Sir:

Four or five years ago I had the pleasure of reading in the Atlantic Monthly an article about Henry Miller and the Big Sur: it was fascinating. In 1948, while in Paris, I visited the well-known firm of Brentano Company on a matter of business. While there I noticed a number of the works of Henry Miller. The *Tropic of Cancer* and the *Tropic of Capricorn*, perhaps the best known of his writings, were temporarily out of print, but, nevertheless, were ordered and eventually sent to me by Brentano. Months passed, the transaction was almost forgotten, when a letter was received from the Customs Office in San Francisco announcing the arrival of two books from France, the importation of which was forbidden. "Would I be good enough to sign the enclosed form authorizing the immediate destruction of these books or their return to France." Not having had the satisfaction of even glancing into these or any other books of Henry Miller, and being at the same time one who is inclined to rebel at legislation designed to decide for one what he should or should not read, I replied, "No, thank you very much." The matter, so far as I was concerned, was surely closed because I was also advised that my failure to comply would lead to their prompt destruction anyway.

In 1949 I was again in Europe where I received a press clipping to the effect that the United States Attorney, now interested in the matter, was seeking an order for the destruction of these books. The same mail brought a request from the Pacific Coast Director of the American Civil Liberties Union for permission to take up the case. From the press clipping I was again led to believe that the books were well on their way to the incinerator: I did not pursue the matter further. On my return later in 1949 I was informed that the books had not yet been consigned to ashes. I again asked if the Civil Liberties Union might not be permitted to take up the case. Title to the books was formally conveyed to the American Civil Liberties Union and the issue was then closed so far as I was concerned.

Apparently, however, the books are almost indestructible and the case is far from dead if one may judge from the press clippings which came to my attention in 1950 and September 18, 1951.

The purpose of this letter is not to discuss whether the importation of these books should be permitted. It is a trivial matter. I have no further interest in the case, and it is of small importance as to how it may be decided. To discuss adequately the question of censorship in such matters would take up too much of your space. Suffice it to say that the existing legislation is certainly puerile and quite inadequate anyway for the purpose for which it was

designed. Fortunately it permits the importation of Chaucer's *Canterbury Tales* which are available throughout the world and constitute a recognized requirement for English language majors. Many other classics, including the Old Testament, may also be imported.

The real purpose of this letter is to suggest, if I may, that the columns of your paper should really be used for matters which are not quite so trivial. During the past two weeks at least seven members of the Stanford Faculty, or from the institutions closely related, were in attendance at the Jubilee Meetings of the American Chemical Society and the International Congress of Pure and Applied Chemistry in New ork and Washington. It is just possible that, had you chosen to interview any one of the six or seven attending, something of much greater consequence might have been discovered. One of the participants, a former member of the Stanford Faculty, now back in Palo Alto, has been in India for the past two years. I am sure that he has much to tell that would be of great interst to your readers. There is no evidence that you have sought to interview him. Two years ago several from here were in Europe for an extended period of time and came back with observations that conceivably could have been of interest to your readers. Again, to my knowledge, no serious effort was made by your staff to determine whether or not they had anything to report. Indeed, it so happens that in 1949, when the "United States vs. Two Books" case was getting nicely under way, I was in Europe as a United States Government delegate at a conference in Paris, as a participant in two congresses in England, and later as an official representative at the 16th Conference of the International Union of Chemistry. I do not wish to imply that I would necessarily have had anything of great consequence to report to your readers, but it strikes me that you then displayed a singular lack of perspective in devoting space to a stupid case involving two books instead of to a dignified report on the congresses.

As the *Palo Alto Times* says of the *Palo Alto Times* (Sept. 19, 1951), "With the privilege of serving you goes a responsibility. We are ever mindful of this obligation." I would like to think that in your "awareness of this responsibility" you would give us much less of the trivial and much more of the substantial.

J. Murray Luck

September 21, 1951

Dr. Murray Luck
101 San Mateo Drive
Menlo Park, California

Dear Dr. Luck:

our letter of September 20 brings up points of very great interest, as regards both the book incident and our sins of omission.

As you know we tried insistently to reach you when the San Francisco papers and AP carried the latest story on the books. I regret that the background you now give me was not available at that time. It is not clear to me whether or not you intend your communication as a Forum letter, or merely as information to me. Since it is addressed "dear sir," I assume it to be the former. If that is the case, some cutting would have to be done. As you know,

Forum letters must be no longer than 400 words; this runs between 700 and 800.

I should very much like to use the material on the Miller books, if not in the Forum, then in a story. I certainly have no objections to using the criticism in the last two paragraphs. Undoubtedly we miss much important material and use much that is trivial. Why we do that is a subject we could discuss for days and never agree on, I suspect. As far as McBain goes, we have been trying for three days to get in touch with him, but have been unsuccessful to date chiefly, I think, because we have been desperately short-handed and have not been able to make repeated calls. I trust we will have the story in a day or two.

In general, we count on Fred Glover's office to keep us in touch with what Stanford faculty members are doing in their professional fields. In general, Fred has proved extraordinarily adequate.

I will be out of town until Monday, but would appreciate it very much if you would let me know what use of your letter you had in mind. As I said, I very much want to use the book part and am entirely willing to use the other.

Sincerely,

Elinor V. Cogswell
Editor

S. P. L. S rensen

In 1935, supported by a General Education Board Fellowship, I spent three months in Cambridge and three in Copenhagen in research on the liver proteins. For visiting biochemists, the Chemical Department of the Carlsberg Laboratory, headed by S. P. L. S rensen, was a sort of Mecca. S rensen, I suspect, was a very kind and considerate man of the old-school type. He made frequent rounds of the laboratory and derived, so it seemed to me, a special pleasure in finding everyone hard at work. I never felt able to confide in him, partly because he seemed to be very formal and I regarded him as up there somewhere among the Olympians of science, quite distant from the mere mortals in the lab. When I mentioned to him that I was planning a hurried pre-Christmas trip to Paris, Brussels, G ttingen, Berlin, Munich, Zurich, Prague, and Budapest to meet certain biochemists (European authors for the first volumes of the *Annual Review of Biochemistry*), I felt that he considered such a departure from the laboratory as a wasteful fortnight.

S rensen was 67 when I studied at the Carlsberg Laboratory. He died at the age of 71. "Time made him gentler, he became a delightful old man, calm and wise -just, unselfish, and warm-hearted. He expected a lot from his pupils, but that is no more than every good teacher ought to do."[1]

[1]K. Linderstrom-Lang, "Obituary of S rensen (1868 1939)." *C. R. Trav. Lab. Carlsberg. Ser. Chim.* 23:27 (1938).

S rensen's first assistant, later his successor, was Kai Linderstrom-Lang. I am sure that everyone who knew Kai loved him. He was friendly, affable, helpful, and possessed of a delightful charm and good humour. Like S rensen, he was a superb and imaginative scientist at that time engaged in the development and use of ultramicro-analytical techniques. I was especially interested because of his identification of the cells in pig gastric mucosa in which urease activity is localized.

First Teaching Institute of the Association of American Medical Colleges

In October 1953 I was privileged to participate in a National Teaching Institute held in Atlantic City. The proceedings are presented in the following.

FIRST TEACHING INSTITUTE OF THE ASSOCIATION OF
AMERICAN MEDICAL COLLEGES
Atlantic City, New Jersey
October 19 23, 1953

The purpose of this Institute was to evaluate the instruction currently given to medical students during their preclinical years. The departments recognized for participation were biochemistry, physiology, and pharmacology. I was invited to be one of the six or seven representatives of biochemistry from Johns Hopkins, Stanford, Virginia, Louisville, Tufts, and Western Ontario.

The Institute operated on a workshop basis, the delegates being divided into study sessions, each of which met twice daily. The subject for discussion on the first day was "content." I recall that the chairman remarked that he felt completely unprepared and inadequate for the job. This he illustrated by a story about an Arabian sheik who had occasion to leave his sheikdom and his harem for several months. He was careful, however, to give to a cousin the responsibility of seeing to it that no other man entered the harem. When the sheik returned he found to his amazement and distress that several of the women were pregnant. He discussed this with his cousin, who insisted that no other man had entered the harem; but, as an afterthought, the cousin recalled that being confined to bed with a severe cold, he had asked his brother to take over for a few days. This led to the comment that his brother was probably "not cut out for the job."

In response to a questionnaire directed to students and delegates, some very informative answers pertaining to content were received. The question that had been circulated read, "Do you believe that the subject material stressed in lectures and laboratory work in physiology, biochemistry and pharmacology was the most appropriate to give you a good foundation for medical practice " Those of us who represented biochemistry were disturbed but probably not surprised to learn that only four of those who responded were of the opinion that instruction in biochemistry was most appropriate for a good foundation of medical practice, while 15 responded negatively. In some detail it was pointed out that the lab work and lectures in biochemistry

were designed, so it seemed, to teach chemistry rather than lay the foundation for the practicing physician. The class was in unanimous agreement that concepts should be emphasized. The senior students pointed out that biochemistry emphasized techniques whereas physiology and pharmacology emphasized concepts.

In general, the discussions that took place among the hundred or so representatives in attendance were very informative and worthwhile. The Institute was well organized and the proceedings in all respects were of a high quality. I suspected that comparable institutes would be held in subsequent years, but so far as I know this was the first and only Teaching Institute of the American Medical Colleges that has been held.

This appendix constitutes an informal report of the proceedings. It is designed to be a synopsis of my own impressions and observations and is not intended to summarize with any degree of completeness the results of the studies carried out by the many sections of which the Institute was constituted. It was stated that a full report in book form would be published under the auspices of the A.A.M.C. in about a year's time. [Note added in 1989: I have not seen the book.]

Supplement to Luck Report

"The Model Colleague"
or
"Incompleted thoughts on the complete preclinical teacher."
(Content, Interrelationship, Teacher, Techniques)
John Fuller Taylor (Louisville)

With information theoretic, clinical, tutorial,
He is the very model of a colleague professorial.
He's integrated every fact of knowledge biochemical,
From college basic science course to application clinical.
He's correlated every bit of data physiological,
Arranged the lecture schedule in an order strictly logical.
Explored obscure relationships of drugs pharmacological,
To stress their exhibition in a manner biological.
He finds some time to introduce all features mathematical,
To deal with man as entire whole he knows the psychiatrical.
He goes to every lecture that is given in the Medical School;
Without this information, students think the prof's a stupid fool.
Coordination's incomplete if done in style rhetorical;
Perspective's therefore introduced in work laboratorical.
He puts a sincere effort in design of good experiments,
In finding meaningful results statistics make a lot of sense.
He knows the nicest balance, betwixt the technique practical
And fundamental principle best treated as didactical.
His students are evaluated, by quizzes of objective type,
With essay questions, orals, too, on any day the time is ripe.
The students are examined by every useful testing trick,
To try to help the little men, but never, never make them sick.

His students are provided with a list of projects beautiful
In order that the curious shall have a mental bellyful.
They never, never lose themselves in aspects that are trivial;
Enthusiastic students find the atmosphere convivial.
A fully-trained physician, versed in all the basic lore
A doctor of philosophy who also has gone back for more.
He keeps abreast of all that's new in every field conceivable,
His own research proceeds apace, at a rate that's unbelievable.
In short in matters theoretic, clinical, tutorial
He is the very model of a colleague professorial.

"Food for Thought"
(On the Salaries Deans Would like to Pay)
Alan C. Burton (Western Ontario)

For a Department Head to be happy as a lark
Twelve thousand dollars is about the mark.
If not a head, but only a Prof.
Ten thousand bucks should be quite enoff.
Assistant Professors are relatively cheap
Six thousand dollars is ample to keep.
The lowly Instructor needs little to eat
Four thousand buys hamburg, if not other meat.
The Fellow's metabolism is really quite low
He subsists on three thousand or even below.
But may we point out, without being rude
We would like to have more than intellectual food

Symposium on Teaching Practices in Biochemistry

The biochemists, perhaps somewhat startled by the conclusions of the First Teaching Institute, held a special Symposium on Teaching Practices in Biochemistry. My remarks on that occasion are summarized in the following.

> It is improbable that any symposium on the Teaching of Biochemistry would fail to consider the Report of the First Teaching Institute of the Association of American Medical Colleges. The Institute met here in Atlantic City in October, 1953, and concerned itself with physiology, biochemistry, and pharmacology. Some of us who are here today had the pleasure and stimulating experience of participating in the work of the Institute. Valuable as was the Institute I am certain that none of us harbored the illusion that it answered all the questions which concern the teaching of biochemistry. It was oriented definitely towards medical education and studied essentially the place of biochemistry and two of the closely related preclinical sciences in the medical school and their relationships towards each other.
>
> But the place of biochemistry in the scheme of things reaches out beyond the medical school. A goodly number of students from the biological sciences and from chemistry come to us year after year as undergraduates or as candidates for advanced degrees. Others are interested vocationally in the

curricula of schools of agriculture, of veterinary medicine, and of nutrition and public health. Does this mean that our academic institutions must be prepared to multiply their departments of biochemistry Does it mean that more and more curricula must be prepared and that special kinds of biochemistry must be taught to meet the presumed needs of students with different backgrounds of training and with different vocational objectives Does this mean that biochemistry must continue to be dominated both administratively and, perhaps, in its teaching philosophy by schools of medicine Has the time come for a new orientation of biochemistry within our universities, an arrangement both administrative and instructional which permits and encourages the presentation of the subject matter as that of a pure science May this be accomplished without failure to do justice to our responsibilities to the applied fields

The crux of this perennial problem is always to so improve our teaching and our definition of the subject matter that the biochemists who emerge from our universities may have a top quality training for this ever-new world. If their ultimate interests direct them principally towards research they must have developed a solid foundation in chemistry and one or more of the cognate sciences. They must have had the thrill of discovery and the invaluable experience of experiment design. If they are to practice medicine the student's training in the subject must be such that the place of chemistry and of biochemistry in diagnosis, in internal medicine, in surgery, and in many of the medical specialities may never cease to be recognized and appreciated.

The important question of horizontal integration with the other preclinical sciences, and of vertical integration with the clinical sciences can hardly escape consideration. This is an aspect of medical education which is fresh and provocative. Perhaps it is allied to another problem equally fascinating in its philosophy and its implications, that of project teaching. The experimental sciences are learned through the eyes and the fingers and the value of laboratory instruction may hardly be overestimated. Project teaching has become increasingly popular in pharmacology and I hope that some of our participants in today's symposium may have cause to report upon its possibilities in biochemistry.

Whatever may be the facets selected for consideration by our speakers, I know that we shall be alerted to these and related problems which concern the teaching of biochemistry.

American Association for the Advancement of Science

PARLIAMENT OF SCIENCE A "Parliament of Science," organized by the American Association for the Advancement of Science, was held in Washington, DC, March 15 to 17, 1958. I was invited by the Chairman of the Committee to prepare a paper on "Communication among Scientists and Communication between Scientists and the General Public," and to serve as the discussion leader in Area III. Some seven different areas were organized in an effort to cover science as adequately as possible.

The Conference was unusual in the sense that the papers prepared by those invited to participate were not presented by the authors. Instead of formal pres-

entation, copies of all of the papers, prepared well in advance, were distributed to the invited participants and to any observer who requested copies. The discussion sessions in each area consisted merely in the consideration of questions raised at the time by members of the audience or submitted in writing, in advance, by those designated as observers.

Interesting and informative as the Conference proved to be, I believe it may have been over-organized. Detailed suggestions concerning the content of each invited paper were prepared by the staff and distributed to the participants. This detracted, so it seems to me, from the freshness and originality of the papers prepared by the participating discussion leaders. Repeat sessions of the Parliament in the following years have not been held despite the hope of some that the 1958 Conference would be the first of a series. This suggests that the labor and expense involved in the Conference were possibly not justified by the results.

An outline of the paper I prepared follows.

Communication in Science

Provisional Draft of a Definition of the Problem with Pertinent uestions

I. Communication Among Scientists
Ia. By Personal Contact

The Role of the Academy and of the Learned Society

Until the advent of printing, the private letter was a favored means of communication among scientists. In the 17th century academies and learned societies began to appear under national or royal patronage. These have greatly expanded in number such that now thousands of learned societies exist, many of a very highly specialized character.

(i). What are the present-day values of the academy and the learned society as instruments for communication among scientists

Small Conferences and Symposia

The meetings of some of our learned societies have become so large that their effectiveness for the communication and exchange of information is being increasingly questioned. On all sides there is a very substantial increase in small conferences, symposia, colloquia, and special meetings restricted in attendance, and designed to encourage complete participation in discussion of the subjects under consideration.

(ii). Have the values of the small working conference been adequately developed What, if anything, should be done to increase the potentialities of small conferences and symposia for communication among scientists

Library Visitation

The early scientist was, in many instances, an itinerant scholar. Time was expended in personal visitation to the laboratories of one's more distant colleagues. The present day fellowship programs of various agencies and foundations, private and governmental, are clearly intended to permit and

encourage the continued development of this means of communication and study.

(iii). Is there a need for expansion of our fellowship programs Is a supplementary type of program desirable in particular one which would facilitate communication among scientists by visits to laboratories rather than for a settled period of study in one laboratory, the present standard type of fellowship program

Communication with the High School Teacher and the High School Student. The Visiting Scientists Program

(iv). What can be done to promote the transmission of scientific information from the research laboratory to the high school teacher and the high school student

International Congresses

An important means of communication among scientists of many countries is the international congress. Participation in such meetings is frequently found to be a stimulating and valuable experience in the training of a scientist. The cost of travel to an international congress is sometimes prohibitive.

(v). What should be done to strengthen the international congress and the international scientific unions through whose auspices such congresses are commonly organized

(vi). What should be done to make more readily possible participation in such congresses by the scientists of our country

Ib. Communication By Printed Media

The Scientific Periodical

With the founding of scientific academies in the 17th century and the birth of the scientific society, though in a rather rudimentary form, scientific periodicals began to appear. For the first sixty years of the 18th century the number of papers published in the rather small number of periodicals then in existence averaged not more than 3,100 or so per year. A *World List of Scientific Periodicals Published in the ears* appeared in 1925 1927. It included 150 libraries and 24,028 titles. The *Second World List of Scientific Periodicals* published in 1934 gave 36,000 or so as the number of titles of scientific periodicals then received by the 187 or so cooperating libraries in Great Britain. In 1934, about 750,000 scientific papers, rated as good or fair, were published worldwide. A third edition of the *World List of Scientific Periodicals,* covering the years 1900 1950, was published in 1952. A fourth edition for the years 1900 1960 was published in 1963 1965. The number of titles of scientific periodicals had risen by then to over 60,000. By 1956 or so, the number of papers, good or fair, had risen to about 2,000,000 per year. Contrast this with the first 60 years of the 18th century when the annual rate of publication averaged about 3,100 per year, as mentioned above.

The *Third World List,* published in 1952, contained a total of about 50,000 scientific periodicals. However, Sir Charles Sherrington, from a study of the *World Lists,* concluded that 20,000 or so of a 50,000 total were of trivial importance as journals of science publication. *Chemical Abstracts,* which applied its services to 4,300 periodicals in 1946, found itself abstract-

ing some 7,000 in 1956. About one-third to one-half of these are believed to have been born in the past decade (1946 1956): they are new. *Biological Abstracts* has reported (1957) on the explosive growth of the periodical literature covering biological research, exclusive of medicine and agriculture. The growth rate is quite comparable to that in the sciences generally and is likewise characterized by a high birth rate and a low death rate. The National Library of Medicine with some 233,500 bound volumes of serials on its shelves on June 30, 1957, is adding newly acquired ones at a formidable rate of increase. It is generally agreed that this spate of periodicals embraces not less than 2,000,000 papers per year.

(vii). What can be done to bring the contents of the world's periodical literature more effectively and more efficiently to the attention of the scientist

(viii). Must the periodical literature continue to expand Can a more effective means be devised for the recording of scientific information and for its circulation among scientists

The Secondary Avenues of Publication

(ix). Must the secondary avenues of publication be increased in number and in kind abstracts, reviews, monographs, and encyclopedias and their distribution facilitated

The Foreign Language Problem
Translation Programs
The Teaching of Foreign Languages

The language problem, troublesome as it has been in the past, has unquestionably become much more serious in the last few years. Dozens of new Russian language periodicals have appeared since the war. There is an expanding volume of scientific literature in Japanese and some indication that Chinese periodicals will soon reappear in appreciable numbers.

(x). Is this problem of such consequence that the present translation programs of the National Science Foundation and the Public Health Service should be greatly expanded and, perhaps, supplemented by other comparable programs

(xi). May it also mean that a much greater effort should be made in the acquisition by science students of linguistic competence in foreign languages Must an expanded program in the teaching of science be supplemented by a parallel expansion in the teaching of foreign languages

By Visual Aids

(xii). What may be done through the extended use of television and photographic devices to facilitate and improve communication among scientists

Interdisciplinary Communication

Much must be done to improve communication among scientists who work in different disciplines, especially between the biological and the physical scientists and between those whose interests are in basic research and those who are more concerned with the application of basic findings to practical problems. The many studies of the past fifteen or twenty years in

nuclear science are but a portent of much greater things to come. We have been vividly impressed by the fruitfulness of collaboration between biologists and physical scientists in the broad field of nuclear science and we are satisfied that much more cooperative endeavor will be necessary in the future. In the medical sciences, it is equally apparent that greater understanding and improved communication between the chemists, the physicists, and those in human biology are of considerable importance.

(xiii). What can be done to improve interdisciplinary communication, especially between the biological and the physical sciences

The Role of the Library and Scientific Information Center

Just as our scientific periodicals are fast increasing in number so are the demands that are being made upon our libraries for more space, more rapid service in acquisition, exchange services and loans, and copying services. For several decades the university libraries of this country have been increasing the volume of their holdings at something over 4 per annum. Libraries the country over double their holdings every 20 years. Science collections may be increasing even more rapidly. I calculated some months ago that were this present rate of increase to continue, the entire present floor space of Stanford University would be quite inadequate 100 years from now (2056) for the housing of its library collections, its library services, and its library staff. Our net rate of population increase in the US for the last 25 years has been about 1.7 per annum but our library holdings, the things that scientists must consult, have been increasing by 4 per annum.

(xiv). What can be done to make the wealth of scientific information that flows into our libraries more rapidly and more effectively available to the scientist

(xv). What can be done, perhaps as a matter of national policy, to build up regional libraries, or regional groups of cooperating libraries in such a way that completeness of holdings, and completeness of services may be a feasible objective for each region Should we proceed to the establishment of a National Science Information Center comparable in its functions and purposes to the Soviet All-Union Institute of Scientific and Technical Information

Scientists in industry, in agriculture, in the applied fields generally and those in our universities and institutes for basic research are equally in need of rapid access to complete library services.

(xvi). What can be done to increase the services that libraries can render to the industries and applied sciences within their regional area To what extent can we resort to mechanization for the more rapid storage and retrieval of scientific information and for the more rapid distribution of information on selected subjects

The Classified Research Problem

(xvii). To what extent is the work of scientists within industry, within government, and in classified research under contracts in universities and elsewhere, hampered by restrictive policies on the free flow of scientific information secrecy in the development of new products and new techniques for industry, and secrecy in the pursuit of research on matters of national security

(xviii). Can declassification be pursued much more rapidly and boldly

(xix). Can the pursuit of classified research be largely restricted to government agencies, industry, and non-university research institutes

The Security Problem

(xx). How can security regulations be cut to the minimum to permit greater freedom of publication, greater freedom of communication among scientists and greater ease of travel for scientific purposes, from country to country

(xxi). To what extent does the machinery for establishing the loyalty and integrity of individuals engaged in classified research impede the advance of scientific research

(xxii). To what extent do our security policies affect adversely the exchange of scientific personnel between the United States and other countries and thus impede the flow of scientific information and embarrass the maintenance of friendly relations between scientists of the world

(xxiii). Is the import and export of scientific periodicals and books from foreign countries, specifically from the USSR and its satellites, jeopardized by our postal laws and regulations or requirements of the Department of Commerce

(xxiv). To what extent do our security regulations affect adversely the making of grants-in-aid for research and the issuance of fellowships by our federally supported agencies

(xxv). Is our national scientific effort impeded by the existence of several agencies for the clearance of scientific personnel and is it feasible, for security purposes, to consolidate the machinery for clearance into a single agency of government

The Science Attaché

The impact of scientific discovery on national policy has come to be appreciated by the national governments of several countries, including our own. This is evidenced by the appointment of science attachés to a number of major embassies.

(xxvi). What can be done to facilitate the exchange of scientific information, and to promote exchange of scientists by the science staffs of our various embassies What other services in promoting international communication among scientists might be most helpfully developed through the Science Office of the State Department

(xxvii). Should similar services be rendered by other departments of government and if so how should they be defined and integrated so as to avoid unnecessary duplication of effort

II. Communication with the Public

It is becoming increasingly important that the layman shall come to understand the nature of science both as to its method and as to the nature and import of its impact on society. This becomes of considerable consequence in order that the public may appreciate adequately the role of science in the well-being of mankind. A harmonious accord between our representatives in legislative assemblies and between the scientist is correspondingly of equal

importance. An increasing number of questions of domestic and international significance are deeply rooted in science while many of the findings of the scientist can have a profound impact on national policy. This has become abundantly clear in the field of nuclear science, in meteorology, in fisheries, etc.[2]

(xxviii). What can be done to improve an understanding of the nature of science by the layman and by our representatives in legislative assemblies How may the findings of science be so communicated as to be sympathetically understood and respected by the public

(xxix). What can be done to expand and improve the services rendered by such mass media as the daily press, popular magazines, radio, and television in the interpretation of scientific discovery to the layman

(xxx). To what extent may information on the acceptance of science and scientists by the layman be obtained by readership surveys, television program analyses, and public opinion polls

Pacific Division of the American Association for the Advancement of Science

Three years after coming to Stanford University as an Assistant Professor of Biochemistry, I was asked to serve as Secretary-Treasurer of the Division. I accepted the invitation and held the office from 1929 to 1944, with responsibilities for maintaining appropriate contacts with the member societies, preparing the programs for the annual meetings, and discharging whatever other duties might be assigned by the President and Council of the Division. I received an annual honorarium of 900 for the services rendered and derived much pleasure from the many friendships that were made during those 16 years.

Beyond a 100 attendance at all meetings of the Division from 1929 to 1944, I participated in virtually all meetings during the 1950s. I prepared official reports of many of the meetings of the Division, which were published in *Science*, for example: Vol. 72, pp. 255 65 (1930 meeting in Eugene); Vol. 76, pp. 303 16 (1932 in Pullman); Vol. 84, pp. 169 74 (1936 in Seattle); Vol. 88, pp. 195 204 (1938 in San Diego); Vol. 94, pp. 121 30 (1941 in Pasadena); Vol. 96, pp. 146 50 (1942 in Salt Lake City). Results of later meetings were prepared for the Council but were not published.

Typically, such reports listed the member societies that participated in a stated divisional meeting, the general evening addresses, and the papers presented within the sectional meetings of the individual societies. Business transactions of the Executive Committee and Council were also reported upon and excursions to places of scientific and cultural interest were described.

[2]Important in relevance is the section of these reminiscences on Science, Technology and Foreign Affairs, pages 192 to 213.

My attendance at the meetings of 1958 to 1961 was often combined with family vacations.

MI ING MEETINGS AND VACATIONS In 1947 I married Eroeda Sinitskaya.[3] In 1948 our daughter, Nadya Elizabeth, was born, followed by our son, Edward Eugene, in 1950. In 1958 Nadya became ten years of age and Edward, eight. My wife and I decided to take our children to the 1958 meeting of the Division in Logan, Utah, in mid-June. The scientific sessions would probably be of little interest to the children, but the drive from Menlo Park would take us through many places of interest and opportunities to make side trips would be afforded. The return drive by an entirely different route also gave promise of additional sights of much interest. The trip to Logan, about 1,000 miles from our home, took us through Sacramento (with a delightful pause at the Nut Tree Inn, near Vacaville), Reno, Saltair, and on to Logan about 100 miles beyond. We camped out for the night in the North Willow Canyon a source of mixed pleasure, anxiety, and sleeplessness. On June 17 we went by bus from Logan to Bear Lake Bird Refuge, a side trip that delighted all four of us. The next two days found us listening to lectures.

By Friday, June 20, we were ready to commence the homeward trip. We drove to Jenny Lake and the Grand Teton National Park. After another campout we reached the South entrance to ellowstone National Park on Saturday at about noon. After crossing the Continental Divide we reached Fishing Bridge Camp where we rented a cabin (for 9 per day). On Sunday morning we went fishing in ellowstone Lake for cut-throat trout. Charley O'Brien, from whose boat we fished, showed us how and where to tempt the trout. We caught six and had them prepared for lunch in the local cafeteria. Sightseeing kept us interested the rest of the day: Mud Volcano, Black Dragon Cauldron, Dragon's Mouth, Mammoth Hot Springs, etc. Bears and a fine herd of elk added plenty of interest. By 7 p.m. we were back at the camp after doing about 100 miles in the park.

On Monday, June 23, we toured the South loop to West Thumb, Old Faithful Geyser (which erupted on schedule at 12:05 p.m.), Canyon Village, and back to Fishing Bridge Camp. The children counted 53 bears that we had en-

[3]We met at a Russian restaurant in San Francisco a few weeks after her arrival from China. Eda (Eroeda) was born of Russian parents in Harbin, Manchuria. She lived there with her parents, brother, and sister until 1939, meanwhile attending a high-level Russian gymnasium. In 1939 she moved to Shanghai. The city was then under Japanese occupation and the times were difficult. She was enabled to come to the USA, doing so on the "General Gordon." We were married in the Russian Cathedral by Archbishop Tychon. As the mother of two children, grandmother of two, and wife of the writer, she has been a remarkable person. She is a devoted member of the Russian church in Menlo Park and a volunteer Russian-English translator in Stanford University Hospital and the Palo Alto Medical Clinic. Since 1948 she has recognized Russian Orthodox Easter every year by a festive celebration with her many friends in our home in Menlo Park.

countered thus far. Again we crossed the Continental Divide (elevation 8,200 feet).

The 1959 meeting was held in San Diego. We left home on June 14 and drove to San Marino (or San Fernando) to visit the Utwich family whose friendship dated back a few years when they lived in Menlo Park. At our home on one occasion, Edward (young indeed) climbed up on a table and was asked by a guest if he knew the Gettysburg address. “No, but I know Mike Utwich’s address.” In school where the two boys were classmates, the teacher once asked, “Mike, who wrote the Declaration of Independence ” “Please m’am, I didn’t do it ”

On June 15, avoiding Los Angeles, we drove to Pasadena, on to the Mission San Juan Capistrano and finally to the Mission Valley Inn in San Diego. We visited the famous zoological garden the following morning and took the bus tour over the large area occupied by the many buildings and open-air enclosures. After a delightful swim and barbecued dinner we went to the seal-chimpanzee amphitheater where Henry Eyring fascinated his audience and many raucous peacocks by a lecture on Antarctica and the International Geophysical ear. As was his custom, Eyring addressed a few questions to members of the audience. The replies, however, came from the peacocks which flew wild and noisily in the vicinity Eyring took the competition without complaint and acknowledged with thanks the peacock answers to his questions. The peacocks and the humans were greatly interested in Eyring’s remarks about Antarctica which is covered by a blanket of ice about 8,000 feet in thickness. We learned that a 30-inch hole has been drilled to a depth of 1,000 feet, permitting measurements of temperature at various levels. Core specimens totalling 1,000 feet in length have been taken, the lowest having been formed about 1,500 years ago. The rainfall was then about three to five inches per year. Eyring pointed out that if the ice over Antarctica were to melt, the levels of the oceans would rise by 300 feet

On the 17th we had an early morning swim and did our duty by attending two or three of the lectures. In the evening we sat in on a very fine lecture pertaining to the Galapagos in which the speaker described his collecting trips in 1956 for wild tomatoes. The illustrations were magnificent. The next day (June 18) we drove to La Jolla and visited Denis Fox with whom I had been associated in a research project at Stanford University. Denis showed us around the Scripps Institute of Oceanography which was well worth seeing. We had dinner at the gourmet restaurant in “Town Country.” It was located just across the road (Highway 80) but crossing was impossible because of the very heavy traffic. We solved the problem by driving east for two miles or so where a left turn became possible and a westward return to the restaurant was feasible. I can hardly believe that traffic in the San Diego area is any better (or worse) at the present time (1990.)

On June 19 we went on a trip by bus to Mt. Palomar Observatory, some 72 miles away. En route we visited the Mission Pola, constructed in 1804 or thereabouts and still ministering to the Indians.

On June 20, we left for Prescott (Arizona) via El Centro, uma, miles and miles of sand hills, the Capo Indian Reservation and uartzite. With the children we explored the nearby hills of rocks. Montezuma Castle (dating back to about 1,000 A.D.) and Tuzigot National Monument were among the most exciting and interesting places that we saw. We reached Flagstaff in mid-afternoon and early on June 22, departed for Meteor Crater about 45 miles east near Winslow. We doubled back to Williams, fascinated by ice caves, lava beds, and the Grand Canyon of the Colorado. From Williams we went on highway 66 through Seligman and Kingman to Boulder City and Las Vegas. Finally, on June 24 we headed for home through Bakersfield, Fresno, Los Banos, Gilroy, and San Jose. In Arizona we drove by hundreds of specimens of the giant cactus (the Saguaro Cactus) or *Cereus giganteus*, the blossom of which is the state flower of Arizona. The cactus grows to a height of from 40 to 50 feet and lives to an age of 150 to 200 years.

Of course, we made it a point to see the then famous Hoover Dam. We were home by 8:30 p.m. on June 24, thus concluding the 2,341-mile trip of 1959.

On June 10, 1960, at 1:30 p.m. we left home, headed for Eugene, Oregon, where the Division held its June meeting. The trip to Santa Rosa and Willits was uneventful. We spent the night at Brooktrails Guest Ranch about two miles from Willits. We enjoyed a swim in their pool and, in the morning, a horseback ride for an hour or so. At 10:00 a.m. we paid the bill (28.10 for two bedrooms, kitchen and bath, four dinners, four breakfasts, and three horses). En route to Brookings we picked up an itinerant missionary, Bob Wallace, whom we drove to Garberville. About 15 miles south of Crescent City we came to the Trees of Mystery and at 7:00 p.m. arrived at Brookings and the Bonn Motel, where we spent the night.

The following morning we visited the Sea Lion Caves en route to Florence, route 36, and on to Eugene, where we arrived at 7:45 p.m. on June 12 (728 miles from home). We stayed at the New Oregon Motel, located near the university. We had various meals at Ford's a nearby restaurant. June 13 was uneventful. Early on the morning of June 14 we drove to the MacKenzie River Forest Experiment Station. This included a fine drive up Lookout mountain and lunch at 3,000 feet or so. We saw magnificent douglas-fir trees, and mountain hemlock. Among a variety of plants we saw wild blackberry, many ferns, wild thimbleberry, coral root orchids, and rattlesnake orchids. At noon it began to rain heavily; we returned to the motel, visiting, en route, the Cougar Dam, which was then under construction.

On June 15 we started the day with a drive to the Weyerhauser Lumber Company, located not many miles from the motel. The mill and pond, filled

with logs, made quite an impression on the four city dwellers. In the evening, after a fine banquet for the Division and its group of participating member societies, an excellent address on Geochronology was delivered by H. P. Hansen. Present evidence (pollen and carbon-14 dating), so we learned, indicate that glaciers occurred at 1,500- to 2,000-year intervals, going back to Cochran which is dated about 10,000 B.P. (B.P. Before the Present). The Nankato glacier (35,000 to 40,000 B.P.) is accurately dated from tree remains on the east flank of Lake Michigan and supporting evidence from Sweden. The period 4000 to 8000 B.P. was warm and dry as determined by the kind of vegetation. Also, elephants roamed the Great Central Plains of Southeastern Oregon. Man came from Asia about 40,000 to 50,000 B.P. at which time there was heavy glaciation. Ice was piled up on land and the Bering Straits were 300 feet lower; a land bridge of 1,000 miles width existed. All over North America artifacts of man's occupancy all dating as far back as 10,000 to 12,000 B.P. have been found, e.g. Danger Cave (one mile north of Wendover) and Rock Cave in Oregon (Fort Rock) which in 25,000 B.P. protruded above lake level: the highest bench line in that area washed the base of Fort Rock. Indians lived there in those early days and sandals from the cave have been accurately dated.

Thursday, June 16, was uneventful. On June 17 in the late morning we came to Crater Lake with its centrally located "island" which constitutes what is left of Mt. Mazuma. By the early evening we arrived at Burns, Oregon, after passing through Silver Lake and Valley Falls. On June 18 we left Burns, headed for Sun Valley, Idaho, passing through Buchanan, Parma, Shoshone and exploring the remarkable ice caves about twenty miles beyond Shoshone. The ice caves, only a few feet below the surface, were discovered by a ten-year-old boy (so we were informed). The area was leased from the government in 1945 1950 after a futile attempt by the government in 1938 to have it declared a national monument. We spent the night in the Jack Frost Motel, which was very good. The room charge, by the way, was 9 a day.

On June 19 we had breakfast in Ketchum and a short time later found ourselves in Sun Valley. To our surprise and pleasure we noticed the large outdoor skating rink in Sun Valley. We spent the morning ice skating and the afternoon enjoying a swim in the large hot-springs pool at Bald Mountain. We resumed our homeward trip quite early on June 20. About 75 miles beyond Ketchum we came to Craters of the Moon, almost as fascinating to us as the Ice Caves in the Shoshone area. We came to Twin Falls in the early afternoon and crossed the Nevada border about 50 miles beyond Twin Falls. We spent the night in Wells at the El Rancho Hotel and, early in the morning of June 21, left for Elko, Battle Mountain, Austin, Virginia City, Fallon, and Sparks (about 400 miles beyond Wells). We slept in the Wagon Train Motel. On June 22 we arrived home in the mid-afternoon after going through Auburn and Vacaville. The round trip June 10 to June 22 represented a total mileage of 2,737.

osemite National Park

In March 1961, the Luck "foursome" went to osemite National Park not because of a divisional meeting of the AAAS but to introduce the children to California's most precious asset, magnificent redwoods (mostly *Se uoia gigantea*), waterfalls, and surrounding mountains that enclose the park. We left home in the morning of March 27 and entered the park on highway 140 from Merced. We were accommodated for two nights in Camp Curry.

On March 28 we drove to Badger Pass where plenty of snow and magnificent weather permitted all the pleasures of a day of skiing. We returned to the valley for dinner at the Awahnee Hotel and an evening program of entertainment. The next morning we hiked to Vernal Falls, less than a mile beyond Happy Isles. At noon we headed for home, stopping in Mariposa for lunch at Half-Way House. We arrived in Menlo Park by 5:50 p.m., completing a round-trip drive of about 500 miles.

I had visited osemite at least twice before. In 1930 or thereabouts I hiked in from the Fresno area with Leonard Keeler, Harold Brown, and two pack animals. We hiked as far as Muir Pass and returned by about the same route some ten days after entry. A few years later, accompanied by a fellow professor at Stanford, Luther Evans (later Librarian of Congress), and his wife, I again visited osemite. We entered the park in May the first day after opening of the park for the tourist season. We camped out and slept comfortably with a good fire next to us. Luther and I alternated in keeping the fire alive, and discouraging the bears that threatened to rip the car open to get the food that they knew was inside. During my first watch, I fell asleep, awakened, however, by the screams of Mrs. Evans who saw a bear in the vicinity. In the morning we examined the Indian Caves and played with the idea of spending our second night therein. Almost alone in the park, we roamed about enjoying the view of El Capitan (elevation 7,564 feet), Half Dome (8,852 feet), Vernal Falls (317 feet), Sentinel Falls (900 feet), and osemite Falls (upper, 1,430 feet and lower, 320 feet). It was too early in the season to permit a complete thawing of the various falls; hence the falling water was fairly meager in quantity.

Bicycling Through Northern Europe

The Conference in Paris on Science Abstracting (see pages 44 to 49) concluded late in June 1949, leaving the month of July free of significant commitments. I had planned to attend the First Congress of the newly organized International Union of Biochemistry to be convened in Cambridge, England, in late August 1949. The time for a few weeks of cycling was opportune.

In Paris I bought a beautiful green Peugeot bicycle and rode it around the center of the city until I felt comfortable and confident that it would carry me to Copenhagen with few objections. I left Paris on July 4 with my worthy steed

heading for northern France and Belgium. I well remember Laon, the first town of real interest. It is atop a conspicuous mountain, actually a long, narrow plateau about 600 feet above sea level and is surrounded by a substantial rampart. My camera fell in love with the town of which the several gates in the monstrous walls are impressive, notably the Porte de Soisson and the Porte d'Arson. Construction of the town commenced around 1160, about the same time as the church of Notre Dame in Paris. Many of the buildings, proud of their antiquity, give to the town a mediaeval touch that must surely be unforgettable to visitors from the New World. For centuries the town was probably impregnable and provided shelter to those who lived in the environs outside of the massive walls. All in all it was well worth visiting. The small towns in northern France are interesting but not for long. The hotels, as I found them, were certainly few in number, no running hot and cold water, no provisions for a bath, the W.C.s in need of repairs, but the hotels were otherwise satisfactory though simple. Of course, excellent food was available even in the smallest.

Northern France and southern Belgium were full of memories of World War I: cemeteries of many, many acres, very well maintained, and with innumerable monuments. World War II had also done its bit, principally during the liberation when the Germans, Americans, and British alike blew up or damaged various buildings, e.g. part of Soisson cathedral and part of the old rampart that surrounds Laon. On July 7 I went through Cambry, Friedmont, and Vervins to Avesnes and the next day through Maubeuge to Mons. We are now in Belgium.

The trip in Belgium ended in Antwerp. I stopped for a few minutes at an outdoor cafe to inquire how one could get out of Antwerp in the direction of Holland. I was seated at a table and ordered a *citron press* which arrived just as another visitor, an American tourist, sat down beside me. In the course of conversation I found out that he had just arrived from Paris, so the obvious question was, "What did you do in the big city " His reply, "Well, of course, I went to the Louvre, but I could have done the whole thing in half an hour if the floors were not so damn slippery "

In Belgium I was impressed by the evidence of well-being and what looked like prosperity. The shops, especially in Brussels and Antwerp, were full of food, clothing, and luxury items of all sorts. In the streets of the cities there were many 1948 Buicks and Chevrolets. They were owned by Belgians, not by tourists. The Americans seemed to be localized in Paris. I met only a few in provincial France and in Belgium. The prosperity was alleged to come from the Belgian Congo but I am not sure. The steel industry around Li ge is not what it once was due to exhaustion of surface workings of coal near Li ge but it was pretty good.

Hotel accommodations in Mons, Brussels, and Antwerp were good and quite inexpensive, even in the Hotel Metropole in Brussels, where I was ac-

commodated in a large bathroom; all regular rooms were taken. I spent Sunday, July 10, in Li ge with the Marcel Florkins. He was Professor of Biochemistry at Li ge. His wife was French and retained her citizenship for which Florkin said he must pay a special tax of about 4 per year. Li ge was badly damaged by V-bombs during the closing months of the war and the station at Antwerp was almost completely destroyed. The station at Mons was destroyed by the British and Americans but I found it to be almost rebuilt. The Florkins lived, at least for the summer, in a very beautiful house on a high rocky island near the village of Ham-Esneux. It is not really an island, but almost, for the river Ourthe nearly surrounds it completely.

Belgium was much divided by language and by Leopold. Northern Belgium is Flemish-speaking. Even Brussels is a French-speaking island surrounded by the Flemish. As for Leopold, the Catholics and the Flemish wanted him back. The liberals, socialists, and the real French insisted that he must abdicate. Leopold, it seems, wanted his old job back and was just waiting.

Northern France and southern Belgium had a peculiar charm due I think to a complete lack of fences and, of course, no roadside signs. Every main road seemed to be a long avenue lined by trees and with the fields of grain coming right up to the roadside. The fences began to appear in Belgium, due, I suppose, to grazing. I crossed into Holland on July 12 and spent the afternoon and night at a very charming old town known as Breda.

I was in Holland for a solid week since it is a long journey from Breda to Rotterdam, the Hague, Amsterdam (where I stopped for one day), Amersfoort, Lochem, Ootmarsum, Denekamp, and the German-Danish border. ou may not have heard of most of these places, nor had I. This was because Holland is so ideal for cycling and the roads, even the small ones, are so good that it was possible to take a route from the Hague which went through real Holland quaint old villages, along the many, many canals of western Holland, where motor cars in many places could not travel.

All of the bridges in northern France, in Belgium, and in Holland were blown up by one side or the other. Many of the temporary structures were replaced but a few more years were required before bridge rebuilding was finished.

The whole trip was fascinating but I think the week in Holland was the most pleasant and interesting. The hotels were good, even if small, the food was excellent though not up to the standards of France and Belgium, and the countryside was charming.

If I ever come to Europe again and we are to travel around by car I think we would keep away from every road recommended by the tourist associations and marked most prominently on the maps. They seem to miss most of the things that matter. On some of them traffic is quite heavy. Briefly, they are unpleasant.

On the 19th I crossed into Germany in the vicinity of Nordhorn. I forgot to mention that eastern Holland (Lochem and Ootmarsum for example) was liberated by the Canadians in April 1945. Canadians were quartered throughout eastern Holland until the end of 1945 and the Dutch people think that Canadians are pretty wonderful. The behavior of the Canadians was exemplary, that of the Germans pretty awful. I had to fill out a police registration form wherever I spent a night. These gave Canada as the place of birth, which pleased the Dutch very much.

I had a military permit for Germany and could have remained thirty days but the seven were just about enough. This is the minimum time, I am sure, in which an old man of 49 can go by bicycle from Nordhorn to Flensburg. The first night was spent in Lingen and the next in Cloppenburg, the third in Rotenburg (going through Bremen en route). After Rotenburg I went through Hamburg and spent the next night in Ahrensburg. Then through Lubeck to Preetz; after Preetz through Kiel, Eckernsfort, and Schleswig, to Flensburg.

First of all, in summary, the pleasant impressions. The people were very friendly and helpful and I liked everyone I met, except the proprietor of the Hotel Manhagen in Ahrensburg, but that's another story. Cloppenburg was very charming in fact the whole of southern Oldenburg was a great delight largely because of the old farm houses constructed by real craftsmen in the early 19th century and late 18th. Around Malente, Plon, Preetz, and Eckernsfort there are lovely beaches, lakes, and all of the beautiful scenery that goes with such things. The food was very, very simple, as a rule, but restaurants and hotels were easy to find. Just as in Holland I had cauliflower until it sprouted from my ears, so in Germany I ate red cabbage from one end of the Duchy of Hanover to the other.

The unpleasant impressions. These are summed up entirely in two words: Bremen, Hamburg. Here the devastation was incredible. I was in London in 1941 and 1948 but saw nothing like Bremen and Hamburg unless it be the area around St. Paul's. London had been tidied up though not reconstructed. But in Bremen and Hamburg the crumbling ruins and gaunt spectres of great buildings without windows or roofs still stood. Were it not for the grass and weeds that grew up among the bricks and tumbling walls one could believe that the bombing was of last week. Block after block after block was completely ruined. Here and there a few small shops surrounded by ruins had appeared; here and there were potato gardens and vegetable patches among and on top of the ruins; here and there rows of shacks or of semi-cylindrical houses (Nissen huts) for temporary housing. Great numbers in Bremen and Hamburg were unemployed there was no money available to make any serious start on the cleaning up of these cities, let alone their reconstruction. Kiel was ugly before the war and of course now it was very unpleasant.

On July 25 I crossed into Denmark and went to Kolding for the night. The next day and night, after a complicated trip by train, were spent very, very pleasantly with friends at Svaejbek in central Jutland. Then I rode back to Veile and Middelfart through very hilly and beautiful country. In the next two days I crossed Fyn and Sjaelland and arrived in Copenhagen on Friday afternoon.

From Paris to Copenhagen I slept in hotel rooms, in bathrooms, in a banquet room, in a villa, and in a private home (in Preetz). All in all, accommodations were good though usually quite simple, and sometimes very primitive. The trip was interesting and enjoyable but I would never do it again by bicycle: people were very curious everywhere and were quite convinced that I must be crazy.

I have now sold the bike, almost regretfully, for we were pretty close to one another. I spent a few days in Copenhagen where I again visited the National Museum which has a vast collection of anthropological and archaeological items relevant to the history of Denmark and part of Scandinavia in general. Of course I visited the Carlsberg Laboratory where I had pursued research in 1935. Kai Linderstrom-Lang was now the head of the laboratory in succession to S.P.L. S rensen, who had died in 1939 (see page 90).

I flew to London in mid-August in good time for the First Congress of the International Union of Biochemistry which convened in Cambridge, August 21, 1949.

V. NUTRITION

I have had a lasting interest in the science of nutrition since those unforgettable years in Cambridge. Hopkins, in his discovery of tryptophane and "accessory food factors," laid a firm foundation for much that followed, the world over, in our knowledge of essential amino acids and vitamins. About all that I myself ever published on nutrition appeared in the following two papers, and in my book which dealt with human nutrition, poverty, and consumer cooperation, referred to on page 62 (and 82).

Wartime Nutrition

Fortification of Foodstuffs
Arguments in Favor:

1. The average American housewife consumes little more than 2000 kilocalories per day. On this food intake it is practically impossible, no matter how the foods be juggled, to obtain the quantities of the several vitamins recommended by various authorities and tentatively proposed by the Committee on Foods and Nutrition of the National Research Council.

2. There is, I believe, good reason for believing that vitamin deficiencies are widespread although some would question the extent to which this is true. There is very little xerophthalmia but the dark-adaptation studies of Pett, Jeans, and associates, and of Dr. Blanchard, convince me that a subclinical deficiency is probably widespread. I admit that Heckt and several others are inclined to be increasingly cautious, however, in interpreting the results of dark-adaptation tests. If weight be given to the studies of Williams and Mason we have to recognize that thiamin deficiency with subclinical manifestations is probably fairly common. I say, if weight may be given to this work, because I have reason to believe that the tests used were subjective in character and the victims were inmates of a state hospital for the insane.

In pellagra we are confronted with a deficiency that is endemic, clinical in character, and perhaps calling for multiple vitamin therapy and other kinds of nutritional therapy. Anemia is exceedingly common. Half of the women in the poor districts of London and Aberdeen have been found to be anemic. Iron deficiency is probably involved but the trouble is more complicated than this. In the case of vitamin D we know that studies on English school children, some thousands selected at random in the poorer districts of London, show a distressingly high percentage 87 of present or past rickets. It would be surprising if the incidence of present or past rickets in our own school children of the poorer classes, were not found to be high.

This sort of story continues on and on. If developed along these lines it would indicate, I am certain, a rather high incidence of nutritional disease, usually subclinical in form. It would also show that with certain vitamins (A

and thiamin particularly) promising results have been achieved by increasing the vitamin intake of supposedly healthy people.

There is one consideration in this connection that is seldom developed as fully as it deserves. The mortality statistics for 1936 reveal 71,527 deaths from tuberculosis, 3,740 from pellagra, 270 from rickets, 33 from scurvy, and 11 from beri-beri. I think that one is permitted to conclude from figures such as these that the number of active cases of any of the diseases mentioned was probably many times the number of deaths, e.g. in 1937 there were probably 200,000 cases of pellagra (only 5 of these actually reported). And what is more impressive is the probability that the number of cases subclinical in form is many times the number of those admittedly ill. This leads one to the same conclusion: that nutritional diseases are probably more widespread than the layman suspects.

3. The extensive use of highly processed foods, white flour, and refined sugar, and bad kitchen technique (exhaustive cooking of vegetables and discarding the water-soluble ingredients) deprives us of a portion of the naturally occurring vitamins. Here we shall beg the question as to whether God put enough of certain vitamins in our foods in the first place. For example, as Barcroft pointed out some years ago, hemoglobin is not a perfect vehicle for the transport of oxygen something like bricks that are made without straw. In other words, we think we know how hemoglobin could be improved, but God did a pretty good job of it for which we should be grateful.

Now against the fortification or enrichment program several arguments can be advanced:

1. It is necessarily expensive, even if we use in fortification suitable concentrates instead of crystalline pure vitamins.

2. It is a practice that is repugnant to one's sense of the fitness of things. All of us must admit that there is something ridiculous in our food technology when we devote much effort to the purification or refinement of our foods (white flour is the choice example) and then turn about and add to the purified product the vitamins we have removed. To be perfectly fair to ourselves, we must of course recognize that whole wheat flour (milled to 85 or 88) does not keep in storage nearly as well as white flour (fortified or plain).

3. There is some danger in this program of giving tacit recognition to an entirely erroneous assumption, viz. that we just about know what all of the vitamins are or that 50 mg of pure ascorbic acid is equal to 50 mg of ascorbic acid in the form of citrus fruit juice; that 4,000 I.U. of vitamin A equals the same amount in the form of certain fats and leafy green vegetables. The point is that our natural foodstuffs almost certainly contain several more accessory food factors of an unknown character and we must not give encouragement to any program that leaves the consumption of leafy green and yellow vegetables, certain fruits, etc. at their present low level (395 lbs capita year vs. 590 lbs capita year as recommended by Stiebling and Ward's liberal diet. In Great Britain in 1934 it was only 212).

I am afraid that the fortification program might give added stimulation to the use of refined foods and would not encourage the consumption of garden produce and other vitamin-rich foods.

4. I doubt very much whether we know what the requirements for various vitamins really are. Perhaps we know the physiological minima but not the optimum intakes. The calculation of these amounts is, of course, made absurdly difficult if any synergism exists between members of the B complex (or antagonism in some cases).

5. While nutritional disease affects even the rich wherever ignorance in the selection and preparation of foods is at work or dietary aberrations exist (such as a fasting diet of Coca Cola and ginger snaps), the poor are most heavily hit by disabling nutritional disease. Fortification programs are apt to lead to more expensive foods and thus aggravate the situation of the lower income groups.

There is something about all of this that is deceptive. For example, "Enriched Bread," (1.0 mg thiamin per loaf). People will eat one or two slices and settle back with sighs of contentment: actually they should eat the whole loaf unless other enriched foods are readily available.

Arguments Against Fortification:

Nutritional education should be stressed.

a. Resort to direct vitamin therapy and the use of enriched foods whenever vitamin deficiencies are endemic.

b. Use enriched flour (at least 3 or 4 mg thiamin per lb of flour) for the armed forces in actual combat service and for the civilian population exposed to special hazards (Great Britain). This is actually done, of course, by government order, but only 2 3 mg per lb of flour is added. If milk consumption is low, calcium should also be added.

c. Restrict by law the use of the term "whole wheat," as applied in the case of bread, to flour that has been milled to 85 or 88 . We don't want molasses bread sold under the guise of whole wheat bread.

d. Require that some stated percentage of all flour used in the manufacture of bread (say 50) be whole wheat or restrict the sale of white flour to those special cases where prolonged storage is necessary.

e. Develop the school lunch program. Here the plan is to take care of the children and let the adults take care of themselves. In every school, for children of all income groups, provide one good noonday meal: a good vegetable salad, a liberal meat course, whole wheat bread, butter, and plenty of milk. When they are at home let them eat what they like and can afford. In 1929 a monthly average of 500,000 undernourished children in 8,632 schools received free lunches. A significant result of this was that the children in receipt of these lunches showed material gains in weight, were absent from school less frequently, and had fewer illnesses than before the program. By the end of 1940 this program was expected to be extended to 5,000,000 undernourished children.

f. I said milk for children. I am not advocating a nutritional drink-whole-milk campaign. Remember that our per capita consumption of milk or dairy products is high enough and in some cases regional substitutes are desirable.

g. Stimulate home gardens and consumption of fruits and vegetables.

h. Do not depend too much on education. It just doesn't work fast enough. One can hardly avoid being pessimistic about changing dietary habits.

i. If fortification is necessary, try by all means to use crude concentrates instead of pure vitamins. Use wheat germ and yeast powder.

A word about the nutritional programs and actual achievements in Great Britain and Germany: In the war of 1914 1918, Germany was defeated not on the battlefield but by the allied blockade. She collapsed through starvation, especially protein starvation, and vitamin deficiencies. Britain herself came almost to the brink of ruin because of insufficient appreciation of the newer knowledge of nutrition vitamins had just been born and the failure of the government to heed the warnings of her scientists. William Runciman, President of the Board of Trade, even in October 1916 refused to sanction any rationing of foodstuffs and Lord Davenport, who was Food Controller from December 1916 to mid-1917, proved to be singularly inept. He knew much about the sale of groceries, and was a great business man, but knew nothing about nutrition and stubbornly refused to heed the warnings of the Food Committee of the Royal Society. He was replaced by Lord Rhondda in May 1917.

The Italians, of course, were in a desperate plight. The ration of men in the services was reduced eventually to 3,000 kilocals (instead of 4,000) and Starling, who studied the situation for the British War Office, reported that at the time of the disaster the soldiers were actually receiving only 1,800 kilocals, despite the 3,000 supposedly provided.

When Germany collapsed in 1918, the morale of soldiers and civilians alike was completely shattered. The working capacity of soldiers and workmen had fallen to a low level and the death rate from tuberculosis alone had increased by 70 . It is estimated that from this one disease she lost 300,000 more civilian lives than would have been lost had there been no nutritional deficiency.

But by the time the present war (1939 1946) broke out, Germany (and Italy alike) had learned much. In fact, in 1935, at the time of the Ethiopian campaign, the Italian army was considered to be the best fed in Europe. In Germany, much has been done to meet all nutritional contingencies. The soybean is used extensively, especially in an army ration known as *Edelso a.* This is a flour of high protein content (40 45) which is added to all sorts of things. This, together with cheese powder, apple powder, and another powder prepared from vegetable and animal protein, gives a very concentrated and very nutritious diet. Soybean sprouts, rye sprouts, sometimes desiccated, are incorporated in meats and meat substitutes. Ascorbic acid is incorporated in various foodstuffs. An increase in night blindness reported in December 1939 led to the extensive use of vitamin A among the population. Vitamin supplements are issued to all the children.

Various vegetables, leafy and otherwise, are dried and pressed into bricks or powdered.

In an emergency ration a sort of pemmican is given to the troops. It consists of smoked meat, bacon, soybean flour, dried fruits, whey, tomato pulp, yeast, green pepper, cranberries, etc. which can be packed or compressed into small spaces, is very concentrated and highly nutritious.

There is no reason under the sun why we in this country and our friends in Great Britain, if faced by a situation that required conservation of labor, preservation of fuel, and most efficient utilization of storage and shipping space could not subsist on rations that were ready-made and were as simple to prepare as food pellets prepared commercially for rabbits, cats, and dogs, and the common laboratory animals such as the white rat. My rats have had the same diet for ten years, yet they live, fall in love, and have big families. For ourselves, we could readily have prepared on a vast scale six or seven different "pemmican powders" which would be equally nutritious but different in taste to relieve some of the monotony. A beleaguered people could use such rations for months if need be, or for two or three days a week, if things were a little brighter.

However, let us see what has actually been done in Britain. Strange as it may seem, nine months were to pass (May 1940) before even an advisory committee on nutrition was set up. This despite the fact that pre-war nutrition surveys had shown that one third of the population were not only inadequately fed but could not afford to increase their expenditure on food. Even though studies, especially in Cambridge (Harris) and Oxford (Peters) had shown that thiamin deficiency was surprisingly common throughout the population, the President of the Royal College of Physicians and Professor Midthram (a member of one of the important advisory committees on nutrition) asserted in their report on nutrition that "few, if any of us" lack vitamin B_1.

Again, the Ministry reported in November 1939 that all margarines were vitaminized to make them equal to summer butter and yet in early 1940 it was still possible to buy margarine that had been "vitaminized," if you please, with skimmed milk. Now, however, the various brands of margarine are pooled and only two properly fortified products are marketed.

But let us pass over this gloomy picture of the first nine months under Chamberlain, including a scandalous situation in which industrial officials holding government positions virtually decided on the operating profits that were to be permitted their respective industries.

Now we have a situation in which, at last, properly fortified margarine is sold. White flour is enriched with thiamin and calcium, only 2 3 of a mg of thiamin per pound of flour, which, unfortunately, is all too little. There has been a tremendous increase in gardening and farming, especially in the production of carrots (vitamin A). Fish farming is being encouraged but will only slowly get under way. Fresh water ponds, enriched with treated sewage, can provide more food per acre (in the form of fish) than agricultural land. The North Sea is not a good provider of food; even in peace its food crop per acre is about one sixth that of farmland.

What more can be done Obviously, foods must be imported. These imports should be restricted to those substances of greatest caloric value per

> unit of shipping space per unit of cost: flour, fats, sugars, dried fruits. Also, vitamins should be imported in quantity as a very necessary reserve and, for fortification purposes, in the form of the pure products for therapeutic use: also crude concentrates, dried yeast, wheat germ, and liver oils. Remember that yeast can be raised very cheaply. The British pharmaceutical industry was horribly behind the times and was as backwards as the dye industry was in 1914. It is to this country that Britain had to look for her vitamins and pharmaceuticals. I am of the opinion that on vitamin-rich, protein-rich diets a population would be able to get along for long periods of time on diets that are much lower in calorie content than those usually recommended.
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> Here in this country we must profit immediately by the mistakes of Britain in the early months of the war. We must recognize that we are irretrievably involved in an international emergency and must resort to a rigorous attack upon the nutrition problems that confront us, grave enough in peace, but greatly aggravated by our obligations as a friendly belligerent in the present conflict.

In the preceding paragraphs reference is made here and there to miscellaneous observations pertaining to nutrition during a trip I made to Britain in the summer of 1941. The report that ensued discusses in great detail the requirement in Britain for various vitamins. The fortification program in both America and Great Britain is discussed at length on pages 41 43 of the report. When the report was distributed to a number of people mentioned in its introduction, I was soon authoritatively informed that further distribution must be suspended until stated portions of the report could be deleted. The report describes in great detail almost all aspects of the nutrition problems of wartime Britain. Copies of the report are to be found in a number of libraries and will be of interest, I am sure, to any who wish to be informed of the food problems faced by the British during the years of World War II.

In case the preceding paragraphs leave the impression that my book, *The War on Malnutrition and Poverty,* must be a curious *Gemisch,* or catchall, I hasten to point out that nutritional disease is sometimes a result of poverty. Poverty, in turn, can find a partial solution in cooperation whereby groups of people, through a united attack on the economic problems that beset them, can do much through a great variety of cooperative enterprises to "pull themselves out of the mud by tugging on their own bootstraps." Unfortunately, with the encouragement of politicians, we find ourselves beseeching our Washington uncle to provide salvation through a multitude of giveaway programs. And all such demands to government, at all levels, are compounded by the insistence of many that we be enabled to live in a risk-free environment. I see about me an almost universal hysteria over food additives and the products of our chemical and pharmaceutical industries, expressed in strident voices by many who should know better, that everything we eat, drink, breathe, wear, and look at be convincingly proven to be absolutely safe. The Environmental Protection

Agency and the Food and Drug Administration, hedged in by a massive burden of legislative directives, are the unfortunate instruments of Congress in seeking attainment of such impossible goals.

The fortification of foodstuffs by the addition of vitamins received much discussion among biochemists in the early 1940s. I participated in a conference on this topic at the University of California in Berkeley and a report on the Fortification of Foodstuffs (extracted above) inclusive of information on the war-time nutrition problems of Great Britain which I visited in the summer of 1941.

Incidentally, I took with me in 1941 a quantity of peanut butter enriched with "beer yeast" provided by Anheuser Busch Inc. Some of this was used in the preparation of sandwiches that were made available at afternoon tea during the three-week voyage to Britain. The children on board, and there were many, ate the sandwiches with pleasure. The English adults, however, were adversely prejudiced: "Why do you call this butter It is obviously not butter at all;" and "made from peanuts;" "Surely you mean 'monkey nuts' "

With a food value of about 3,000 Calories per pound, it had great possibilities for shipment to Britain, requiring a minimum of space for a maximum of food value. However, it was clear that real difficulties would be encountered in introducing the product in Britain. I "tried it out" among some of my friends in England but the efforts were fruitless.

Annual Review of Nutrition

In 1981, the *Annual Review of Nutrition* was organized and is now in its eleventh year.

> When Dr. Darby asked me to participate in the launching of the *Annual Review of Nutrition* by contributing a few paragraphs for use in the introductory volume, I felt singularly honored. I experienced a rosy sort of feeling that was soon replaced by fear and trembling: I know all too little about the modern science of nutrition. Furthermore, as the ravages of age manifest themselves, some of us who were once much younger become cynical, pessimistic, and unpleasantly negative about the happenings in this increasingly complicated world. Had I been turned loose on organizing and structuring this new Annual Review, much of the space would probably have been devoted to attacks on food faddism and tirades against the pseudo-scientific and nutritional nonsense to which the media constantly expose us. And then there are the many who urge that our great uncle in Washington guarantee for us an environment that is totally risk-free, including the food we eat, the water we drink, and the air we breathe. I doubt that even Heaven provides a risk-free haven.
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> Fortunately, the Editorial Committee and the authors, whatever they may choose to do about the dispensers of such nonsense, will harvest much from the ever-expanding literature of science that will be of inestimable value to all who are seriously interested in the science of nutrition.

Recently, in thumbing through the 49 volumes of the *Annual Review of Biochemistry* that have thus far appeared, I was astonished by two discoveries that are relevant and significant. Each of the first 29 volumes contained a chapter on human nutrition. Volume 31 contained a review on germ-free animal research, and Volume 40 brought us up-to-date on nutritional methodology in metabolism research on rats. In a few of the first 15 volumes some bits of wisdom are to be found on the nutritional requirements of bacteria, protozoa, insects, chicks, monkeys, pigs, and cattle. But beyond this, and with only a single exception, the word "nutrition" does not even appear in the subject index of any volume from 32 in 1963 to 49 in 1980. *Horribile dictu* It is, indeed, high time for the science of nutrition to gain the special recognition that it deserves through the *Annual Review of Nutrition.* I wish this new publication well. The first volume deserves a special salute by the biochemical community, for it appears during the Golden Jubilee year of the *Annual Review of Biochemistry* and the 75th anniversary of the birth of the *Biochemical Journal.*

Why was nutrition as a subject appropriate for review dropped from the *Annual Review of Biochemistry* In part, the omission must be attributed to the "spin-off" to which the Editorial Committees of years gone by were dedicated as a means of countering the onset of obesity which has threatened the *Annual Review of Biochemistry* from its infancy. Thus, the advent of the *Annual Review of Physiology* in 1946 permitted the biochemists to give the kidneys, liver, nerve, and brain to the physiologists. In 1950 almost the whole of plant biochemistry was transferred to the fledgling *Annual Review of Plant Physiology.*

As for nutrition, it seems to have merely faded away. But not quite. I think that two things contributed to its disappearance from the *Annual Review of Biochemistry.* More and more of nutritional research was on vitamins, which has continued to be a lively field of investigation and an important topic in the *Annual Review of Biochemistry.* And secondly, much of the remainder was reviewed in the ever-recurring chapters on metabolism (of carbohydrates, lipids, amino acids, and inorganic elements).

But now the early 1960s are in the distant past. The judgments of today's science are not those of yesterday's. Convinced that nutrition, as an active and thriving scientific discipline, has never ceased to be of worldwide interest and importance, I welcome the *Annual Review of Nutrition.* Eventually it may be threatened with the obesity that has plagued its parent but, of all people, those of you who are contributing to the science of nutrition will surely know how to maintain the pristine beauty and health of this new Annual Review.

J. Murray Luck
Founder, Annual Reviews Inc.

Food Prices in Palo Alto

From 1939 to 1953 I made surveys annually of food prices in Palo Alto. In 1944 and 1948 my reports were published in *Science* (Aug. 11, 1944, pp. 124 125; Oct. 22, 1948, pp. 425 426). The surveys upon which these reports

were based were initiated in 1939 and were made annually in the third week of May. Since it was observed that these surveys were of more than local interest, the later data are presented in this section.

First of all, I must refer to studies by Stiebling and Ward of the Bureau of Home Economics, US Department of Agriculture [*US Dept. Agr. Circular* 296 (1933); See also S. Brody, *Annu. Rev. Biochem.* 4:393 396 (1935)]. Brody's review reproduces much of the Stiebling and Ward paper which presents four dietary plans: (*a*) "restricted diet for emergency use," which allows a narrow margin of safety, costs 17 cents per capita per day, and requires 1.2 acres (exclusive of grazing land) per capita per year to produce; (*b*) "adequate diet at minimum cost," which costs 24 cents per day and requires 1.5 acres per capita per year; (*c*) "adequate diet at moderate cost," which costs 42 cents and requires 1.8 acres per capita; and (*d*) "liberal diet," which costs 51 cents and requires about 2.1 acres. The cost of diets refers to average retail prices in the United States during 1931 1932. In terms of cost per average family (two moderately active adults, three children aged 2, 5, and 13 years) the cost varies from 22.85 to 59.48 per month; or on a yearly basis the cost of diet (*a*) is estimated at 350, diet (*b*) 500, diet (*c*) 800, diet (*d*) 950.

The essential difference between the four nutritive levels consists in varying the ratio of grain products, dried beans, and potatoes to animal products, vegetables, and fruits. The following are abstracts of the discussion given by Stiebling and Ward. The grain products, especially if unmilled and supplemented by milk, are inexpensive sources of energy, protein, phosphorus, and iron. Milk is an inexpensive source of calcium, phosphorus, high quality protein, and vitamins A and D, supplying cheaply what the grains lack; hence the dietetic importance of the cereal-milk combination in the low-cost but adequate diets. It is advised that children should have one quart of milk per day. Dried legumes are important sources of energy, calcium, iron, vitamin B, and protein, which is of good quality in soybeans but not so good in other legumes. Green leafy vegetables (spinach, kale, collards, turnip greens, beet tops, mustard greens), peas, asparagus, and snap beans, are economical sources of iron, and vitamins A and D. Carrots, apricots, and other colored (orange or yellow) fruits or vegetables furnish vitamin A. Tomatoes, raw cabbage, and citrus fruits are rich sources of vitamin C. Cod-liver oil (2 to 4 teaspoonsful per day) is included for young children (under 2 years) during the winter months. Most adults in temperate zones get enough sunshine so that the needed amounts of vitamin D are provided by the activation of ergosterol in the skin by ultra-violet rays. Lean meats, eggs, and liver are recommended for their flavor and iron, liver also for vitamins A and D. The daily requirement for vitamin C is probably covered by the quantity contained in an ounce of orange, grapefruit, or canned tomato juice, or raw cabbage (15 Sherman units). How-

ever, a more liberal intake is advantageous. Note that the "liberal" diet is not a luxury diet.

Using the principles defined by Stiebling and Ward, I decided to price a "liberal" diet, one of many that could be devised that would satisfy the basic requirements spelled out by Stiebling and Ward. Parenthetically, I should point out that this system of pricing is far more meaningful than to select 20 or 30 foodstuffs and price them without reference to the amounts of each consumed by a person in a week, a month, or a year. Obviously one cannot equate one pound of meat with a pound of potatoes. The amount of each dietary component consumed by a person in a stated time is what really matters in determining the cost of foodstuffs to the consumer.

Greater Palo Alto (inclusive of Stanford) may still be described as a University town, having in 1934 a population of about 23,000, inclusive of students, University employees, and members of their families resident on the Stanford campus. Of the wage-earners resident in this community in 1954 or so, approximately 27 are employed in San Francisco or other neighbouring towns, 10 are employed by Stanford University, and about 22 by light industries in this area. The remainder are engaged in the manifold activities characteristic of such communities. There is no heavy industry in the area.

The results of the study are as follows.

> The cost of a "liberal" diet was determined for one week's maintenance of an adult man engaged in moderate physical activity. It is recognized, of course, that many different "liberal" diets could be devised, though all would be characterized, according to present concepts, by being comparatively low in potatoes and highly processed cereals and comparatively rich in so-called high-quality protein foods. The particular diet that we have priced contains an abundance of dairy products, fresh fruits and vegetables, and high-quality proteins. It is not, however, a "luxury" diet. Differences in regional dietary practices or in availability of foodstuffs would permit many variations without serious trespass upon the limiting characteristics of a liberal diet. The particular foods about which these surveys have centered would provide, per day, approximately 3,100 Cal, 137 gm of fat, 318 gm of carbohydrate, 107 gm of protein, 1.36 gm of calcium, 2.04 gm of phosphorus, 20 mg of iron, 15,000 units of vitamin A or its equivalent, 160 mg of ascorbic acid, 370 units of vitamin D, 1.4 mg of thiamin, and 2.7 mg of riboflavin. These values refer to the food as purchased and should be reduced by probably 10 to reflect the values for food as consumed. The list of foods, per adult per week, is presented in Table 4.
>
> Five stores were included in the 1939 survey, six in 1940, seven in 1941, and nine in 1942 to 1952, and eight in 1953. Three of the stores in the 1939 list and four in the subsequent lists are members of chains. A large cooperative store was included. All small stores were deliberately omitted as well as one or two stores that cater to luxury trade and are recognized as atypical with respect to distribution costs and retail prices.

Table Foods purchased in the Greater Palo Alto area per adult per week

Bread	1 lb.	Sweet potatoes	1 lb.
Oatmeal	1 2 lb.	Potatoes	3 lb.
Cornmeal	1 2 lb.	Cabbage	2 lb.
Sugar	1.2 lb.	Lettuce	l 2 lb.
Milk	3-1 2 qts.	Carrots	1 lb.
Cheese	3 4 lb.	Beets	1 lb.
Butter	1 2 lb.	Canned corn	1 2 lb.
Eggs (large, grade A)	1 lb.	Oranges	2 lb.
Lard	1 4 lb.	Apples	1 lb.
Bacon	1 4 lb.	Bananas	1 lb.
Beef chuck roast	2-1 2 lb.	Dried prunes	1 2 lb.
Salmon	1 lb.	Canned peaches	1 2 lb.

Table Food prices in Palo Alto, 1939 1953

ear	Average cost at retail price (dollars)	Increase over 1939 ( )
1939	2.28	
1940	2.28	0
1941	2.96	30
1942	3.59	57
1943	4.72	107
1944	4.26	87
1945	4.26	87
1946	4.40	93
1947	5.96	161
1948	6.81	199
1949	6.58	189
1950	6.10	166
1951	7.07	210
1952	7.04	209
1953	6.65	190

In the case of canned goods, the cheapest brands were priced. It is believed that the nutritive qualities were reasonably comparable. To obtain maximum economies in purchasing, quantity prices (up to 10 lbs) were used whenever feasible as the basis for the calculations (see Table 5).

The increases reported since 1939 are not to be considered as indicative of the extent to which the cost of living has increased. This is because cost-of-living indices include many items other than food and also because "liberal" diets are low in cereal products (which have increased the least) and rich in fresh vegetables, fruits, fish, eggs, and meat. For example, by 1953, while bread, sugar, milk, and oatmeal have approximately doubled in price

since 1939, the prices of beef, cheese, butter, and eggs are about three times those of 1939; garden vegetables and potatoes in 1953 are three to four times as costly as in the base year; and canned salmon, prunes, and apples are five to six times as expensive.

The prices used for carrots and beets are those for the trimmed vegetables and represent strictly the cost of the edible portion. It is unfortunate that in most cases retail stores still continue to sell these by archaic practice (by the bunch rather than by net weight).

Since fortified margarine is now to be regarded as an acceptable substitute for butter and tinned mackerel is considerably cheaper than tinned salmon, even though somewhat lower in vitamin A, we have decided in the future to substitute these two items for butter and tinned salmon, respectively, in these dietary surveys. The hamburger now available locally appears to be of higher quality than that sold in 1939, although in composition it is not yet satisfactorily defined. Nonetheless, it is widely consumed. If the list of foods published above were to be amended by the replacement of butter, and chuck roast of beef with margarine, and hamburger, respectively, the cost of the liberal diet would fall from 6.65 to 5.74 for 1953.

VI. POPULATION OVERPOPULATION

As I noted earlier, in 1929, three years after coming to Stanford I was asked to serve as Secretary-Treasurer of the Pacific Division of the American Association for the Advancement of Science. In 1957 I was elected President of the Division. The meeting in that year was held at Stanford University. I had to dream up a presidential address.

Being much concerned with the global population overload and the emerging problems arising from the impact of such a burden upon our environment, I chose as the title of the address, "Man Against His Environment: The Next Hundred ears." The address was published in *Science*, Vol. 126, pp. 903 908, 1957.

In this address, I included the sentence: "Abortion, at the request of the prospective mother, should not only be permitted, but, in some instances, encouraged." To me, this was an innocent and reasonable proposal, but what a storm of protest it generated About 90 letters of outrage were received in the weeks that followed, and 110 clippings of editorials and letters to the editor that appeared in the daily press arrived by mail. Protests and approvals were almost equally divided. One concerned citizen urged that I be fired from Stanford and another that I merely be castrated. The whole collection gives an illuminating picture of Americana in 1957. As an example, please read the following editorial from the *Wall Street Journal* and my response.

> Today's Eyes for Tomorrow's Decisions
>
> By the year 2050, says a biochemist before a meeting of the American Association for the Advancement of Science, mankind will have a tough time feeding himself. There will be nine billion humans, quadruple the present number. Not only will there be a shortage of food, the scientist avers, but there will be "inequalities of distribution."
>
> And that isn't all. The exploitable resources of bauxite, copper, lead, tin, zinc, and the like will be all but gone. So, asked this biochemist, Dr. J. Murray Luck of Stanford, would the struggle against "such terrific odds" be worthwhile
>
> Having drawn this grim view of the future, and having asked that grim question, Dr. Luck hints of a solution. It lies "in the maintenance of a very definite balance between industry and agriculture and a worldwide reduction in the birth rate," he states.
>
> There have been plenty of keepers of charts and dreamers of great plans who have tried doing these very things over the past few thousand years. For Dr. Luck's problems, or similar ones, have been with us for a long time.
>
> For example, over a century ago a man named Malthus argued that the human race was heading for inevitable starvation as the population was increasing faster than the food supply. This has failed to materialize because scientists have found ways of increasing food output. Certainly "inequali-

ties" in food distribution are a long-standing phenomenon; they are almost a rule of life.

In fact, if history shows anything it shows that such problems have always been with us, and that somehow they manage to get solved.

We don't know what the solution will be. It may be that scientists will produce substitutes for the minerals which may be depleted. As for the food supply, scientists have schemes afoot for farming the oceans and for further increasing the amount of food grown on land.

We do believe, however, that we know where the solution is not to be found. That is in the construction of some "master" plan, which would require a mastermind to grapple with problems so vast they could not possibly be handled by any braintrust: who is to get how much food and what kinds; what materials are to be produced and for what; who is to be permitted to be born and who is not. Inevitably, tomorrow would be fitted into a fine cloak which would look good with today's eyes but tomorrow would be only a straight jacket.

Rather there should be a natural solution worked out in time, which ties together the limited horizons of millions of individual eyes into a horizon that is limited only by the number of human beings there are.

The Editor
Wall Street Journal

Dear Sirs:

It had not been my intention to comment on the many newspaper reports and editorials which have followed upon my address of August 28, but your editorial of September 4 ("Today's Eyes for Tomorrow's Decisions") is too disturbing to pass over.

First of all let us take a look at Malthus. In stating that his predictions have failed to materialize you imply that he was fundamentally in error. Not so. He was uncomfortably correct in his basic thesis, that population increases faster than the food supply. The Director General of FAO reported that in the interval from 1934 1938 to 1950 the world's food production increased 9 but population increased 12 . We slipped behind by about 100 calories per capita per day.

The 150 post-Malthusian years were marked by emigrations of people from the Old World to the New, the discovery and development of efficient means of transporting the food surpluses of the New World back to the Old, the fixation of atmospheric nitrogen and the development of an enormous fertilizer industry, and the discovery and application of various means of increasing the productivity of our arable lands. Just how long will our luck hold out Some of our agricultural economists concede that new lands, largely marginal in quality, that may yet be brought under the plow, are sufficient to double the world's food production (over the 1946 levels). Enough for 2050 A.D. By no means. Can we greatly increase our yields per acre Here the real problem, from a global point of view, focuses on the world's reserves of phosphate, the so-called "bottleneck of the world's hunger." Though still tremendous (enough for 1,000 years or so) they are obviously diminishing. Ultimately the phosphate ends up in the sea. Whether or not it can ever be re-

trieved is a nice little problem. Given sufficient energy it probably could be; so also could we turn to more and more marginal and submarginal phosphate deposits. But let us not forget that we cannot mine the oceans, the granites, the igneous rocks, and the clays without using energy in quantities more fantastic than we dare estimate even if thermonuclear fusion processes are eventually harnessed for peaceful purposes.

Next, your complacence, my dear Sir: our head-in-the-sand philosophy as expressed by "such problems have always been with us, and somehow they manage to get solved." They were never solved by people subscribing blindly or tacitly to any such *laissez-faire* attitude which urges one to leave the destiny of mankind to the whims of chance. ou overlook entirely the fact that the population problem is everything that Malthus claimed it to be in 1798 with a few quite new 20th century components added. It is now clear to all who will see that the world's population is not only increasing more rapidly than the food supply; this is part of the thesis, not original to Malthus, to which you refer. To this we must add a bit more. As the growth of population accelerates (it now doubles in 50 years) our reserves of metals, fossil fuels, exploitable energy sources in the fantastic amounts that are called for, and even of industrial and irrigation water are doomed to diminish at an accelerating rate.

Nor will the problems be solved by apathy, fear, and superstition towards the real nub world population control. How can we afford to ignore, if interested at all in the good life for our children and our grandchildren, the inevitable consequences of diminishing death rates and of birth rates that have been increasing for 25 years. The choice is simple. We can either encourage the practice of the humane Christian virtues inherent in the whole concept of planned parenthood and birth control or we can shed a few hypocritical tears as children and adults die in increasing numbers from famine, nutritional disease, and violence in various parts of the world, and say regretfully that "God has willed it."

We can also leave the whole problem alone, which seems to be your advice, and straight-jacket ourselves into a controlled economy and a usurpation of our freedoms to an extent that could make the totalitarian governments of the present and recent past seem as kindly as dear old grandma.

our concluding paragraph is a bit of poetic gibberish which, like all mumbo jumbo, is devoid of meaning. If you will explain it to me I shall send you a complete copy of the text of my address: you have been at a disadvantage without it. I think we shall find ourselves in much closer agreement than is suggested by the cavalier and capricious way in which your editorial treats an uncomfortable but important problem.

ours very sincerely,
J. Murray Luck

I do not remember when I first became interested in the population-overpopulation problem. In the late 1950s and early 1960s several happenings came to a focus on this as a subject of commanding interest that seized me in its grasp to the near total exclusion of everything else, including biochemistry. The importance of the problem, as the twentieth century comes to an end, is

widely recognized. Have we sufficient intelligence to devise a means of putting the brakes on population growth and enough determination to put it into effect I doubt it.

Conference on World Population Emergency Campaign

My interest in the population problem has continued undiminished. In 1960, the following quotation expressed a widely shared concern:

> The dilemma that unfolds before us involves an explosively burgeoning population in a world that is threatened with the loss of many of its natural resources and increasing assaults upon its precious personal freedoms. The years before us may prove to be chastening in the extreme, and I would respectfully urge that the problems before us today be faced with all the courage, humanity and intelligence that we can summon to the task.[1]

In March 1960, on invitation of the organizers, I participated in the conference with the address just quoted. The one-day Conference was held in Princeton, New Jersey, with about 100 invited guests in attendance. Its purpose was to consider the role of government in solving the population overpopulation problem. The seven or eight speakers included Margaret Sanger, the courageous battler in causes such as this; Sir Grantley Adams, Prime Minister of the West Indies Federation; Dr. Ansley J. Coale, Princeton University; Dr. Philip Hansen, University of Chicago; and Lady Rama Rau (India), Chairman of the International Planned Parenthood Federation.

The background of the Conference should be mentioned. In 1959, for the first time in American history, the population problem was officially recognized by a Committee appointed by the President to examine United States foreign aid. The chairman, General William Draper, Jr., reported and recommended on behalf of the Committee specific actions that the Federal Government should take to lead and support the struggle against overpopulation. However, President Eisenhower took the position that this was a task for private organizations.

Subsequently, a Gallup Poll indicated that the American public was overwhelmingly behind the Draper recommendations: “Therefore, in the not too distant future it may well be that Government will yet respond to private leadership and make available resources necessary to deal more adequately with the problem. Meanwhile, American citizens can no longer close their eyes to the many urgent appeals for assistance from abroad.”

[1]Concluding paragraph of an address on “Hunger and Want or Population Control” at the Founding Conference of the World Population Emergency Campaign, Princeton, NJ, March 20, 1960.

To meet this challenge, the following twin programs were proposed:

1. "*Education* within the United States to lead public opinion to an understanding of the population problem. This program will be designed to facilitate constructive action."

2. "*Action* in various individual countries to meet immediate and long-range needs of millions of suffering people by providing technical aid and other assistance upon request. Such programs will be administered, whenever possible, through their representative local private organizations."

Millions of Americans, both educated and relatively uneducated, believe that no problem exists, that the world can readily support a rapidly increasing population for centuries to come if modern technology is harnessed to the task. Other millions think that the problem is beyond human planning and must be left to God. If such attitudes were to be permitted to have the major weight with public opinion, the accomplishment of constructive results would be hopeless. Accordingly, we propose a large scale informational campaign through the mass media institutions of the American system print, radio, television, motion pictures, etc.

Prospects within this field of popular education are hopeful. Within the past year unprecedented attention has been directed to the population problem by many leading organs of mass circulation. In the wake of the Draper Report, thoughtful publicists have become aware of the immense importance of this subject. To mention but a few the Columbia Broadcasting System's television reports; articles in *Life* and *The Reader's Digest* the repeated comments of the *New ork Times'* Arthur Krock all give evidence of this awakened interest. This interest must be strengthened and mobilized in support of our *action* program.

In February 1959, students, scholars, and professionals in the field of population planning from throughout the world met at New Delhi in the Sixth International Conference of the International Planned Parenthood Federation to discuss and take action in the face of the mounting world crisis. Held under the patronage of Prime Minister Nehru, who delivered a major address, the Conference brought American participants together with their foreign colleagues and enabled the American delegation to learn of specific world needs. A vast amount of aid is required.

Please note that much of the above has been reproduced from *A Statement of Purpose, World Population Emergency Campaign,* Princeton, New Jersey, Sunday, March 20, 1960.

Being invited to participate in the Conference, I gave the following address under the title "Hunger and Want or Population Control."

Hunger and Want or Population Control

I do not know who first described the current growth of the world's population as explosive. Perhaps it was R. C. Cook, Director of the Population Reference Bureau, who has a keen feeling for the right word. I believe, however, that we must agree that a real population explosion is in the making. If we take as a reference point the population of the world at the time of

Christ, about 300 million, we find that 1,650 years were to pass before the first doubling of the population. In the next 300 years, which brings us to 1950, the world's population quadrupled. If present trends continue, the population will quadruple again in 100 years and our descendants will find themselves milling about in a world of 10 billion people in 2050 A.D.

Perhaps at this point it might be profitable to speculate upon the qualification "if present trends continue." The first permissible generalization is, so I believe, that the death rate for the world's population is more likely to decline than the birth rate. The former now stands at about 18 per 1,000 of population per year and the latter at 34 per 1,000 per year, giving us a net rate of population increase of 1.6 per annum. If one compares birth rates and death rates for the five-year periods 1950 1954 and 1945 1949, he will find that the birth rates clustered around an unchanging level while the death rates fell in all countries or areas but three (Israel, Gibraltar, Hawaii) for which data were available. Over a period of 20 years, the crude death rate for the world's population has fallen steadily to about 18 per 1,000 at present. In our own country the birth rate has remained at about 25 per 1,000 of population per year since the end of World War II and the death rate has fallen from about 10.8 to about 9.2. In a number of countries with sizeable populations, the death rate has now fallen to as little as 8 per 1,000. So it is that one may reasonably expect the world death rate to fall appreciably below the existing level of 18 per 1,000.

Why have death rates been falling Entirely because of the advances of the past few decades in sanitation, nutrition, medicine, and surgery. The chlorination and purification of drinking water, the introduction of DDT, of the sulfa drugs, and of antibiotics have had a most extraordinary effect. Prenatal and perinatal mortality rates have fallen tremendously, infant mortality rates have been reduced, maternal mortality rates have gone down, many infectious diseases are now well under control, likewise the diseases such as malaria, transmitted by insects, and so on. Surely it is a foregone conclusion that these advances in medical practice, in sanitation, and in public health will be carried into India, the Middle East, Central and South America, and the native populations of Africa. So it is that I subscribe to the belief that present trends indicate for the world at large a continuing reduction in the death rate that may more than compensate for any possible decrease in the birth rate. In fact, no one can confidently predict any fall in the birth rate, except that which may be brought about by the wide acceptance of contraception, or abortion, or sterilization, or all of these practices.

It is worth noting that present trends of population growth would lead to a US population in 2050 of about one billion. In my own calculations I weakened to the extent of assuming that we might fall back, though there is no evidence to support this, to the pre-war birth rates of around 20 or 21 per 1,000 per year. If so, our population in 2050 would approximate 600 million and our population density of 200 per square mile would equal that of present day China.

Will the world be able to support a population burden of ten billion people in 2050 A.D. Can they be fed even at minimum levels of around 2,300 calories per capita per day I believe that we will have the knowledge to permit achievement of this Herculean task. But will we be able to apply it on the

vast scale that is demanded Even now, when the pressures upon us are slight as compared with those that will confront us as the years pass by, the world's population is increasing more rapidly than its food production. Admittedly there are over one billion acres of marginal land that can be brought into cultivation if we are prepared to invest vast sums to maintain the stability of the soils, to prevent erosion, to provide irrigation or drainage, and to produce the necessary fertilizers. But our cities and towns and highways are currently withdrawing 1,500 square miles per year from agriculture.

I said that we had the knowledge to achieve much more. Soil fertilizers and stabilizers could be used more extensively and intelligently than they have been used in the past. Domestic animals sheep, pigs, cows, horses, and poultry could be and probably will be eliminated. They use three times as much of the world's calories as does the entire human population and are notoriously wasteful converters of energy. When we ask cows, pigs, sheep, and poultry to convert grains, leaf proteins, etc. into food for us, 80 is irretrievably wasted. So far as I understand the operations of the ruminant stomach, it has only one trick in its repertoire that appears to be beyond our capacity: it can, with the help of symbiotic protozoa, digest cellulose the part of the grasses, of corn stalks, etc. that is quite indigestible by man. We also know how to capture a little more of the solar energy and how to squeeze a bit more of the product out of photosynthesis. But the real question is whether we can and will apply this knowledge sufficiently rapidly and extensively. Upon this question I will not speculate though I confess to having grave doubts about man's ability quickly to seize upon and administer this as a world problem which knows no national or regional boundaries. Are we really able to apply the fruits of science to these tremendously vast problems in technology with the rapidity and upon the enormous scale that the times demand

Do we have the reserves of minerals and of certain essential elements, adequate for the presumed requirements of a world population of ten billion Here I must introduce two assumptions, (*a*) that people will insist upon a standard of living at least as high as that to which they are presently accustomed, and (*b*) that industrialization, with its increased demands upon our mineral resources, will continue to spread into the erstwhile agricultural countries of the world. This is a very difficult question upon which to speculate, for the answer, even after acceptance of the stated assumptions, is intimately related to economics. Just how far is man prepared to go, and able to go, in the processing of ores of low yield Will our supplies of energy be sufficient and will effective substitutes be found for several of the metals for which the reserves are negligible If our conclusion were to rest upon the present level of technology we would be obliged to admit that the world's exploitable reserves of many important minerals will have diminished to the vanishing point within 100 years. Metallurgy, of course, will make tremendous progress. Lower-grade ores will be exploited. Aluminum may be recovered from clay, and magnesium in vast quantities from the sea. Even ordinary igneous rock may be a source material but only at the expense of incalculable amounts of energy.

Shall we have enough sources of energy to satisfy the ravenous demands of ten billion people The pessimists insist that our fossil fuel reserves

that are really amenable to extraction may be as low as 800 billion tons. At anticipated rates of consumption this would suffice for perhaps 150 years. The heartening thing is that, thus far, additions to our reserves of petroleum seem to have kept pace with our ever increasing demands upon them. How long will our luck hold out This seems to me to be a very pertinent question. There is a very real possibility that man will consume in a scant 250 years the fossil fuels that Nature required 250 million years to make.

To what extent will our reserves of energy in the form of unexploited hydroelectric power help us out If they could all be put to use and put to use soon, and if we could exploit them on a maximum flow basis three very large "ifs" the power so derived could have a significant effect within the first few decades (equivalent to 4 billion tons of coal per year) but would satisfy only 3 to 15 of the world's energy requirements a century from now. The trouble is that our demands for energy are growing at a rate of 2.5 to 3 per annum and our greatest unexploited hydroelectric power resources are mostly "where the people ain't," Tibet and the heart of Africa, for example.

Fortunately, harnessing of the atom will greatly add to our reserves of power. If the uranium and thorium reserves of the US alone (500,000 tons) were to be fully exploited, and if the fission process could be carried to completion, an amount of energy equal to that of 1,500 billion tons of coal could be derived. Perhaps within 50 or 100 years the thermonuclear fusion processes will be harnessed for peaceful purposes and a virtually inexhaustible source of energy based on the limitless reserves of deuterium will be ours. Perhaps we shall even succeed in trapping a little more energy from the sun, although the solar engines and solar batteries that are now being developed do not sound very promising for the large scale development of additional power. The problem is certainly intriguing if we but remind ourselves of the fact that in only three days we receive from the sun as much energy as could be obtained by burning all our reserves of fossil fuels and all of our remaining forests.

It is difficult for some of us to think of fresh water as one of man's requirements of which he may indeed run short. Industrial usage is the largest component in the nation's water demand, being very considerably in excess of irrigation usage. The paper industry, petroleum refining, the steel industry, and electric power generation in steam plants require tremendous amounts. Per capita consumption within the home, purely domestic usage, has been increasing very rapidly with the advent of washing machines of all sorts, garbage disposal units, and a general mania for cleanliness. The wide scale introduction of air conditioning imposes a new and very heavy demand on our fresh water resources. True, much can and will be done in the salvage of water, in its re-utilization, in impounding more and more behind dams and in catchment basins, and in reducing runoff into the sea. Water will be increasingly diverted from areas of plentiful supply to those of shortage. Admittedly this is the kind of problem that can be considered only on a regional basis. National averages in the supply and demand of fresh water may mean very little. Certainly, one should not seek comfort in the statement that we in the US are now making use of only 1 8 of the total yield of our streams, lakes, and underground aquifers. What is well recognized is that our consumption of fresh water is doubling every 20 or 25 years, that in a typical year over half

of the municipalities in this country encounter water shortages, and that the water-deficient areas are increasing in number and in size. I do not happen to be acquainted with any long range forecasts of fresh water supply and demand that spell out in any useful way what the future has in store for us a hundred years from now. Nor can I imagine that one could attempt this bit of arithmetic with any confidence in his efforts since so much can and will be achieved by conservation, salvage, and re-utilization.

To summarize the story thus far, I think that mankind is now caught in the midst of a population upsurge that threatens to be catastrophic. If we extrapolate present rates of world population growth into the future, we will be faced in another hundred years with a population burden of at least ten billion. There are grave doubts as to whether we will be able to feed 10 billions of people, whether we have the resources of hydrocarbons and of minerals to maintain the standards of living and the gadgetized sort of civilization to which the industrialized nations of the west have become accustomed. The further development of nuclear fission and the hoped-for harnessing of thermonuclear fusion may, if one allows himself to dream, give us the energy needed to salvage minerals from the sea and to extract them from even the igneous rocks. Our fresh water supplies may be in jeopardy, certainly if we continue to draw upon them with the prodigality of the present. I suppose, with but little stretch of the imagination, other bottlenecks can be conjured up.

More disturbing than the reduction in standards of living implicit in such struggles with the environment is the increasing loss of our freedoms. It is certain that our society will become so complex, because of the evolving pattern in industry, the pressures of high population densities, and the inevitable increases in controls of all sorts designed to husband our diminishing resources and to keep us at peace with our neighbours, that governments will become more and more pervasive and more and more domineering; the precious freedoms of the individual will diminish. As Sears puts it "We should think of these trends toward a heavily populated underfed world in relation to the most important question of not how many people can exist on earth but what kind of a life will be possible for those who do."

It is perhaps incumbent upon anyone, who paints a picture in the sombre blacks and greys that I have used, to turn to some brighter colours. Fortunately there are promising solutions to the problem. Most of them are directed towards population control. Some of them have been tried on a sufficiently wide scale to hold forth an element of promise. Induced abortion, so it seems to me, should not only be legally permitted at the request of the prospective mother, but in some instances, encouraged.[2] Education in the practice of contraception should be increased and, in some countries, clinics for the teaching of contraception and the distribution of contraceptive materials and devices, should be established or further encouraged. The very promising ovulation inhibitors should be made more readily available and their distribution as avowed contraceptives should be permitted.

[2]Note added in 1988: For an authoritative discussion of the abortion problem I hasten to recommend "Fertility Control through Abortion" by Professor Carl Djerassi (*Bulletin of the Atomic Scientists,* January 1972).

Sooner or later any species bumps up against its environment. The wolves keep down the deer; man and disease get the wolves. We, however, in our allegedly infinite wisdom, do not allow disease, or the *Anopheles* mosquito, or this or that virus to get us. When flour beetles become too numerous they start to eat their own eggs, perhaps because random collision will cause more beetles to bump into more eggs. I am not advocating cannibalism or the return of infanticide: they have lost in acceptability and respectability. I would only point out that in combating the environment by introduction of death control, we are apt to jeopardize the continuation of the species unless we are equally aggressive in the propagation of birth control.

A part of our environment is the Roman Catholic Church. It stands as the greatest obstacle in the way of family planning and population control by contraceptive techniques. While approving all that tampering with Nature that goes on under the cloak of death control, the Church is unalterably opposed to the humane practices of birth control by so-called artificial methods.

In the matter of death control we make tremendous efforts, and quite successfully too, to eliminate mortality at birth and *in utero.* In the matter of birth control and perhaps as a fundamental part of family planning we devise some good contraceptive techniques only to find that the Church stubbornly opposes any physical or chemical device that might prevent a good live sperm from meeting up with a healthy ovum. We then go one step further and discover a means whereby the ovum is not even released from the ovary. On this method the Church has not passed judgment. Since the antiovulation agent in question is also a fertility pill, I regard this most hopefully as an approach to population control that will get the Church and its theologians completely and totally confused if anything ever will.

Of course, we could also leave the problem completely alone in the hope that time would provide a pleasing solution of its own. I am quite prepared to admit that one stands on somewhat shaky ground when he tries to pontificate on the future of the species.

There are, for example, a number of imponderables on which there is a singular lack of data. It has been suggested by some, but on very scanty evidence, that the childbearing period is lengthening, a factor which would add to the number of children that a woman could bear. The age of onset of the menopause may also be changing; it may be advancing or retreating. In either case the childbearing potential of women would be affected. All in all we have very little understanding of the economic, social, and religious factors, as well as the phobias and the philias that underlie occasional declines in fertility and its recovery.

One very important consideration is the notoriously low reproductive rate of man compared with most other animals. Multiple births are rare; women are fecund for only about half their lives; the gestation period is long; conception may be inhibited during lactation; and more or less complete sterility is surprisingly common. A domestic pig that is of comparable size and lives on much the same diet as does man, produces more offspring in a year than most women do during their entire lifetime. We know very little indeed about human fecundity and what I am suggesting, though in the complete absence of any supporting evidence, is that the future, for some strange reason, may bring with it a further decrease in human fecundity.

As for myself, I would not leave the problem alone. I cannot subscribe to the philosophy that, just as all crises of the past have been solved by the Fates or by human ingenuity, so the problems inherent in growing population pressures will find their own solution. I find myself as a strong advocate of family planning and of birth control, recognizing at the same time the inevitability and desirability of still further research in the medical sciences and in lowering even more the death rates of the world's populations. I deplore the widespread tendency among governments to offer tax relief and subsidies to the parents of larger and larger families and at the same time I can appreciate to the full the dangers inherent in the national advocacy of birth control if the programs impinge upon the wrong population groups wrong from the eugenic point of view.

I have rather strong feelings about the distribution of food surpluses to countries in need. I would hope that the day would come, and soon, when those countries that are advanced technologically, and that have the resources to permit aid to other countries, would act in concert in extending such assistance. An essential prerequisite should be clear proof that an applicant country has introduced an acceptable program of population control and will not continue to burden the rest of the world with all the troubles inherent in fast-expanding populations.

Finally, I should emphasize that there is little that is new in these lamentations and doleful prognostications. Over a hundred years ago John Stuart Mill (1848) predicted that "a time would soon arrive when no one would have more than necessities, and soon after, a time when no one would have a sufficiency of those, and the further increase of population would be arrested by death."

Before Mill and intellectual leaders of the 19th century, there was Malthus whose famous "Essay on Population" (1798) had as its central theme the tendency of population to outgrow the available food supply. In the third century A.D., Tertullian is reported to have written "what most frequently meets our view is our teeming population; our numbers are burdensome to the world, which can hardly supply us from its natural elements…. In very deed, pestilence and famine, and wars, and earthquakes have to be regarded as a remedy for nations, as a means of pruning the luxuriance of the human race."

Late in the 1950s, Stanford University introduced a series of seminars upon a broad variety of subjects. Participation in at least one of these was required of senior students. The seminar of choice had to be outside of the declared major of a student; for example, a student with a major in history could not satisfy the requirement by selecting a seminar in history. I agreed to lead a seminar on population overpopulation in the fall quarter of 1960 1961 and again in 1961 1962. Ten to fifteen students were enrolled on each occasion. At the end of the quarter each of the participants was required to submit an essay on one of many relevant topics selected from a master list. This was in lieu of a written examination of the conventional type. One of the students in the 1960 1961 group selected as the subject of his essay "How Overpopulation Might be Countered: A Proposed Solution." His proposal was unique: by the age of 65 one will have completed his contribution to the welfare of society. By then he will have exhausted his ability to do anything worthwhile to benefit the environment or his fellow man. He can no longer be regarded as

an asset to society and his life should be mercifully and painlessly terminated. I was then 61 or 62 years of age, but recognizinig this as a unique and potentially effective solution, I was glad to commend his ingenuity and sense of humor by grading his paper A.

At the Conference, some hundreds of thousands of dollars were pledged by those in attendance to set in motion specific actions that had been proposed. The enormity and severity of the population problem have been summarized in the following three quotations:

1. "It is the basic problem of the world today, and unless we can solve it, no other major problem of our world society can be solved at all." Harry Emerson Fosdick
2. "All other problems fade into insignificance by comparison. Until the population problem is dealt with, we are wasting time trying to solve the others." Marriner Eccles
3. "It is at the very heart of the problem of our existence." United Nations Report

The Margaret Beattie Lecture

In 1961 I was invited by the Planned Parenthood Association of San Mateo County to give the 8th Margaret Beatty Lecture. The invitation was conveyed through William Reich, then an officer of the Association, who expressed the hope that the lecture would focus on the Population Overpopulation problem. I accepted the invitation and gladly approved the suggestion that the lecture pertain to the question of population control. The text is presented *in e tenso* in the following.

THE MARGARET BEATTIE LECTURE
January 27, 1962

I am honored by your gracious invitation to present the 8th Margaret Beattie Lecture. It was never my good fortune to be associated with the University of California as a student or a member of the faculty, and I was denied the great privilege of knowing Miss Beattie. I shall try to make amends this evening. The subject I have chosen is rich in controversy and speculation. I can only hope, ladies and gentlemen, and you particularly Miss Beattie, that you will share with me the belief that some of the issues to be raised are of very great importance even though we may be of different minds on how to solve the problem if there is a problem. I have deliberately suggested an interrogation mark as an essential part of the title "Overpopulation " for it is as a question or as a series of questions that I would like to introduce the subject.

Is the world overpopulated Is it seriously threatened with overpopulation in the years to come Just how many people can be supported on the habitable areas of our planet at that very thin interface between the heavens and

the earth I rule out all possibility of gaining more *Lebensraum* by burrowing underground or by fanciful excursions into space. Can we feed 15, 20, or 30 billion people Are we prepared to make the necessary capital expenditures in drainage, in irrigation, in soil stabilization, and in fertilizers, to bring more than a billion acres of marginal land into cultivation Can we apply the fruits of science to the technology of the problem with sufficient rapidity and upon the enormous scale that is demanded When we speak with optimism of the tremendous advances of recent decades in genetics, in soil science, in plant physiology, in plant pathology and so on, and of our tremendous fund of knowledge in these arts and sciences, do we adequately appreciate the vastness of the problems of implementation and application Much of the basic knowledge has been with us for decades, but even so the per capita food production of the world as a whole increased only 1 in the last 20 years. In most of Asia it decreased by 10 and in Latin America by 3 .

Man's struggle to attain higher and higher living standards finds expression also in a hunger for more and more of the gadgets and material things of daily life. Have we the reserves of minerals that will satisfy the demands of an industrial complex adequate to meet the burgeoning requirements of 10, 20, or 30 billion people Will our discoveries of new reserves continue to keep pace with our expanding demands Will the technological advances and energy capacities of the future be adequate for the mining of ores that are more and more marginal and submarginal Just how long will our luck hold out

All of this industrial expansion requires energy in almost incalculable amounts. Have we any reason for confidently believing that our world deposits of coal, amenable to exploitation, will be adequate into the far distant future Can we predict with any assurance that our reserves of natural gas, liquid petroleum, and oil shale will satisfy the requirements of the fast expanding petrochemical industry and our tremendous need of these hydrocarbons as sources of heat and power for many billions of people Do we seriously believe that the discovery of new reserves will keep pace with our fantastically increasing requirements Knowing something of the geography of our rivers, streams, and basins and the unfavorable location of those that might offer some promise as new sources of hydroelectric power, can we with any assurance assume that the undeveloped hydroelectric power resources of the world will offer us substantial relief Perhaps we shall enjoy a respite, insofar as electric power is concerned, as we harness more and more effectively and completely the thermonuclear fission processes. Our reserves of uranium and thorium look good. If and when thermonuclear fusion can be carried out as a controlled reaction perhaps in the distant future our energy requirements will probably be satisfied for centuries to come. Are we prepared to spend the billions required for research on the science and technology of these problems or is it better to shoot hardware into space Or, can we do both

Shall we have fresh water in the abundance required by the world of the future This is largely a regional problem, but it should be noted that even here in the USA over half of our municipalities go through periods of water shortage every year. Are our fresh water supplies in peril, or may we assume that conservation measures, re-utilization and salvage will keep pace with

the fast expanding requirements of industry and of the ordinary household As for the latter, the problem is aggravated in this country by ever thirstier gadgets for washing and for garbage disposal and by our frenzied devotion to cleanliness.

And, do we fully appreciate the vastness and the intricacies of the international problems that arise as we exploit (and also contaminate) the oceans, as we begin to conquer and to exploit outer space, and as we endeavor to control the movements of great air masses or monkey with the polar ice caps for purposes of climate control Can we learn in time to subordinate some of our national interests in an endeavor to work harmoniously together in the global solution of such challenging problems as these

But the world in which we live is more than a world of material things. There are the things of the spirit and those precious liberties for which our fathers and their fathers for generations back have fought and died. One of the functions of Government is to keep us at peace with our neighbors. If our neighbors, even within our own country, increase excessively in number, the penetration of government into our daily lives will become increasingly vexatious and pervasive. Controls of every possible sort will be designed to husband our diminishing resources, to increase the income of the State, and to keep us at peace. As Sears has posed the problem, "We should think of these trends toward a heavily populated, underfed world in relation to the most important question of not how many people can exist on earth, but what kind of a life will be possible for those who do " Aldous Huxley puts it before us in a somewhat different way by asking the very pointed question, "What are people for " We are certainly not here merely to broaden the tax base or to increase the gross national product, or to produce more and more of our kind without giving any thought to their future, or to outbreed our potential enemies. I shall not be so presumptuous as to say why we are here, but I believe it only right to pose the question and to suggest that any discussion of population, overpopulation, and population control would be completely off-balance and quite wide of the mark if it did not face up to these very special values precious, intangible, and, perhaps, seriously in peril.

And now for some pertinent facts and figures. The human population of the world is currently about 3 billion and that of our country about 185 million. This country and the world at large have about the same net rate of population increase, approximately 1.6 per annum. If present trends were to continue and certainly no one in his right mind would insist that they will, we shall be faced with a world population of more than 6 billion by 2000 A.D. and of more than 12 billion some 50 years later. In our own country, our population at the turn of the century would approximate 300 million and, some 50 years later, 600 to 700 million. ou may feel as I do that predictions of this sort are extremely hazardous and this is why I must insist on the qualifying phrase, "If present trends continue," and must also indicate to you with the aid of a few lantern slides, a few simple premises that underlie such predictions.

The first slide suggests that even the friends of Charlie Brown, the man on the street, regard the threat of overpopulation as a serious problem.

The next slide, which is taken from a paper by Professor Kingsley Davis, published in the *New ork Times Magazine,* portrays rather dramati-

cally the growth of the world's population since the turn of the century and the projections made for the years 1975 and 2000 by the staff of the United Nations. The various regions of the world are not increasing in population uniformly as shown in the next slide. Asia is expected to contribute most significantly to the world's population during the next 25 or 30 years. This illustration, which is drawn from the *Population Bulletin* for March 1959, carries the population data back some 300 years and again serves to illustrate fairly dramatically the acceleration in population growth which is characteristic of our times.

The next slide carries us back even farther into the past; in fact, to the beginning of the Christian era, at which time, according to a rather broad consensus, the world's population was of the order of 100 to 300 million.

The next illustration, which is drawn from an article by Sir Julian Huxley, published in 1956 in the *Scientific American,* goes back much farther into the distant past. It has a peculiar fascination for me because it displays quite unintentionally the tendency of the world's population to soar like a meteor. Were the world's population to increase at present rates or, if you please, were the meteor to continue its fiery ascent for another 700 years, we should have, as all of you have heard many times, a planet in which the land surfaces, even the whole of Antarctica, would be barely sufficient to provide standing room for the species.

The next slide is made from an illustration which appeared in the same article by Julian Huxley. It is intended to show what we mean by standing room only. Here we have drawn within the compass of the camera a crowd of 5 million people. Lest we be too frightened by the awful prospect of standing room only, it is comforting to know that a population of even 10 billion, if standing side by side and with an allowance of 3 square feet per person, would only occupy about a thousand square miles. In other words, they could be packed into an area the size of Rhode Island.

The purpose of the next slide is to draw attention first of all to the disparity in the net rates of population increase which are highest for Central America and South America, and relatively low for most of Europe. Attention should also be drawn to the great diversity in birth rates that prevail in various regions of the world and the corresponding disparity in death rates. I would emphasize again that the population explosion, if one may use this controversial term, is largely attributable to the advances of the last fifty years in medical science and the great impact these advances have had on the death rate in many parts of the world. Perhaps a very disturbing thought is that society is not yet prepared to do much in the way of deliberately reducing the birth rate, yet in all countries and in all elements of society man responds eagerly to every effort that is made to reduce the death rate. With this consideration in mind, we must look forward to further and quite appreciable decreases in the death rate in such regions as Africa, Asia, and Central and South America. As I see it, it is reasonably certain that in time the death rate throughout the world may diminish to seven or eight per thousand of population per annum. Unless such a decrease is attended by some corresponding decrease in the birth rate, for which man seems presently to be ill-prepared, the renewed impetus to population growth may be most serious in its impact.

On the next slide, I would like to draw your attention to the history of population growth in our own country; especially to point out that with the exception of the troublesome '30s our rate of population increase has held between 1.4 and 1.7 per annum for 50 years. I mentioned earlier that various people interested in these problems have made predictions of the world's future population. The most noteworthy of these were made by Pearl and Reed, who, in 1920, predicted that the world population would level off by 2100 A.D. to an asymptotic value of a little over 2 billion. In 1936, they revised the figure upward to 2,650,000,000. I need hardly emphasize the fact that these estimates soon proved to be quite erroneous for already the world population is approaching 3 billion and there is no convincing indication that a levelling off process has gotten under way. Dr. Joseph Davis at Stanford University, one of the very distinguished students of population, has brought together a number of estimates in a paper just published by the Milbank Foundation. I am indebted to him for permission to produce the pertinent figure. This slide, which deals with the population of the USA, consists of a projection made by Pearl and Reed in 1920 and a number of other projections, of which the most realistic is that by the Bureau of the Census. What I wish to emphasize is that the one common factor to all published estimates hitherto made of the USA population or of the world population have been erroneous and that all have erred in the same direction, namely, in being too low. This should give us pause to reflect for it suggests that if we have hitherto been making serious estimates of the impact of future population loads, we have probably in unison underestimated the magnitude of the impact. The hazards attendant on burgeoning population increases have, in other words, been underestimated rather than exaggerated.

I should also show you an illustration drawn from a paper by a distinguished plant physiologist, Professor Virtanen of Finland. The slide in question suggests that the world's population might eventually level off around 12 or 13 billion, but in the course of the paper, Professor Virtanen was careful to point out that although the human population curve must eventually flatten out, it may, indeed, rise very much higher than is suggested by this illustration before it begins to turn downward. In other words, it is a mild suggestion of things to come, but not a firm prediction.

ou may wonder, as I have, whether there is any firm basis resting on scientific discovery, for population growth curves such as I have shown. To some extent, there is such a basis and the concluding few slides may serve to illustrate the point. The first of these reports on the growth of a population of yeast. Lest you argue that the behaviour of yeast is quite irrelevant, we should, I believe, remind ourselves that from the biochemical point of view there is not much to choose between a yeast cell and a cell from growing mammalian tissue. When yeast grows in the presence of an abundance of nutrients, in a culture medium of fixed volume, the growth rate eventually levels off as is shown in the slide an S-shaped curve is the result. The next illustrates the growth of a banana fly population, something like yeast except that the cells are stuck together and are differentiated in function within a confined space and in the presence of an abundance of food. Again, the growth curve assumes an S-shaped form and presently levels off. Incidentally, if the banana flies be grown in a somewhat larger bottle, the same S-

shaped curve results, but the asymptotic value of the insect population is quite appreciably higher. It goes without saying that man is in about the same situation as banana flies growing in a bottle. Even though our species had an abundance of food, it would still be restricted to a confined space the fixed and constant land areas of the earth. Eventually, it is argued, the population growth curve must, as in the case of yeast and banana flies, assume an S-shaped form and level off.

The next slide, which represents an illustration from the famous book by Raymond Pearl entitled "The Biology of Population Growth," is based upon this premise. From the first portion of the curve which is derived from actual census counts, it is possible to derive a mathematical equation which permits one to plot the rest of the curve into the distant future. At least it does so if one is permitted to assume that the existing data are sufficient to reveal the point of inflection in the ascending limb of the curve. The trouble, however, is that no such point of inflection has yet become apparent and the population growth curve, rather than assuming the form that Pearl and Reed predicted, is still continuing to rise even more steeply than before. For example, the population in 1960, far from being 158 million as the curve would predict, was actually 185 million or more. A similar consideration applies to the curve for Sweden a projection which is very much in error as evidenced by the fact that the 1958 population was 7.5 million. Finally, the last of the slides, again based upon the very hazardous premises that are mentioned, reveals the same sort of serious underestimate as do the preceding slides.

Although I have tried to be dispassionate and objective in presenting a subject that is charged with emotion and rich in controversy, it is probable that I have raised doubts regarding the world's ability to support a population load of 10 or 20 billion in an environment wherein life may be abundantly enjoyed and precious intangible values may be preserved. If the future of the species appears grim because its numbers may be getting out of hand, we must necessarily ask ourselves whether we of this generation should do anything about it.

We could, of course, leave the problem entirely alone. Man has gone through many great crises in his long and troubled history. Somehow or other the problems of the past, yes, even the problems of population pressure, have had a way of finding their own solution. The deliberate cultivation of food plants, the domestication of animals, the opening of new worlds beyond the oceans, the industrial synthesis of ammonia and of nitrates, the development of far-flung transportation systems by land, by sea, and by air, the invention of the steam engine and of the internal combustion engine all of these (and many more) outbursts of discovery, have had a way of coming along at the right moment in human history. The ingenuity of the species, it is argued, will continue to express itself and to rise to the needs of the occasion as it has always done in the past.

We could even do some very wishful thinking a free wheeling of the imagination. We might find ourselves arguing, without any sound basis in fact, that the strange population pressures of the future will reduce the fecundity and perhaps, the fertility of the species. As Professor Goodhart has pointed out, human fecundity is already low and perhaps we find ourselves asking, may it not go even lower. A woman is capable of bearing children for

a scant 30 years; multiple births are rare; sterility is relatively common. The biologists point out that a pig, which is of about the same weight as a woman and likewise omnivorous in its diet, has as many young in a single litter as a woman does during her entire lifetime. I repeat that it would be folly to entertain the hope that the fecundity of our species might diminish in the crowded years of the coming century; it is just as possible that it might increase.

To do nothing is, of course, an easy way out but, as I see the problem, it is not the kind that can be prudently ignored. And this is because a new dimension has been added which is uniquely applicable to this particular crisis. I refer, of course, to the explosive upsurge in population which has paralleled so closely the "Golden Age of Medicine" as so colorfully described by Maurice Tainter. It runs hand in hand with man's triumphant conquests over infectious disease, his advances in public health, sanitation, surgery, infant and maternal care, in the treatment of the hypertensive diseases, nutritional diseases indeed his extraordinary progress in the whole broad field of medicine. All of this has been attended by increases in life expectancy and decreases in the death rate. The death rate in some countries is as low as 7 per year per 1,000 of population and it is almost certain that within a very few years the death rates of various heavily populated countries at the other end of the scale will fall several points from present levels of 12, 15, or higher. No corresponding decreases in the birth rate are in sight. Man is faced with the dilemma of welcoming with enthusiasm and gratitude all those advances in science and technology that reduce the death rate, but of receiving with a questioning mind, with grave caution, or even with avowed hostility, other advances that permit us, by the most humanitarian of means, to reduce the birth rate. Need I point out that we may not have our cake and eat it too. If we insist on tampering with all the checks and balances by which Nature over the millennia has kept the species within reasonable numbers, we must face the consequences. Our tampering has been with but one side of the balance sheet; we have worked strenuously to reduce death rates and we have adopted social policies that favor an increase of births. I suggest that the time has come when man must be prepared to adjust the other side of the balance sheet and to do so by the most direct approach that is possible reduction of the birth rate.

To be sure, this is not the only way to restore a state of balance, at least an approach to an equality between death rates and birth rates. We could revert to Nature's methods we could restore the primitive levels of high death rates: war, which in these days would be catastrophic in magnitude and in conseqeuences; abandonment of all efforts to improve the health of mankind; bringing an end to the expenditures of our fund-granting agencies, public and private, in the fields of health and welfare; termination of the public support of research into the diseases that ravage mankind; and abandonment of our publicly supported health programs of all sorts, here and abroad. But is this what we want to do Of course not. And as for the other kind of war again we know the answer. It is that the very survival of the species is at stake. War has long ceased to be the simple pruning operation of past centuries. We now have no alternative but to abolish war, as a completely outmoded instrument for the settlement of intergovernmental disputes, or face the destruction of organized society, the loss of the innumerable values accu-

mulated by man in his centuries of struggle, and the probable return of the survivors to a ravaged environment and to primitive ways of life for which many would be ill prepared.

The practice of infanticide, even of cannibalism, could again be made permissible, socially acceptable, and even encouraged. In some societies there was at one time no question about the desirability of these practices sometimes deliberately pursued as a means of maintaining a balance between food supply and population.

Shall we try the compulsory sterilization of men and women Are we, in fact, able to apply those basic principles of eugenics that would be involved Do we have enough wisdom to decide who should be sterilized Could we accept with equanimity, here or in any other country, the decisions of an all-powerful board of referees and adjudicators, clad with the requisite authority to order the sterilization of so and so yes, even of you and me The problem, you see, is not the sterilization of certain types of criminals or the carriers of certain transmissible and intolerable diseases. It assumes, rather, the aspects of a wide-scale effort to reduce the numbers and enhance the quality of the human race.

Some may even endorse the idea of transporting our excess populations to outer space to other planets or even to other stellar systems, the nearest of which is over four light years distant. This is heady stuff, but if any of you endorse this as a solution you will be in the distinguished company of the President of the American Rocket Society, of an eminent British politico-economist, and a choice assortment of crackpots.

No. We dare not leave the problem alone nor may we attempt its solution by scrapping the high ethical values which, hopefully, we believe are beginning to characterize the slowly evolving product of long centuries of development. To save human life, to battle against disease, to refuse to accept war as a solution of anything this great development in morality is becoming, I believe, as much a part of man as his red blood cells.

Well, what may we do Are there any solutions that may be proposed, yes even urged, as constructive approaches to the problem of actual or potential overpopulation

I am not prepared to insist that here in the United States of America the problem, in its many facets, has already become grave despite the certainty that population pressures are developing and that the impact of our rapid population growth on the intangible values of life is already serious. But I would urge that we should even now institute certain measures. There is little to be gained by sounding the fire alarm after the house has burned down.

1. We should re-examine our system of taxation with the particular objective before us of discouraging the large family and encouraging the small. For example, the first one or two children in a family should be treated as tax exemptions and all above two in number should be subject to a tax surcharge. Perhaps there should be a system of tax rewards based on the children we do not have rather than the children we do have

2. Maternal benefits designed to encourage the large family, such as hospital care at public expense during childbearing, and direct maternal payments by government, quite common in some countries, might well be re-examined.

3. Our system of school support should be examined. I would suggest that the tax support of our school districts should not be exclusively a charge against property but in large measure should be a charge against the parents the taxes to be levied from family to family in direct proportion to the number of school-age children.

4. Our systems of relief for the indigent should be thoroughly studied. Many instances of grave abuse have come to light and as a product of our good intentions we are encouraging the birth of more and more children by mothers whose husbands are ephemeral, fleeting, and, because of the curious requirements of the relief system, very prone to be of no fixed address and quite unidentifiable as husbands and fathers.

5. I would also suggest a system of rewards to women, perhaps within the framework of tax benefits, to encourage late marriages. In our country the average age at first marriage is 20.3 for women. Forty percent of all first marriages by women are those of teenagers. In Western Europe, where the net rate of population increase is roughly half of ours, the corresponding age at marriage is 22 to 26. In Ireland, 26 of women aged 50 have never married. In the USA, the figure is only 8 . There is abundant proof that postponement of marriage can be an effective solution. The problem is to bribe, or otherwise induce, our young women to buy this kind of a package.

6. Consider, for example, the legalization of abortion. At present, induction of an abortion is a criminal offense throughout the USA. The operation is permissible on request, almost unconditionally, in Japan and the USSR, and the Scandinavian laws are quite liberal. Note that reliable estimates place the number of illegal abortions in our country between 200,000 and 1,000,000 per year most of them performed by the incompetently trained and under perfectly shameful conditions. I would suggest that the moral tone of our society would be improved were we to regard abortions with much more charity and to lift, by legalization of the operation, the cloud that presently envelops the practice. Note that we are concerned with global aspects of overpopulation. In some countries, not necessarily ours, abortion is as readily accepted as contraception in family planning and in population control. In Japan it is publicly endorsed and encouraged and within 15 years has cut in half the rate of population increase; from 1.8 or so to 0.9 percent per annum.

7. The voluntary sterilization of men by vasectomy. The cutting of the vas deferens is a simple operation that can be performed in a few minutes in a doctor's office. I believe that this may be gaining in favor especially among men who recognize that the bearing of additional children may present serious problems in child care and maintenance, or whose wife, for medical or other reasons, should cease to have children. The operation is favorably regarded in India and is encouraged by education and by financial reward by several of the State Governments of that country. Because of its simplicity, its low cost, and its foolproof results, this is perhaps the best approach to which that great country can turn in seeking a solution to its very serious population problem.

8. Not to be overlooked, of course, are the ovulation inhibitors those oral contraceptives which, like the natural hormone progesterone, inhibit ovulation. This remarkable group of compounds is unquestionably the soundest and most effective of the various means of contraception that man has yet discovered. The work of Pincus, of Rock, and of the many steroid chemists who produced these compounds is deserving of public acclaim. As a matter of public policy we should willingly and gladly make these substances available to countries abroad where, plagued with overpopulation, government may turn to us for guidance and help. I regret that President Eisenhower, in rejecting an important section of the report of the Draper Committee (his own Committee) announced to the world that we would not, as a government, give to other countries that so requested, any help through our public agencies, in the procurement of contraceptive materials or in the dissemination of information on contraceptive practice. It was left entirely to the privately supported philanthropic agencies. I would suggest that were India to request it, our government should be just as eager to provide her with a few tons of oral contraceptives as with a few hundred thousand tons of wheat. Note that 60 or 70 tons per year of one of these ovulation inhibitors such as Enovid, given to half of India's women of childbearing age, would cut the birth rate in half expensive but effective.

   Obviously, the most effective solution of all is absolute continence also the most difficult and the most unrealistic. The rhythm method, heavily endorsed as the so-called natural method, is probably the least dependable method of all.

9. There is, however, another approach, seriously under study, and with some real progress to report a method of oral contraception for the man. This is based on a family of compounds which inhibit spermatogenesis and are extraordinarily effective. Like the ovulation inhibitors they are transitory in effect sperm formation is resumed when they cease to be taken. This work is only in its beginnings but the progress to date is substantial and promising of ultimate success.

10. An immunological approach is also being explored. Here the desire is to achieve an immunity against the proteins of spermatozoa, obviously to avoid any general sort of immune reaction but to establish for periods, long or short, a very specific incompatibility between the proteins of spermatozoa and those of the ovum.

11. There is also much need for research into the development of compounds which may be taken by mouth, and which are spermatocidal, or ovicidal, or prevent the implantation of the fertilized ovum.

I wish to conclude with a few observations pertinent to our own country and with several rather sweeping generalizations. First of all, we are disposed to write off overpopulation as a problem, a matter of concern, we agree, for various far-away countries but not ours. We are well aware of our present great surpluses of farm products, we know that our population density is relatively low, our living standards are high, and we are blessed with

an abundance of the good things of life. But let us not forget that the problem is developing and can gain in impetus. We are currently withdrawing 1,500 square miles of our productive lands every year for the needs of housing, transportation, and industry. Our wilderness areas, our forest lands, and our mountain valleys are being more and more aggressively invaded. More and more regulation, more and more restrictions, more and more curtailment of our erstwhile freedoms are steadily and insidiously building themselves into our lives. The hand of a beneficent government becomes inevitably more and more oppressive as population grows and more and more regulation is judged to be necessary.

I must also point out how pitifully, if not shamefully, laggard we are in the legislative approach to some of the problems we are considering. Think for a moment of the fact that in the great states of Connecticut and Massachusetts the sale of contraceptives, the dissemination of information on contraception, and the maintenance of birth control clinics are illegal.

Statutory provisions against contraceptives constitute a very minor part of a large body of laws devoted to obscene literature, abortion, unnatural vice, and other perversions. For instance, "Crimes Against Chastity, Morality, Decency and Good Order" is the general title of those sections of the Massachusetts laws dealing with contraceptives. Also classified under this title are adultery, polygamy, incest, fornication, abortion, sodomy, buggery, keeping a house of ill-fame, and detaining a woman therein. An attorney going to the digests for cases on birth control will likewise look in vain for any such primary classification as "Birth Control." In certain digests, birth control cases are listed under such headings as Abortion, Obscenity, Statutes, Constitutional Law, and Post Office.

Finally, I draw your attention again to the rigorous and unyielding nature of our laws against abortion. I suggest that the present proscriptions against induction of an abortion are inhuman, cruel, and conducive to the perpetuation of a most vicious racket illegal abortions, performed by the incompetent and the avaricious.

As for the global problem the great population pressures that are building up in some parts of the world, the never-ending struggle to provide enough food, the actual or threatening shortages of minerals, of fresh water, of fuels, of energy, of the multitude of materials and of services required for a very complex world in all of this we find a challenge that will tax all the resources of human intellect. The solution of the problem demands infinite wisdom and human understanding, as well as technical progress, because the adaptations we must make in the next century or so cannot be in material things alone. We shall have to adapt emotionally and morally. Our world of ideas, our standards of right and wrong, our ethical judgments, the things of the spirit, will be subject to strange new pressures as our cities grow larger, as expanding populations draw more heavily upon us, as governmental controls reach farther and farther into even the sanctities of our lives, and as our personal freedoms diminish.

In the vastnesses of these problems the physical scientists are optimists; they are keenly aware that the technological progress of the future may shade into oblivion the advances of the past. The biologists are traditionally pessimists. They know that species may come and species may go and they are

prone to question the commonly accepted credo that eternal survival is a unique quality of our species. As a biochemist, and hence a sort of "optipessimist," I do have enough faith in the inherent wisdom of man to believe that present trends will not be allowed to continue, that the growing insistence on human survival will triumph, and that we shall have a world in which the material and spiritual values of the good life can be enjoyed for many centuries to come.

Lecture to the Swiss Friends of the USA

In early March 1964, while serving as the US Science Attaché (see below), I addressed the Swiss Friends of the USA in Zurich, Switzerland, on "Some Aspects of the World Population Problem." The text follows.

Some Aspects of the World Population Problem

So much of fact and fancy has been reported in the past few years on the world population problem that it is no small challenge to a speaker to contribute anything new. I propose to review the facts, on which there is substantial agreement; to draw a number of conclusions on which there is much less agreement; and finally, to suggest a few solutions on which there is much disagreement.

The problem, despite its complexity, is easy to define. If the population growth rates of the last few decades were to continue, the world population would double in 44 years and in 2050 would exceed 12 milliard. That of the United States would exceed 700 million, while Switzerland with a much lower growth rate would approach 12 million.[3] What is the maximum world population which, in the light of our present knowledge, can be fed, housed, and maintained at the ever higher living standard which we have all learned to expect Can we raise enough food Shall we have enough fresh water, enough minerals, enough unpolluted air, water and soil, sources of energy adequate for the tremendous demands of the future, and enough petroleum and other hydrocarbons to support the great chemical industries upon which we more and more depend And shall we be able to adjust to the multiplying problems of urbanization and to the strange new pressures of the future, to the crowding and to the restraints on personal freedom that will inevitably develop

The problem is rich in paradoxes. It is an old problem and yet it is a new problem. In the third century A.D., Tertullian is reported to have written, "What most frequently meets our view is our teeming population; our numbers are burdensome to the world, which can hardly supply us from its natural element…." In what is now the State of Ohio, 15,000 Indians once lived, and possibly suffered, as their hunting grounds became inadequate to meet the needs of their population; but at the present time the population of Ohio approximates 9,000,000 and with little awareness among many of its residents of a population problem. There are, however, some very good reasons for regarding the problem as new and these we shall explore later.

[3]To simplify the problem, we may assume that the recent heavy influx of foreigners would not continue. This, for several years, has doubled the rate of population increase.

The problem is also a world problem and yet it is not a world problem. We live in one world and yet we live in several worlds, worlds that may differ profoundly in their ideology, in religion, in education and economic development, and so on. There are the developed countries and the less developed countries. The former produce food and industrial products in abundance; the latter produce people. The competence of the one is in production; of the other, in reproduction.

Some of you will remind me that there are no scientific, engineering, or logistic problems that stand in the way of so distributing the world's people and the world's products that the burden of the one would nowhere be oppressive and the pleasures, comforts, and satisfactions of the other would everywhere be enjoyed by all. But we also know that it is unrealistic, perhaps even foolish, to speak of a world which enjoys free movements of its peoples, of the products of its farms, industries, and oceans. Even the exchange of ideas and the flow of knowledge do not proceed freely from country to country. In fact, there are great walls between our worlds, invisible but almost impenetrable. And just as serious I am sure you will agree are other invisible barriers: the culture of a people, their habits and customs, and traditions that reach back into distant centuries that greatly retard the acceptance of innovations in agriculture, in the handicrafts, and in industrial techniques and materials. And without this acceptance, the population problem almost defies solution. One fact of life that impresses me more and more is that people, en masse, are extraordinarily resistant to change. And I believe it to be most unwise to ignore this simple truism in facing up to the problem before us.

Now let us review, quite superficially, a number of facts which are clearly pertinent.

1. The world rate of population growth is now 1.6 to 1.8 per annum. It has been high and even climbing slowly for 30 years or more. Such a rate of increase leads to a doubling of the population in 44 years or less.

2. There is no reserve of undiscovered land. The surface area of the world's land is known and is not likely to change appreciably in the next few thousand years. In 6,000 years the oceans have risen about five meters. We have actually lost habitable land by this rising of the waters and unless the polar ice caps increase tremendously the submerged land will never be regained. The habitable areas of these lands have been determined and give us a present population density of 23 persons per sq. km. Of course, what we consider to be habitable today is not what we shall regard as habitable 200 years from today. By then we may have learned how to live happily and comfortably in the uppermost reaches of the Alps. And as for the population density of the earth's surface, we can only be sure that it will tend to increase. While we are reasonably certain that the upper limit has to be about 1,000,000 per sq. km., which will permit us to stand but not to sit, we can only speculate on the optimum population density. I suggest that this cannot be determined experimentally or calculated by shrewd guesses even for a small region such as Switzerland or the canton of Zurich. We still do not know enough about people and how they react to specific components of their environment. We are beginning to learn how

experimental animals behave when crowded and this may teach us a little more about people.

3. Man and all the living things upon which he depends are confined to the thin interfacial layer between the heavens and the earth. In this we are effectively imprisoned and there is nothing self-evident that we can do to increase our *Lebensraum,* either by burrowing down into the earth's crust or by fanciful homes on space platforms or by acquiring real estate on other planets. Remember that we are concerned with an annual increase of 50,000,000 in the world's population load.

4. Man requires a food intake daily of, let us say, 2,300 calories. We may consider this as a world per capita average. I am not insisting that this figure is very precise but we all know that there is such a thing as a biological minimum below which we cannot go. This means, in effect, that the population problem can never be solved by a continued tightening of the belt and I can think of nothing that man can do to decrease his average calorie requirements other than to spend much more of his life in bed.

5. We also require a gaseous atmosphere which must conform to certain physiological necessities. The oxygen tension may not go below a certain minimum, the carbon dioxide content must not exceed a certain maximum, and the total atmospheric pressure must also fall within certain limits to which we are adapted. We don't really know what the rate of change of the atmospheric composition is, but over the very long term it seems probable that the CO_2 would tend to increase and the oxygen to diminish. Much more serious is the question of pollution of the air. The great increase in factories of all kinds and especially in the number of motor cars that we must expect in the future may result in a loading of the atmosphere with a bewildering array of irritating and dangerous substances. This is not an insoluble problem by any means but is one of the possible hazards for which our future city dwellers must be prepared.

6. The climate. Over the short term the climate here and there may undergo quite noticeable changes. Most of us would agree that the present European winter differs somewhat from that of last year. But over the long term, hundreds of years, there can be no significant change. In trying to think of the world as a unit we cannot anticipate any change in the average temperature of the earth's surface, in the average amount of rainfall, or in the amount of solar energy that hits the earth. This is important in considering water supply, agriculture, and housing of the future.

7. The nature of man. And finally I am quite convinced that man himself will be about the same kind of an animal throughout the coming centuries. However drastic may be the man-made changes in his physical and biological environment, as viewed from the year 1964, there is little reason for believing that there will be any change in his genetic qualities. Influences of his environment, good or bad, will not be transmitted to his children or his children's children.

And now for the conclusions that may be drawn from these facts. I have already stated a few. First, let me make it perfectly clear that I am not predict-

ing a world population of over 12 milliard by the middle of the next century or of 30 milliard by the year 2100. I am only saying that if present trends continue a world population of at least this magnitude must be expected. All of this is a by-product, a rather unexpected result, of science and technology as applied to public health, preventive medicine, and therapeutics. What we have done, in effect, is to achieve a remarkable reduction in the death rate without a compensating reduction in the birth rate. Births are high and deaths are low and will tend to fall even lower for some countries. They have hardly begun, even today, to feel the impact of modern medicine. And so one is driven to conclude that the population estimates I have given are apt to be too low, just as all estimates made by demographers in the recent past have proven to be too low. They are bound to be too low unless something happens and it is important to know what could happen that might slow down the human race. I omit the catastrophes that could assail us as a result of continued international tensions and of unceasing political manoeuvering to attain positions of strength, and likewise the catastrophic consequences of worldwide epidemics from new viruses that might decimate our crowded cities of the future. I choose to think only of what man could do and might do in a deliberate, carefully planned, and beneficent attempt to restrain population growth.

But before doing this, let us first ask ourselves some searching questions and speculate on the answers. How many people can the world feed Is it 10 milliard, 50 milliard, or 100 milliard If we are optimists, as most economists appear to be, we are likely to accept a pretty high figure such as 50 milliard. If we are pessimists, as many scientists appear to be, we hesitate to suggest even 25 milliard, for we are impressed, I believe, by the tremendous inertia of the great population masses of India, China, Melanesia, and Africa, and the resistance to social change that is inherent in ethnic groups everywhere. We know something of the remarkable advances in food production attained in the more developed countries of the world by the application of modern science and technology but we ask ourselves just how rapidly this knowledge can be extended to and applied by the underdeveloped and overpopulated countries of the world. We are also acutely aware, as are the economists, of course, of the persistent and increasing withdrawal of arable land everywhere by urban expansion and interurban roadways. In the United States alone we withdraw from cultivation about 2,500,000 hectares per year. And we also know that despite all the intensive efforts to increase the world's food supply, the rate of food production is barely keeping pace with the rate of population increase.

And yet it is easy to be an optimist. We know that much can be done, even in the developed countries, to increase farm productivity. Oddly enough, on a per hectare basis of farmland, the agricultural productivity of the United States is surprisingly low for wheat and rye, for example, only about one-third that of Northwestern Europe. But it is part of our curious agricultural policy to keep it low. And we also know that in the underfed and overpopulated countries agricultural productivity need be pushed upwards from a mere two percent to a growth rate of only three or four percent per year to solve the food production problem. Whether this could be long sustained is another matter.

Shall we have sources of energy in the future, adequate to meet the tremendous demands that can be expected And here we can be very optimistic. Our proven reserves of hydrocarbons, specifically natural gas and petroleum, continue to increase despite the fantastic and exponential increase in their utilization. The world's reserves of uranium and thorium are also such as to support our estimated energy needs for many decades. When we harness the process of nuclear fusion so that it may be controlled and used for peaceful purposes, and this may be achieved within 100 years, we shall have a clean and abundant source of energy that should be adequate into the very distant future.

But what about the minerals, some of which are pretty rare, which we use in fantastic quantities to provide the appliances, the gadgets, the motor cars and the exotic instruments and alloys of the space age For these, too, the demand increases exponentially and it is easy to predict their exhaustion. But given the electrical and thermal energy, and this we shall surely have, we shall find ourselves making use of ores and deposits that are vanishingly low in their mineral content completely uneconomic in the world of today. Aluminum will be recovered from clay, magnesium in vast quantities from the sea, and even igneous rock may be used as a source of aluminum, iron, titanium, manganese, chromium and so on. The energy expenditure will, of course, be incalculable.

The limitless resources of the sun, as a source of energy, may also be further exploited. It was pointed out in 1952 that in only three days we receive from the sun as much energy as could be obtained by burning all our reserves of coal and lignite plus all of our remaining forests.[4]

Perhaps with none of our natural resources are we so vulnerable as with fresh water. I have no figures at hand to indicate the magnitude of this problem. Many of our industries, paper mills, for example, require virtual rivers of fresh water. And from some, recovery of fresh water from the outflowing wastes is completely uneconomic. In my country we also have a mania for cleanliness and this, combined with such water-hungry gadgets as garbage-disposal units, automatic laundry appliances, and air conditioning units, make extravagant demands upon our fresh water sources. Although very much of a regional problem, it is such that over half of our American towns and cities go through periods of fresh water shortage each year. Much can and will be done to add to our fresh water supplies by recovery from the oceans but I find it to be very difficult to be optimistic unless we greatly restrict certain kinds of water use.

I leave it to you to decide whether we have a population problem. If we have, society will make one of the three following choices: (*a*) it will leave the problem alone; (*b*) it will take steps to increase the death rate; or (*c*) to decrease the birth rate.

If we leave the problem alone, we shall do so in the fond hope that the problem will solve itself, as many other crises in the long history of man appear to have found their own solution. We might even entertain the thought that human fertility and fecundity will decrease perhaps an inborn defense mechanism of the species against such a hazard as overpopulation. There is,

[4]E. Ayres and C. A. Scarlott, *Energy Sources* (McGraw-Hill, New ork, 1952).

of course, no evidence to support such a theory though it has been pointed out that man already suffers from low fecundity and perhaps an even lower level faces the species in the years to come. One important consideration is the notoriously low reproductive rate of man as compared with many other animals. Multiple births are rare; women are fecund for only about half their lives; the gestation period is long; conception may be inhibited during lactation; and more or less complete sterility is surprisingly common. A domestic pig that is of comparable size and lives on much the same diet as man, produces more offspring in a year than most women do during their entire lifetime. We know all too little about human fertility and fecundity and certainly we have a scant understanding of the economic, social, religious, and environmental factors generally, as well as the phobias and the philias that may affect the reproductive capacity of the species.

In principle, we could close the gap between births and deaths and achieve the desired balance by the adoption of measures designed to increase the death rate. We could abandon all further efforts to conquer disease and discontinue the use of all the new drugs, the insecticides, the antibiotics, and the prophylactic and therapeutic substances which got us into this trouble in the first place. We could even encourage the return to cannibalism, infanticide, and the "mercy killings" of primitive societies in the past. All of this is theoretically possible but would be recommended by no one in his right mind. On the contrary, man's efforts to conquer disease will continue and will grow, for the desire to save life is a much a part of us as our two hands. I say this with the full realization that it is not applicable to certain societies and even in the so-called civilized parts of the world it undergoes an unfortunate perversion in times of war. No, we have to approach the problem by trying to control the birth rate or we might just as well abandon the effort completely and hope that by a miracle it will find its own solution.

Oddly enough, there are certain economic possibilities and I do not suggest these casually or flippantly. There is little justification in the UK and the USA, for example, where there is chronic unemployment, for tax benefits and direct subsidies that encourage or make somewhat less costly the having of large families. To go to the other extreme, perhaps we should even be given a tax deduction for each child we do not have instead of for each child we do have. To the contrary, one of our distinguished senators has just proposed that each pregnant woman should be paid a minimum wage of 125 per month throughout pregnancy. The proposal seems to assume that she is pregnant only 40 hours per week. However, it is an election year and we must be prepared for anything.

I believe we should also encourage, by some form of tax benefits or otherwise, postponements in marriage. In the USA the average age of first marriage by women is 20 to 21. In Ireland it is 27 or 28 and Ireland is about the only country in the world that has been undergoing for some years a steady population decrease attributable, I must point out, much more to postponement of marriage than to emigration.

The cost of our public school systems in America is covered by property taxes. I would suggest that it would be much more to the point to have it covered by a tax which in part at least would be a function of the number of school-age children in the taxpayer's family.

Enough for the economic deterrents. In considering next the biological deterrents, we can be more realistic but also much more controversial. One can start with the A's and say a word about Abortion. Although this is approved by law and encouraged by government in Japan and although it received such wide acceptance that the Japanese rate of population increase was almost cut in half in a very few years (from 1.9 to 1.0 per annum), there are not many students of the problem who recommend abortion as the answer. At the same time, I do believe that any woman, on request, subject only to a few obvious safeguards, should be permitted to terminate a pregnancy by an abortion induced by a qualified physician. I say this knowing that no physician anywhere in the USA is permitted to induce an abortion except to save the woman's life. The point, however, is that the number of illegal abortions performed by charlatans and under most undesirable conditions has been estimated at anywhere between 500,000 and well over 1,000,000 per year. Insofar as the practice became legally permissible and socially acceptable, there is no doubt that it would contribute to a reduction in the birth rate. And in some societies we must also recognize that abortion is more readily accepted than contraception.

Abstinence from sexual intercourse has been suggested by the Church and is practiced within some Orders and some religious sects. I cannot believe that it is a very realistic approach to the problem.

When we come to Contraception, the practices and possibilities are numerous: all of the well-known physical methods designed to prevent contact between a spermatozoan and an ovum and chemical methods based on the intravaginal use of spermaticidal agents. Of recent history and evidently of very great promise are the oral contraceptives, the family of steroids which serve as very powerful ovulation inhibitors. They function like progesterone, which during pregnancy serves as Nature's ovulation inhibitor, but they are effective in much smaller amounts, five milligrams or even less per day. In considering their use in such a country as India, for example, we cannot overlook the fact that they are still very expensive and that the self-discipline and knowledge required to continue the intake on a very fixed schedule presents some serious problems. It is interesting to note that about 6,000 kg. per year of the appropriate steroid would be sufficient to cut India's birth rate in half. It need only be taken by half the women of childbearing age unfailingly throughout the 240 intermenstrual days of a calendar year to achieve this remarkable result. From time to time, one hears rumors that their incorporation in certain foodstuffs is under consideration as a means of silently and unobtrusively achieving the objective.

On the experimental level there is much that is being done to discover effective agents for oral use that will equally inhibit spermatogenesis (some promising substances with this property have been discovered), or will serve very specifically as spermaticidal substances, or will destroy sperm motility or will inhibit penetration of the egg membrane, or will prevent implantation of a fertilized ovum in the uterine mucosa or will bring about an early resorption of the foetus (at least two very effective substances with this property have been discovered), etc. The possibilities, I suspect, are numerous. Also in the realm of possibility we may look forward to an immunological approach to the development of specific antibodies to spermatozoa proteins

such that an incompatibility would develop between spermatozoa and ova and render fertilization impossible.

Finally there is the question of voluntary sterilization of the male by cutting the vas deferens. The operation is effective and simple but there are still rather formidable difficulties that stand in the way of the wide acceptance of this approach to the problem. It is indeed practiced, and even encouraged, in some parts of India by local governments who are reported to pay for the operation and give the subject 5 as well. One may well ask why any man, after having fathered a family of sufficient size, should not be permitted to have this operation. Nonetheless, American physicians, and for quite understandable reasons, are loathe to accede to the request. The sterilization of the female is a major operation and I cannot imagine that anyone would seriously propose that this be encouraged.

The subject we have considered is inexhaustible. Its importance, I am sure, is recognized by all. We can only hope that the grim spectre of an overpopulated world will be avoided by intelligent planning and humane methods. I am glad to report that at the highest levels in the American government the full dimensions and seriousness of the problem are now recognized and active steps are at last being taken to assist in its solution.

With a current (1988) population of somewhat more than 6,500,000, it may be hard to believe that Switzerland need be concerned about overpopulation. However, her numbers include about one million foreigners and only about 25 of the country lends itself to agriculture and industry. Lakes, rivers, highways, and the more or less uninhabitable parts of the high mountains make heavy demands upon the country. Beyond all of this, Switzerland enjoys a very enlightened citizenry, whose interests go far beyond the national frontiers. It may be said, with little exaggeration, that world problems are also Switzerland's problems.

VII. AN INTERLUDE IN THE USSR

In 1960, as a member of an exchange mission, I went to the USSR. There were five of us in the group (Henry Sebrell, Jr., Clifford Barborka, Floyd Daft, Currier McEwen, and myself). As guests of the Ministry of Health, we visited a number of institutes in Moscow, Leningrad, Kiev, Sikhumi, and erevan, hoping to learn something about the status of research in the USSR on arthritis and metabolic disease. Although assured by our hosts that we could go anywhere in the USSR that we wished, practical considerations, such as shortage of time, limited us to European Russia.

> Joint US USSR Communique of January 27, 1958
> On Exchange Missions Excerpts
>
> This Agreement is regarded as a significant first step in the improvement of mutual understanding between the people of the United States and the Union of Soviet Socialist Republics, and it is sincerely hoped that it will be carried out in such a way as to contribute substantially to the bettering of relations between the two countries, thereby also contributing to a lessening of international tensions.
>
> Both parties agree to provide for the exchange in 1958 1959 of eight medical delegations of five to six specialists for periods of two to six weeks to become familiar with research and achievement in the following fields: new antibiotics, microbiology, physiology, and pharmacology of the nervous system, radiobiology, community and industrial hygiene.

Something like 15 million Russian men were reported to have lost their lives in the Second World War. Hence, we were not surprised that the directors and many staff members of most of the institutes we visited were women. Many other occupations, including heavy labor (e.g. hod carriers) in building construction, usually restricted to men, were at this time taken over by women. As an official policy designed to restore population losses, special encouragement and allocation of resources were then given to pediatrics. The research in progress, notably in biochemistry in the institutes we visited, was quite pedestrian, partly because of wartime destruction of facilities, inadequate access to foreign periodicals, and constant bureaucratic political meddling.

In 1961 I attended an international biochemical congress in Moscow. I was accompanied by my wife, who is of Russian parentage. Russia, or the Union of Soviet Socialist Republics (USSR), at that time was strange, even forbidding, in many respects. Some of the problems we then encountered are exemplified in the following few paragraphs.

> My wife and I were accommodated in the Hotel Ukraine. I had learned from an earlier experience that breakfast could be a time-consuming affair punctuated by innumerable delays. The opening ceremonies of the Congress were scheduled for 9:00 a.m. in a rather distant assembly hall. Because of the

anticipated delays in the breakfast service, my wife and I decided to have it as soon as possible. The woman in charge of our floor and the elevator operator sleepily assured us that breakfast was available at 7:30 a.m. At 7:45 we were about to enter the restaurant. The door was locked but a sign on the door stated that the door would be opened at 7:30. I reported to the manager, "The sign on the door says that it will be opened at 7:30; it is now 7:45 but the door remains closed." Her reply, "If the sign on the door says it will be opened at 7:30, it will be opened at 7:30." Again at 8:00 I approached the manager with a second report and received her unchanged reply, "If the sign on the door says it will be opened at 7:30, it opens at 7:30." Finally at 8:15 we entered for breakfast but arrived at the assembly hall too late for the opening address of welcome.

We had planned to lead nine of our friends on a "tour" of European Russia when the Congress ended. To facilitate communication it had been arranged, successfully, that all of us would stay while in Moscow at the Hotel Ukraine. On the day of departure, I asked the hotel manager to provide me with the room numbers of our nine fellow travellers. "Oh, this is very difficult to do; much time will be required. Are they all Americans " " es indeed." "Please come back in a few hours; by then I may have the information." Finally, with a list of the room numbers, I attempted communication by phone, only to find that the room numbers were not identical with the telephone numbers. At last I was told that if I would go to room 343 the telephone numbers could be procured. Room 343 appeared to be an ordinary bedroom with a bed and a desk. The two young women on duty received the request and promised to have the telephone numbers in another two hours. I managed then to phone all of the travellers and asked them to be at the railway station in good time (by 23:30) for departure on the Red Star at midnight for the eight-hour trip to Leningrad.

From then on everything went well, or almost so. However, we were not to be deprived of another problem. Two members of the party, by a pre-Congress arrangement, left us at Leningrad for Helsinki and an early return to California. The following day the remaining members of the party with the necessary travel papers went to the airport for departure to Kiev. Then the fun began. "We have seats on the plane for seven only. Moscow has advised us that you are now only five in number since six of the party left at Leningrad." "Just a moment, here we are, nine of us each with his proper travel documents. Count us out. Only two left us at Leningrad." At last the pilot "booted out" two "Comrades" and accepted the nine of us for travel to Kiev. Apart from a repetition of the problem in procurement of hotel accommodations for nine instead of Moscow's five, and again in air transport to alta and more of the same (hotel accommodations in alta and transportation back to Moscow), officialdom in Moscow finally agreed that their records were in error and nine of the party were still in the USSR.

The Congress was fairly well arranged and papers could be presented in English, French, or German. Complaints focussed on a few trivia such as identification badges with numbers instead of names. The numbers led into a member catalogue which then permitted a final identification of number 1794, for example, as Rene Duranier (who had probably disappeared from view by the time the search for his name was completed).

VIII. SWITZERLAND

The Luck family lived in Switzerland from March 1962 to the spring of 1964. A stranger in Washington an officer in the Department of State phoned me in 1961 to inquire if I would be interested in serving for two years as the Science Attaché in the American Embassy in Bern. How could one fail to be interested in a two-year tour of duty in Switzerland Nevertheless, months passed before the prospective appointment became a reality. Involved in all of this was also a cherished belief that the human organism needs a real jolt from time to time a radical change of scene, a new type of intellectual or physical activity, a greatly altered human and physical environment. A two-year change seemed to be about right long enough to be jolted out of those comfortable ruts that had become deeper and deeper in the preceding wonderful years at Stanford, but not long enough to require another severe jolt to effect a return to California and to Stanford.

Shortly after arrival, I had the pleasure of meeting Dr. Hugo Aebi,[1] Professor of Biochemistry in the University of Bern, and Dr. Alexander von Muralt,[2] Professor of Physiology and President and founder of the Swiss National Science Foundation (Schweizerischer Nationalfonds). I suspect that it was through them that the University of Bern appointed me a visiting professor (without salary) for the duration of my stay in Switzerland. I was required to give at least one lecture per year to the students.

Radio Interview

Several months after arrival, I was told that I would be expected to participate in a radio interview concerning Swiss science. The questions and the answers constitute the substance of the following few paragraphs.

Radio Interview Concerning Swiss Science, November 5, 1962

> UESTION 1: Professor Luck, the US Government has Science Attachés at US Embassies in only a few countries of Europe, such as in the Soviet Union, Britain and Western Germany, and, this year, you, Sir, were appointed as the new Science Attaché of the US Embassy here in the Swiss federal capital, Berne. Could you explain for us why this post of Science Attaché at the US Embassy in Switzerland was thought to be necessary… why in Switzerland, which is a small country compared to other larger European nations where there are no US Science Attachés

[1]Hugo Aebi was killed in a fall, July 15, 1983, while climbing alone ( ) in the Swiss Alps. He fell from Mt. N nenen, well known as a particularly treacherous, if not a vicious, peak.

[2]Alexander von Muralt, sometimes regarded as the “uncrowned king” of science in Switzerland, died May 28, 1990.

ANSWER: es, it is indeed so that Switzerland is a small country but its importance in world affairs, certainly in science, is completely out of proportion to its size. I do not happen to know, of course, exactly what the population of scientists in Switzerland is. But I do know that your universities and research institutes enjoy a very great reputation abroad for their high quality. ou probably have, or have had, more Nobel laureates per capita in Switzerland than in almost any other country.

Another very important consideration is that Switzerland, a neutral country, occupies a unique position in the affairs of western Europe. This, incidentally, gives to the country an unusual interest from the point of view of science and industry. It means, among other things, that a number of world organizations such as CERN in Geneva, the World Meteorological Organization and the World Health Organization, among many others, have found it clearly desirable to center their operations in this neutral country. Beyond this, many American companies, essentially scientific or technological in their operations, have important representation in Switzerland, again because of the obvious advantages of being in a neutral country which has a long and enviable reputation of integrity and solidity.

I do not mean to dwell on this question too long but I think it is an important one and should perhaps be in a somewhat different form. A subsidiary question might be why there are any Science Attachés posted at United States embassies anywhere or why other countries have found it desirable to establish a Science Attaché program I suppose the answer to this question is that science is now believed to have a real impact in the formation of foreign policy. All sorts of matters have arisen over the years which are essentially rooted in science and yet have an impact on foreign policy. As a boy I remember that a copper refinery on the Canadian border used to blow its smoke, by act of God, across the border and year after year did a great amount of damage to crops on the American side.

Fish have a habit of ascending rivers that cross national frontiers, and do so in order to reach the headwaters for spawning. Whatever is done to fish in the headwaters or in the lower reaches of the rivers can have an impact on international relations.

The pollution of such streams, the building of dams, or the diversion of such rivers all of these have scientific and technological aspects and also at the same time affect relations between the countries involved.

International fishing operations off the Grand Banks of Newfoundland, around Iceland, the whaling industry in the approaches to Antarctica, likewise present problems that are both scientific and political. Now, of course, there is a question concerning the space above us. The detonation of an atomic bomb high in the atmosphere leads to the falling out of atomic debris over wide areas of the entire earth with very obvious effects on harmonious relations which everyone wants to establish and maintain among the nations of the world.

Within a relatively few years, much may be accomplished in control of the weather and you can well imagine how unhappy Country A will feel if Country B succeeds in precipitating the rain from the clouds which would ordinarily drift into the neighbouring Country A. Whether or not man will ever succeed in pushing clouds around is very dubious, but it is very obvious that

the moment we begin tampering with the weather, it is very possible for things to happen in one country that may affect adversely the weather of neighbouring countries. One need not multiply the examples space communications, weather satellites, etc. I wish only to leave with you the thought that science, particularly that of the present and the near future, has considerable impact on many major questions that affect international harmony and goodwill and hence have a bearing on foreign policy.

UESTION 2: Could you tell us, Sir, how you came to be appointed to the post our reputation as a Professor of Biochemistry at Stanford University in California is known not only in the United States, but here in Europe too. In fact, in recognition of your work, Berne University recently appointed you as Guest Professor of Biochemistry. How did you become the Science Attaché at the US Embassy here in Berne Was it essentially because you yourself are a scientist and are familiar with many scientists and aspects of science in Switzerland

ANSWER: Unfortunately, I do not know the answer to this question. I can only tell you that about a year ago someone whose voice I did not recognize called me from Washington and asked if I would be prepared to serve as Science Attaché in Switzerland. I was, of course, honored by the proposal and after a few further inquiries, a visit to the Embassy in Berne, and a discussion with our Ambassador, I gratefully accepted.

UESTION 3: Now, could you outline what your work as a Science Attaché entails Are you primarily concerned with promoting a greater exchange for scientific findings between Switzerland and the United States, and, if this is the case, how do you hope to achieve this

ANSWER: I doubt that the Science Attachés have anything very specific to promote. They are interested first of all in becoming acquainted with the scientific community in the country to which they are posted and in learning as much as they can about the problems, whatever they be, that concern in a mutual way the scientists of their country and mine. Assisting in the exchange of scientists is certainly one that we enjoy and hope to encourage.

UESTION 4: Would you say that there is very much collaboration between individual Swiss and American scientists, and could you give us a specific example of successful collaboration between Swiss and American scientists

ANSWER: Collaboration takes many forms and *in toto* there is a great deal of it between Switzerland and American scientists. It consists in part of exchange of scientists and technologists for periods of a few weeks up to a year or two with the purpose in mind of carrying on advanced study during such a visit. In various fields of learning your universities have a great reputation. For example, over the years, many American scientists have come to Switzerland to study under such great organic chemists as Karrer, Ruzicka, and Reichstein. Many of your scientists have come to my country, particularly within recent years, to study in certain laboratories in which they hope to learn certain special techniques or to enjoy the general stimulation that comes from working with high level fellow scientists anywhere.

Collaboration also takes the form of mutual participation even at a distance in scientific research on problems of common interest. Some of this goes on although it is manifestly difficult to achieve on a big scale. The results of the collaboration that comes about are the number of contacts established at the many international science congresses which are now very much the fashion and are held in your country, my country, and indeed throughout the world.

UESTION 5: At present there are about 200 or 300 American specialists engaged in scientific and technological research here in Switzerland, especially at the European Center for Nuclear Research in Geneva, as well as in the laboratories of various Swiss research institutes and corporations. Is there any particular field of science for which American specialists come to Switzerland to study In other words, in which branches of science do Americans feel Switzerland is in the forefront

ANSWER: I come to you as a biochemist or chemist and so it is perhaps that I am tempted to think of chemistry as a principal field in which Switzerland has achieved a very great reputation. It was because of your great strength in organic chemistry that you were able to establish a pharmaceutical industry for which Switzerland is world famous. And so I would mention chemistry as one field in which your country has been very much in the forefront, but I do so in full recognition of the fact that your country is equally famous in various other branches of science, about which I know all too little.

UESTION 6: Does the US Government encourage American scientists to come to Switzerland to study

ANSWER: es, and no…. There are several government agencies which, through the funds assigned to them by the US Congress, assist in the travel of American scientists almost anywhere in the world for purposes of study. I cannot imagine that any of these programs would single out any one country as being uniquely the goal of such efforts. The point of it all is that these programs are designed to give the American scientist an opportunity to pursue further studies in other countries where there is an unusually unique sort of know-how in such fields. Or they may be encouraged by the existence of such programs to go to a laboratory in Switzerland or elsewhere to work in the laboratory of a scientist of great distinction. Insofar as public funds are concerned, it is essential that the laboratory in which the applicant proposes to work be one of unusual distinction or be one in which certain aspects of science can be studied but which cannot be pursued in the United States. As far as this latter aspect of the problem is concerned, American scientists who are interested in fundamental problems of meteorology, in the study of avalanches and glaciers, would find unique opportunities for such studies in Switzerland. Likewise, if interested in problems of high altitude physiology or in cosmic radiation, there is this excellent laboratory on the Jungfraujoch which operates under the presidency of your distinguished Professor von Muralt. Clearly it would be to the advantage of any of my countrymen interested in problems of this sort to pursue work in such a laboratory and I am confident that qualified scientists would be encouraged to come.

UESTION 7: There are many Swiss scientists and research specialists who have left Switzerland to go to the United States to work and study. This is particularly true of Swiss scientists and technicians who are interested in nuclear physics, astrophysics and space research. Do you think this will continue at the present rate in the future

ANSWER: Almost certainly so…. In the specific fields that you mention, great new areas of research are fast opening up and space research is an area in which your country is now becoming very actively interested. We have had in the United States a number of visiting fellowship programs which are particularly designed to facilitate the visits of competent foreign scientists who wish to study in the many great laboratories in my country that are now devoted to research for peaceful purposes in nuclear physics and space.

UESTION 8: Are the many large American research institutes and corporations particularly interested in obtaining the services of Swiss scientific specialists

ANSWER: Unquestionably, yes….but please bear in mind that great as is the need in my country for more and more highly skilled scientists and engineers, all of the programs mentioned above are designed as programs to permit advanced study for periods of only a year or two. The visas that are granted to your scientists for study in the United States require that they leave the United States and return to their country within not more than two years. Should they desire to return to the United States for permanent residence, they may not be granted the necessary visa until the lapse of at least two or more years.

Under consideration is that your country is small and you do have a shortage of scientists and technologists and there is not a large pool of such people upon whom an expanding research institute or corporation in Switzerland can draw. In my country, while a tremendous need for more and more scientists and technologists exists, it is only fair to say there is still a very large pool which can be drawn upon; individuals who, if necessary, can move from one area of scientific activity to another. A specific example of the need, however, which may be brought to your attention is that of the National Aeronautical and Space Administration, which administers the expanding programs in space research, and has expressed a need within the next few years of not less than another 50,000 to 100,000 highly trained scientists and engineers.

UESTION 9: What facilities exist between the United States and Switzerland for the exchange of university science students Here in Switzerland, we have hundreds of American students studying such subjects as higher mathematics, chemistry and medicine at Swiss universities, and, of course, there are many young Swiss men and women studying in the United States. Do you think there is any likelihood of an increase in the number of scholarships offered by the two countries

ANSWER: In the United States, a number of fellowship programs exist, funded by the National Science Foundation, the Public Health Service and still other agencies. These are designed to provide the money to permit scientists to go to Switzerland or to many other countries for the purpose of ad-

> vanced study. There are at least 50 or 60 American scientists currently in Switzerland under such programs. I exclude the 400 or more Americans who are here as medical students or as candidates for B.A. degrees in science. Almost all of these are here under their own resources; we have no government programs applicable to Switzerland that permit the granting of financial aid to students still in undergraduate training. Through the Nationalfonds, you do have in Switzerland some means, perhaps not as extensive as you would like it to be, to facilitate the study of Swiss scientists in American and other universities. I hope that such fellowships will be increased in number and certainly that more and more of my countrymen will find it possible to come to Switzerland for advanced study, provided only that Switzerland and the Swiss universities are themselves interested in having more American scientists here for advanced study.

In 1963 I gave a lecture on histones to the medical students of the University of Bern. Professor Ernst L scher of the Theodor Kocher Institute generously corrected the text, which was rich in grammatical errors, until his final polishing converted the German into something that was understandable to the audience. I was graciously introduced by Professor Aebi. Somewhat overwhelmed by his generous and felicitous remarks, I succeeded in dropping all 20 25 pages of the text as I rose to walk over to the podium. After a bit of a scramble, everything was retrieved. I could not resist explaining to the audience that it is not unusual for a speaker in the USA to "drop a few remarks" in a variety of situations, of which this might be one. The trouble at the moment, however, was that I had dropped not a few remarks but my entire speech. A modest amount of laughter followed from the few who got the point.

Both Aebi and von Muralt did much to see that I met many from the Swiss science community. von Muralt saw to it that, as a guest, I was enabled to attend the annual meetings of the Swiss Natural Science Society (Schweizerische Naturforschende Gesellschaft). One such meeting was held at Schuls-Tarasp-Vulpera in the Graubunden, wherein the President, Professor Gian Tondury, delivered his welcome to the visitors in that quaint language, Romansch, then spoken by only a relatively few residents of the Graubunden. In the following year a meeting was held in Sion (Sitten) in the canton of Valais. von Muralt also invited me to accompany him in attending several meetings of the Swiss Physiological Society and international congresses, for example, in high-altitude physiology. Likewise, Aebi saw to it that I was enabled to attend meetings of the Swiss Biochemical Society and a congress on nutrition, with representation from the USA and the United Kingdom. The Aebis and the von Muralts entertained my wife and me on many social occasions, usually with others present whom our hosts were eager that we meet. And there were many others who in a variety of ways greatly enriched my years as a science attaché: Josef von Ah, Lukas Burckhardt, Peter Fricker, Charles Heubi, Urs Hochstraasser, Christoff Lang, Ernst L scher, Arnold Sauter, Vinzenz and Mi-

chaela von Tscharner, Walther Wilbrandt, Hans Martin Winzenried, and Hans Ulrich Winzenried.

I was sworn in as the Science Attaché in Switzerland in March 1962. The Ambassador, Robert McKinney, happened to be in Washington at the time and attended the ceremony. He kindly invited me to have lunch with him. Of course I accepted and sensed that this would be a most welcome opportunity to find out what his science attaché would be expected to do. "Mr. Ambassador, I would be most appreciative indeed if you would indicate, I assume in quite general terms, what my responsibilities as your science attaché will be." His reply was immediate and somewhat unexpected, "(Expletive deleted), that's for you to find out." We changed the subject.

I soon learned that I might be required to prepare several of his speeches, of which an ambassador delivers many during his term of office. Actually, I drafted only one. The occasion was to be a dinner in Basel where he would be the host to a select group of executives from the Swiss pharmaceutical industry and the heads of two or three of the Swiss banks. I suspected that he was concerned about his own investments; rumor had it that he had sold his own holdings in pharmaceutical stocks. No ladies were to be invited. He was usually bored by idle dinner-party chatter; this had to be avoided. He made it clear to me at the very beginning that he wanted to give an address that would provoke a lively discussion.

As far as he was concerned the pharmaceutical industry was on its way out hence the rumored sale of his stock in the industry. But, perhaps to the contrary, the age of pharmaceutical discovery was in its infancy. And so I conjured up an address in which both possibilities would be presented. One could start by lamenting that there are indeed many who believe that all of the vitamins, all of the antibiotics and other medicinals have been discovered; nothing new remains for the industry to produce. Conversely, it could be argued that the future is rich in new antibiotics and other pharmaceuticals that will emerge from the research laboratories and production lines of the industry. Also, more efficient and less costly manufacturing methods will certainly be found and will add to the economic strength of the industry.

The Ambassador agreed that such a topic could provoke a stimulating discussion. I gave the first draft to the Ambassador on a Friday. He took it with him to Gstaadt and returned it to me on Monday. There were many red ink interlineations and marginal comments. Before he left again for Gstaadt I gave him a second draft. Again, more red ink, a few words of encouragement, and a third draft. When this was returned I found the red ink was still in use. "Mr. Ambassador, I have appreciated your comments and proposed changes, but I have given to the text all that I have." "Oh, don't be discouraged; I have never accepted the text of an address until it has gone through seven drafts." So I ground out draft number four but identified it as number seven. I assumed he

was satisfied, for on return from his weekend in Gstaadt, he failed to order another revision of the text.

I accompanied him to Basel. We went by train. We exchanged barely a word about his address, the text of which was in his hands. The dinner went well. The guests were graciously welcomed. Then came the speech, which was delivered without reference to text or notes, and very well received. To my surprise and interest, the content pertained to something far removed from the plus or minus state of the pharmaceutical industry.

I also learned what the science officer would be obliged to do besides writing speeches. Any relevant correspondence originating in Washington that pertained to science or technology would be referred to him for action. American scientists coming to Switzerland, sometimes on an official mission, had to be assisted. Swiss scientists, proposing to visit the USA, frequently had questions or problems wherein the science officer could be of help in planning and working out the details of the visit.

He also had to greet and dispose of the "inventors" who came to the Embassy to sell their discoveries to the USA. I have notes on a number of such visits: the first wanted one million dollars for his discovery, the nature of which he would not reveal because of "its tremendous importance," until purchase by the USA was assured. Another claimed to know how to trisect an angle but would not reveal the details until purchase of the method was guaranteed. There were also cancer cures; a method for the synthesis of gold; a plan to push the clouds around and thus control the weather; and secret information on the nature and structure of the universe and the destiny of mankind. One inventor had something to sell to our government for 25,000 but the nature of the discovery would not be revealed in advance. In all such cases, the inventor, if not discouraged, was instructed to refer his proposal to the appropriate office in Washington.

The Fallet Award

Then there were the addresses, always on something in science or technology. In 1963, a year or so after my arrival at the embassy, I was told by the ambassador that there would be an award ceremony in the very near future to recognize the contributions of Dr. Fallet. The ambassador instructed me to prepare an address which would describe the duties of a science attaché with such relevant additions as seemed appropriate. My remarks on the occasion were as follows.

Fallet Award Ceremony, Bern 1963

Mr. Ambassador, Dr. Fallet, ladies and gentlemen: First of all, Dr. Fallet, I wish to transmit to you the congratulations and good wishes of our mutual friend, Dr. Currier McEwen of New ork University School of Medi-

cine, with whom, I believe, you once collaborated. Dr. McEwen is professor of internal medicine and a well known authority on the rheumatic diseases.

It occurs to me that the timing of this award to you, Dr. Fallet, is very appropriate. It is practically coincident with quite an animated discussion in the Nationalrat over the Federal support of research and therapy of rheumatic disease. The concern of the government has been explained by Bundesrat Tschudi, who in a discussion a few days ago emphasized that crippling rheumatic disease is one of the most common causes of sick leave and absenteeism from work in Switzerland.

From the viewpoint of a scientist this is a remarkable country and I suppose one of the functions of a science attaché is to discover just how remarkable it is. It is perhaps optimal in size. One is still able to retain an extensive acquaintanceship within the community of scientists and scholars that is very personal. In the distribution of funds for scholarly investigation, one can still do this through one or two committees of modest size because even if every scientist does not know every other scientist they come very close to doing so. In my country we have long since lost some of the values and conveniences that go with smallness. In the disbursement of research funds provided by agencies of our federal government we have had to resort to more and more committees of greater and greater size and to complex interlocking advisory agencies to evaluate and appraise research and fellowship applications. The mechanisms we use are more complicated than a Swiss watch and they certainly do not operate as quietly and smoothly. All of this because the American community of scholars is too large; we no longer know each other, possibly even within a single university our neighbours in the next building may be almost strangers to us. Perhaps there is also much more stability in the Swiss universities than in the American. Our people, for reasons that may not be easy to understand, move about a great deal from university to university into government or into industry and back to the university, almost a game of musical chairs. As a very new observer on the Swiss scene I suspect there is much less of this seeming restlessness, instability in positions, and tendency to move elsewhere.

Finally, I have been very greatly impressed by the official view of your government and of the Nationalfonds towards the support of basic research in science. Science to you is much more than physics, chemistry, and biology. ou recognize that there is much more to be learned about man and his environment than can be learned only by the use of test tubes and the complicated instruments of the scientific laboratory and so it is that your Nationalfonds supports basic research in the whole broad field of scholarship. ou have discovered that the search for truth must go on into all those fields of learning wherein man's curiosity may lead him.

My countrymen have much to learn from yours and, in case you want more American scholars visiting your universities for a year or so, I am certain that they can and should be encouraged to do so. Visits, in fact exchanges, of this kind are very important in giving added substance to the belief that I know is yours, Mr. Ambassador, that science is in fact one of the great unifying forces in an otherwise confused and divided world.

Swiss American Society Lecture

In response to an invitation from the Swiss American Society in Bern, I presented the following address on March 5, 1963, on "International Science."

> Luncheon Meeting of the Swiss American Society, Bern, March 5, 1963
> "International Science"
> J. Murray Luck, Scientific Attaché, American Embassy
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> The editors of scientific publications commonly require that an author shall preface his paper with a summary: the conclusions come first. I shall follow a similar practice; first, to indicate in the next few minutes what I might have talked about had I have talked about it, and secondly, to encourage the chairman to gavel me into my chair when the allotted time has been expended.
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> Science has always been transnational. Until recently, governments and national boundaries played little if any role in the pursuits of the scientist. But now, partly because of the grandeur of its experiments, science has assumed international dimensions and requires tremendous government support.
>
> More and more problems, deeply rooted in science, present themselves to our governments in search of international agreements: disarmament, telecommunication, weather reconnaissance by artificial satellites, reduction of the radiation hazards from nuclear explosions and from the use of highly active radioisotopes, minimization of contamination of the earth, the seas, the air, and even of space itself by the products of nuclear explosions and so on and on. Many of the older international problems that beset our governments can now be approached with more sophisticated scientific techniques; e.g. in fisheries, in oceanography, and in the pollution of rivers, lakes and the atmosphere.
>
> The magnitude of the world's efforts in science and technology require, on a scale hitherto undreamed of, a vast marshalling of the human resources of the more developed countries and great wisdom in utilization and exploitation of the world's natural resources. Tremendous training programs are under way in the universities, the research institutions, and the major industrial companies of the western world. NASA, alone, is calling for 100,000 additional trained scientists and engineers by 1970. New international laboratories, sponsored by the government, are constantly coming into existence with needs for trained personnel. Progress in reactor technology and manufacture, and in the designing and the construction of fine instruments, of space probes and of artificial satellites make extraordinary demands upon the world's resources in trained men and exotic materials.
>
> The international traffic in scientists, engineers, and administrators has reached great dimensions as has also the number of international conferences, symposia and congresses. There is a vast exchange of people, of information, of equipment and of resources a remarkable sort of international ebb and flow.
>
> Somewhere in this boiling and bubbling milieu are the recently invented science officers who find themselves drawn into the many problems, such as the above, that involve the mutual interests of the countries concerned. Each science officer is a member of a team. The others are from commerce, agri-

culture, the military, the political section, the consular office, public affairs and so on. Each of us sees a problem that comes before the mission with a different pair of eyes. Each has a background of experience and interest that is different from that of his neighbour and each, in principle, has something unique to contribute.

If I have implied that science officers have been newly invented, perhaps I have been taking a few liberties with history, for my first point is that science attachés, parading under different names, have been in existence for a very long time. Some hundreds of years ago when royalty was in flower and science was more poetic than at present, every court had its astrologer or necromancer. Their principal function appears to have been to determine the most favorable dates for engaging in military combat and for starting any great adventure political or amorous. Foreign policy decisions frequently rested upon their dubious advice.

Benjamin Franklin, in more recent times, can be thought of as a scientist *cum politico* whose activities and personal associations in the USA and abroad were an inseparable mixture of science and statesmanship. One hears little, at least in this context, of Benjamin Thompson, later known as Count Rumford, born in Woburn, Massachusetts, in 1753. He was a brilliant man, erratic it is true, and very much of an adventurer. I mention him because he carried his science from one country to another, was an adviser to government, and left a distinct imprint upon national policy wherever he went USA, England, Bavaria, and France.

It would be too tedious to mention many others from various countries, who as scientists and quasi-scientists, were invited to serve their governments in an advisory capacity in foreign posts. What we now speak of as the USA Science Attaché program, and this would be my second point, had its beginnings in the cooperation that went on between British and American scientists during World War II. Much of this became quite formalized and had to be carried on through tight intergovernmental channels for security reasons and because the contracting parties were government agencies not private organizations.

I know that it was clear to all concerned that this cooperation was so helpful that steps were taken on ending of the war to facilitate continuance of the partnership. In November 1944, President Roosevelt wrote to Vannevar Bush, then Director of the Wartime Office of Scientific Research and Development, and requested his recommendations on the post-war scientific policies of the Federal Government. Dr. Bush's remarkable report, entitled "Science, the Endless Frontier," led to establishment of the National Science Foundation, which now administers 110 million of public funds per year for the support of research and development. The report was also instrumental (perhaps not quite as Dr. Bush had contemplated) in setting up the National Institutes of Health with a current budget for research and development of 440 million per year. The report also recommended "that scientific attachés be appointed to serve in certain selected United States Embassies." If it needed any strengthening it came in two other significant documents: the Steelman report of August 1947 a five-volume report on Science and Public Policy by a Committee appointed by President Truman and in a report in 1950 to the Department of State by Dr. Lloyd Berkner, "Science and For-

eign Relations." This document called on the Department to "take science and technology into consideration in the formulation of foreign policy and the administration of foreign affairs at all levels." The report recommended the creation of a science staff in the Department of State and proposed also the establishment of science staffs at selected US diplomatic missions, integrated into the normal Foreign Service structure of the missions. This recommendation was implemented in 1951. Despite a few ups and down in the program, it took hold, as you can well imagine it would, as soon as Sputnik I took off in space.

At present, the Department of State has science attachés posted to 10 diplomatic missions and four more have been authorized. The ONR, DOD, NIH, and NSF also have a few science officers abroad principally in Europe. This reflects the fact that 22 USA organizations support various types of scientific programs in foreign countries. Beyond this there are numerous international organizations, not intrinsically scientific in character, which nonetheless have very active science programs and have concluded that science has an important impact upon their various activities such as: NATO with two science offices; one concerned with its military functions, the other with its non-military functions (which I may add are of profound importance); the UN with UNESCO, FAO, WHO, WMO as its scientific appendages; the OECD with some 20 member countries, including Switzerland; and even the Council of Europe, a parliamentary type of organization with 17 participating countries. Some countries such as Belgium, France and the United Kingdom even have departments of science headed by ministers of cabinet rank.

My third point is a question: Why all this interest in science by government, a principal function of which is the maintenance of peaceful, harmonious, and friendly international relations I suppose part of the answer is that science has become just too big as we say in America "too big for its britches." The day of the test tube, of the retort, of the mortar and pestle, and the simple gravimetric balance has long since passed. Many of the grand experiments of present day science could never be undertaken without massive government support.

Along with bigness, one of the characteristics of modern science is its interest in the very very small, the very very large, and the very very remote a very expensive type of curiosity. The smaller the object of study the larger become the pieces of machinery that must be devised for the research. To dig into the center of an atom, the apparatus now most commonly used is about the size of a football field.

At various universities and research centers, cyclotrons, linear accelerators, and other types of atom smashers have been devised and constructed fantastic in size and in cost. At Stanford University in California, a linear accelerator is under construction at a cost of 130,000,000. The instrument will be three kilometers (two miles) long. It will discover new particles in the atom and will add a few more to the thirty or so that are now known to exist. It will yield much more knowledge about the very very small.

As for the very very large and the very very remote, just think of the extraordinary instruments used in modern astronomy and space research telescopes of greater and greater size to probe the remote reaches of space, radio-

telescopes of fantastic size to pick up the faintest of signals, space probes and satellites heavily instrumented, shot up in space sometimes for a life span of a few minutes, sometimes placed in orbit to continue their studies in space for years to come. All of this requires tremendous expenditures the magnitude of which could not have been conceived a few decades ago.

The Stanford University accelerator (130,000,000) is so expensive that the money has to come from the Federal Government through a special congressional appropriation. In Wurenlingen you have the fine experimental reactor "Diorit" around which is clustered the Institut f r Reaktorforschung. The expenditures of this one institute are about one-half of those of the whole Eidgenossische Technische Hochschule, with which the institute is associated. Important as such a reactor is to modern physics, there are few, if any, universities anywhere in the world that can afford such instruments without massive governmental support.

Some enterprises in research are of such a magnitude that they exceed the resources of any one country; at this point science moves into the international sphere. For example, the very fine laboratory (CERN) near Geneva, maintained by a group of European countries, runs along on an annual budget of about SFR 90 million, of which Switzerland is currently contributing about SFR 3 million. Space research the manufacture and launching of satellites for research on telecommunication, for fundamental research in meteorology, for astronomical and astrophysical research; this is beyond the resources of almost every country, perhaps even of the USA, which will expend at least 50 billion in the vast amount of research and development that will be necessary to place a landing party on the moon and bring them safely home again. So it is that 12 countries in Europe, including Switzerland, have organized ESRO (the European Space Research Organization) for the cooperative pursuit of space research. The program for the first eight years will cost SFR 1340 million (about double that of CERN) of which Switzerland will contribute a total of about SFR 44 million. The budget is modest because the construction of launching facilities is excluded, and manned vehicles are not contemplated.

In going international, as one may say, scientific research does so because of the tremendous cost of some undertakings. But in so doing, it serves as a powerful integrating force for peaceful purposes among the participating countries. I ask you to think, for example, of the beneficent results that might accrue from world-wide participation in a single great international network for space communication a system owned, controlled, and operated by a single world-wide agency. The scientific community is well aware of the splendid results both in science and in international understanding that accrued from the world collaborative study of Antarctica during the International Geophysical ear.

Finally, and this is my last point, science now finds itself with representation in many government agencies, which are essentially nonscientific, because of the profound impact of scientific discovery on national and international policy. The high altitude explosion of nuclear devices is accompanied by"so-called "fall-out," a long sustained shower of radioactive substances, such as strontium-90, over many countries. The resulting contamination of the earth may be accompanied by contamination of space itself through crea-

tion of new earth-encircling belts, of ionized particles and highly penetrating radiation, trapped in the earth's magnetic field. The ordinary citizens of many countries may well be concerned and the scientist interested in the study of uncontaminated space may be equally disturbed. So it is that the problems of control of such explosions and reduction of the radiation hazards assumes international dimensions, affects international policy, and prolongs interminably disarmament conferences between the great powers.

Weather satellites are now used for valuable reconnaissance by photography. For example, Tiros V, with only a 20 coverage of the earth, has discovered, in advance of their impact, 50 of the tropical storms which have hit the earth since it took to space. Such satellites can be used for ice reconnaissance, for determining in advance the break-up of ice in rivers, for snow cover determinations and for the detection of locust swarms as they form and take off from their centers of origin, e.g. in the basin of the Niger. The problems involved are international in their consequences…the tropical storms, the migrations of the locusts, etc. The results of satellite reconnaissance are so promising that the cooperation of all countries will eventually ensue in an effort to reap the maximum benefit from such a wonderful scientific instrument.

A similar consideration applies to the world-wide development of a single network for communication the world over by satellites. Here, incidentally, the roles of science and of diplomacy are clear; determination of the frequencies to be used for such communication is a scientific problem but the obtaining of international agreement on the allocation of a certain spectrum of frequencies for such a purpose calls for a great deal of negotiation at the political level. In both cases, the impact of science on the development of international policies is self-evident.

The tragic thalidomide story. It is by no means certain that we have heard the last of this. From a more rigorous national control of the testing and distribution of new drugs, it is probable that the international aspects of the problem will come to the fore. Medicinal principles discovered and marketed in one country may easily flow into neighbouring countries. Should it emerge later, as with thalidomide, that a drug with wonderful properties in certain respects may be found to have tragic or delayed secondary effects congenital malformations, production of cataracts, etc. it becomes clear that serious international problems can arise.

The control, eradication, and prevention of foot and mouth disease of cattle, essentially scientific in every way, has long been a serious international problem in which the harmonious relations of countries concerned may be seriously and adversely affected by the quarantine measures that are currently necessary.

And now the lobster war a cold damp war between Brazil and France. The question: do lobsters spend most of their time swimming around near the ocean floor If so, France may argue effectively at the political level that her lobster fishing over the Continental shelf of Brazil should continue. Or do lobsters spend most of their time crawling around on the bottom, perhaps almost as sessile as an oyster or a coral If so, Brazil may be able to talk the French and any other "intruders" out of lobster fishing near Brazil.

Science has always been transnational. Until recently, governments and national boundaries played little, if any, role in the pursuits of the scientist. But now, because of the grandeur of its experiments, science has assumed international dimensions and requires tremendous government support. Scientific discovery and the fruits of scientific development have a profound and increasing impact on human relations nationally and internationally. And with all of this, science has inevitably been drawn into the affairs of many policy-making agencies the world over.

The USA-NASA Space E hibit

In 1963 I was invited to make some introductory remarks at the Institut f r exakte Wissenschaften of the University of Bern in connection with the opening of a USA-NASA space exhibit. The text follows. As I now read it over some 25 years later, I find that much of what was then said is still applicable.

"To appreciate space research we must first understand that space is all-pervasive. All the solids and liquids around us contain far more empty space than solid substance."

Many years ago I was introduced to some of these mysteries of space by Sir Arthur Stanley Eddington, then Astronomer Royal and a Professor in Cambridge University, England. I remember that he placed his hands upon a large and heavy table and said, impressively, "if all the particles in all the atoms present in this table could be squeezed together so as to exclude all intervening space, the table would become about as small as the head of a very small pin. Despite the discovery since Eddington's time of many more elementary particles or swirling satellites in the ultramicro-universe of the atom, I suspect that just about as much empty space exists in the solids about us as Eddington described.

But we have assembled today because of our interest in a quite different sort of space research the dramatic study, by methods unheard of 50 years ago, of the universe about us. In many respects it is not new astronomy is perhaps the oldest of the sciences. Man's extraordinary ingenuity now permits, however, the fashioning of instruments and devices that can penetrate the farthermost reaches of space. We have opened up a completely new era almost frightening in its possibilities for the study of our solar system, the galaxies, the atmospheres of our earth and of other planets in our solar system, and of interplanetary space. Indeed, I seem to have read somewhere that landing parties are to be sent to the moon.

I have mentioned two kinds of space research quite deliberately because in one important respect they are very similar. Each is incredibly expensive. To study the universe of the atom, to identify elementary particles with life spans of less than a millionth of a second and about half of them are as short-lived as that requires a piece of apparatus as big as a football field. If you prefer to spread it out to something long and thin, you may do so, but you will save little if anything. Stanford University has done so and is constructing an apparatus two miles long. It will probe more deeply into the empty spaces of the atom and may even find another particle or two. It will do so at

an initial cost of about 130,000,000 and an annual operating expenditure of about 11,000,000. As for the devices required to launch and place into orbit effectively above the earth's atmosphere the instruments we require for astronomical research, for meteorology, for telecommunications, and for the study of space itself, the cost is even greater several dimensions greater.

I suppose the only scientists whose needs are modest are the biologists, the chemists, the biochemists, and the newly emerging breed of molecular biologists. Any of these would be handsomely provided for in a laboratory with half a million dollars worth of equipment. Some, for example the x-ray crystallographers, might have to spend a few hundred thousand dollars annually for rental of a computer, but I would submit that the only ones who really spend the money are those who study the ultramicro-universe of the atom or the ultramacro-universe of the great cosmos about us.

This brings me to another point and perhaps the most important of all. The kind of research of which we speak exceeds the resources of many countries. Switzerland took a magnificent step forward when, at the General Conference of UNESCO held in Florence in 1950, she joined other European nations in the establishment of CERN, the European Organization for Nuclear Research. In this we have an outstanding example, of which this country and the city and canton of Geneva should be very proud: a productive laboratory in nuclear physics in which at least a dozen countries are able to participate. The costs are equitably distributed, the burden upon any one of the member states is not excessive, and all of the fringe benefits to be found in a scientific laboratory with a cosmopolitan complexion are present.

Switzerland also played a leading role in the establishment of ESRO, the European Organization for Space Research. Here too we have a splendid example of eventual participation by the member states in a scientific project of such a magnitude that the costs can most wisely be shared by several countries, and the research projects be pursued in an atmosphere of international cooperation.

President Kennedy has proposed a program of international cooperation, essentially bilateral as between the USSR and the USA, in respect to exploration of the lunar surface. These two great powers, opposed as they are in their economic and political philosophies, have cooperated splendidly in Antarctic research and in the overall studies of the International Geophysical ear. I have little doubt but that in time they will find a solid basis for cooperation in lunar research and perhaps also in many studies of our solar system that can only be pursued by well-instrumented satellites and space probes. One need not look far into the future to permit us hopefully to witness the development of a world-wide system of space communication in which all major countries will share in ownership, manufacture, and operation.

A few words should be said about some of the items in this exhibit. A few statistics should also be put before you. As of mid-August 1963, about 195 spacecraft are known to have been placed in orbit: 153 of these were American, 40 were Russian, one was British, and one was Canadian. Of these, 67 American, 10 Russian, and the British and Canadian satellites are still in orbit. 101 have re-entered the earth's atmosphere or decayed. There have been 15 successful re-entries and landings with dogs, monkeys, or peo-

ple on board. Two of the spacecraft have hit the moon and another one, to be launched within two or three years, is designed to make a soft landing and to send us reports on the nature of the lunar surface a hard crust or a deep layer of soft cosmic dust: the moon has had over four billion years in which to collect cosmic fallout or dust.

The fourth satellite that was shot into space is still in orbit after five years of orbital flights. It ceased to transmit data after five months but what a wealth of data it was. A model of this satellite Explorer I is on display. It is credited with discovery of the radiation belt that envelops the earth.

Also on display is a Tiros weather satellite. Seven of these have been placed in orbit since April 1960 and have returned more than 200,000 usable cloud-cover photographs. Six more are to be launched. They will be succeeded by the Nimbus a very fancy-looking satellite and much more sophisticated than Tiros: it will be earth-oriented, that is, its cameras will always face the earth.

ou will also see among the exhibits, the most bizarre of all, viz. Mariner. Mariner II is the craft that passed by Venus at a distance of 21,000 miles, and reported to us among many other interesting things, a Venus surface temperature of over 400 degrees Centigrade. It is now in orbit about the sun and continues to send us messages, which we can recognize, from a distance of over 50 million miles. Mariner III is intended to make a trip to Mars 230 days of flying. If all goes well, it will pass within 13,000 miles of the illuminated side of Mars. Prospective passengers should sign up soon. It is scheduled to depart in late 1964.

In the communications field at least five satellites are in orbit. The first is Echo I, a great gasbag which in a passive way has tried to do its part for three years. It has been reflecting signals from the earth but its surface is now rather badly wrinkled and its television transmission is, in consequence, rather poor. Telstar I has been in orbit for over a year. This is an active transmitter and continued to do its work for at least eight months. Perhaps most promising are the synchronously orbiting satellites, of which Syncom II, over Brazil, is a very successful example. Three Syncom satellites, properly placed in space, will give us the necessary relaying system for a world communication system and will be as effective, for such a purpose, as 30 to 50 Telstars.

And at last, Apollo, the wonderful spacecraft designed to carry a party of two to the moon and back. The spacecraft alone will weigh 43 tons, of which a 12-ton capsule of instruments and men will land on the moon and initiate its return flight to earth a day or two later. With its first and second stages which will be jettisoned, the entire package will weigh over 15 tons. This, I believe, is as far as our flights of imagination should be permitted to carry us this afternoon. Despite the incredible cost of this program, I believe that my country is prepared to see it through to a finish. It will certainly do so by international cooperation, if possible, and with free and open publication of the vast amount of basic scientific data that will be accumulated in the lifetime of this exciting program.

I must confess that some of us, perhaps too old and too conservative to know any better, are disturbed by the tremendous emphasis that is now given in training programs and by fund-granting agencies for research and development in the physical sciences. Physics and engineering are important but

they are not the whole of science and great institutes of technology, fashionable as they may be, cannot take the place of universities. The very important questions that arise from such considerations are currently being debated in the USA, in Great Britain, and I am sure, in every country wherein a policy for science is being discussed. In the formulation of government and university policy in matters such as these we must be sure that man's impulsive and impatient desire to reach the moon and to penetrate the great spaces beyond will not replace his duty to till the soil at his feet with patience and humility.

The UNCAST Conference

In February 1963 an international conference on science and technology was held in Geneva, Switzerland. As the Science Attaché it was my responsibility to attend and report upon the conference, the United Nations Conference on the Application of Science and Technology (UNCAST) in the Interest of the Underdeveloped Regions. The report was as follows.

Impressions of the UNCAST Conference, Geneva, February 4 20, 1963
by J. Murray Luck

The Conference was designed to cover all aspects of science and technology in relation to problems confronted by the less-developed countries. In respect to organization of subject matter, it embraced agriculture, health and nutrition, natural resources, human resources, energy, population trends, industrial development and still others. Of necessity it penetrated deeply into the social sciences. Although political problems were to be excluded from deliberations of the delegates, it became evident as the Conference proceeded that many of the problems under consideration drew within their framework many subjects of political import.

Not only did the Conference cover great areas of science and technology, and the social and cultural sciences, but it concerned also underdeveloped countries with problems that differed greatly from one region of the world to another. All of this gave to many of the presentations a thinness of content that was probably unavoidable but detracted somewhat from what might have been achieved in a Conference of a narrower scope.

It is, however, proper to add that some of the special sessions at least were able to concentrate on scientific and technological questions of a much more specific sort and dissipated to some extent the disappointment expressed by some delegates during the first day or two of the Conference.

As the Conference proceeded, quite a few of the delegates from the less-developed countries expressed in personal conversations or in formal presentations the desire to have small regional conferences, in which the subject matter would be restricted to the scientific and technological problems facing a relatively small group of neighbouring countries with similar developmental problems.

It soon became clear that politics could not be completely excluded. It started with the address by Fedorov of the USSR who at the first session on February 4 drew the attention of the delegates to the experience of the USSR and its constituent republics in economic development. At the end of this re-

port I have added excerpts from his speech as freely translated. These, in turn, are followed by somewhat similar thoughts which were expressed by Professor Lange of Poland who, *inter alia,* commented on planning, new trade relations, aid to the underdeveloped countries and disarmament. These comments, expanded upon rather briefly, follow upon the remarks by Prof. Fedorov.

Dr. Wiesner introduced the session by introductory remarks which evoked a great outburst of laughter and applause, clearly because his remarks indicated to the bloc countries that socialist propaganda would not be received sympathetically by delegates from the less-developed countries. It was soon noticed that the propaganda efforts abated considerably and at the general session on Friday, February 8, there was clear evidence of a retreat from a hitherto doctrinaire position. The quotations at the end of this paper are taken from the remarks of the translator. They are not found as such in the English language texts, but in the judgment of the reporter represent essentially what the translator reported.

A session on population trends evoked much interest. Little that is new was presented in the principal papers. Of considerable interest, however, was the reaction of delegates from several African countries to the implied suggestion that family planning for population control might presently be found necessary in trying to face realistically the problems that attend developing countries with high rates of population increase. Three of the Central African delegates from three different countries stated that population control in any form was not in the immediate interest of their country.

They have vast undeveloped areas in which people are badly needed for the production of more food for the country as a whole.

The infant and child mortality rates are still so high that many children are required to make reasonably sure that a few will survive to a productive age.

In this session two or three of the speakers commented on the very large number of people that could be fed if the agricultural resources of the world were properly developed in the sense of taking full advantage of the world's present store of knowledge in food production. No one, however, discussed the question of values and the implication was clear that all that was really at issue were questions in the field of science, technology and economics. No one raised the question of what people are for and whether a world of 50 billion people would be a world in which the values now cherished by man could really be preserved.

I had many conversations with Africans, with Latin Americans, and with several foreigners (French, Belgian and British) who have been in Africa for many years. These conversations brought to the fore a subject of some delicacy but of considerable interest for which little if any provision was made in setting up the Conference. This concerned the quality and motivation of the administrative and leadership personnel in the less-developed countries. There was a considerable consensus that in many of the less-developed countries, serious difficulties arise because the leadership and administrative personnel are allegedly motivated only by self-interest and display little if any sense of social responsibility.

It was stated by Receveuir, who has been in Central Africa for 30 years and is currently Counselor to the Minister of Rural Economics in the Niger, that throughout his many years in Africa, the economic and social conditions of the masses of peoples have not improved in the least. Conversely, the number of people in the upper class (the administrative and leadership personnel) has greatly increased as has also their real income. The opinion was expressed by several that unless this very difficult problem of leadership could be solved, various trends would continue to develop which might not only precipitate violent revolution but would in any event greatly deter a proper utilization of resources and the adoption of development practices that would be in the interest of a country as a whole.

I found the discussions of regional development to be of unusual interest. The cost of industrial development, at least for certain major projects, could be of such a magnitude as to require capital expenditures well beyond the resources of any one country. Various delegates indicated that the solution to such a problem might be found in regional development schemes whereby several neighbouring countries would cooperate in certain areas of development, designed for the benefit of the participating members, but beyond the resources of any member nation operating singly.

It was, however, surprising that at the special session devoted to regional planning, all of the speakers interpreted a "region" to be a geographical area or an economic segment within a country. No one seized upon the opportunity to discuss international planning in which a group of nations, functioning as a region, might cooperate in certain specific schemes each of which would be manifestly beyond the resources of anyone of the participating nations. Such a type of regional development would be a counterpart to the European Economic Community.

I conclude the report on UNCAST by a number of assorted impressions.

1. That the lesser developed countries are in need of much assistance in furthering their development is admitted.

2. Part of the assistance desired, and obviously needed, is money for capital investment. I would favor, first and foremost, capital investment by private companies interested in utilization and development of the natural and human resources of a country. Various American and Western companies would be interested, provided that firm and irrevocable guarantees of the security of such investments could be obtained. Perhaps this is too much to expect in view of the obvious instability of many governments in the less-developed countries. However, without such guarantees, designed to facilitate development of the private sector, loans to these governments, many of which are shaky and corrupt, should not be made.

3. Gifts of money, of materials needed for development, and perhaps even of foodstuffs should not be made by our government. Philanthropic agencies can do what they like.

4. Such a negative policy would deter the development of these countries. But why hurry Let them work out their destiny in "God's good time." Would the Russians leap in if we failed to play Santa Claus I doubt it. Here, however, there is a calculated risk that must be taken.

5. On the positive side, I believe we should cooperate, but only in response to very specific requests from the countries concerned, by sending advisers and technical experts for guidance. They should be well trained, bright, young men who would be prepared for two or three years to live in the country concerned to help where they can. Even here, the financing should be on a matching basis and if the USA or our private foundations or our universities participate in such schemes, the recipient country should bear a good proportion of the cost.

6. I am completely unimpressed by the alleged urgency of development of these countries. Why must it be achieved in 20 or 30 years Because the Russians say it can be done Even on humanitarian grounds development must be a very slow process. We can cause more trouble than one can contemplate by trying to change speedily the mores and the ways of life of "backward" (or any other kind) of people.

7. Re "time required for social change." Excerpt from discussion of paper by Sir Edward Fellowes K.C.B., C.M.G., etc…. The Development of Parliamentary Procedure in the Commonwealth, *Journal of the Royal Society of Arts*, Vol. 111, No. 5080, pp. 290 301 (March 1963).

Dr. James Batten interrupted with a comment based on page 299 of the cited reference in paragraph 7 to the *Journal of the Royal Society of Arts*: "I wonder if Sir Edward met overseas the point of view that perhaps 300 to 400 years was rather too long to wait to attain social change."

The Lecturer: "Indeed, and not only overseas. I remember once expressing to the Assembly of the Council of Europe the view that they were progressing rather faster than the English Parliament. They also replied that 200 or 300 years was rather a long time to wait Of course, things will move more quickly now, but nevertheless, I do think it will take time Twenty years is a very short time in which to jump from a stage of irresponsibility to complete and absolute responsibility."

Fedorov of the USSR:

1. The Socialist form of government which now embraces one-third of mankind is developing the material and cultural needs of people. It also helps the national liberation movement.

2. These countries are seeking development and many of them are searching for a socialist form of authority.

3. At one time many of the republics of the USSR were among the most backward countries but now they exceed in their economic attainments many non-socialist countries.

4. One of the great difficulties is that colonial rule slowed the development of underdeveloped countries and dampened their initiative.

5. The Soviet Union will gladly share its experience in development with all of the underdeveloped countries. The Soviet Union will gladly train personnel in the developing countries.

6. The goal of all such efforts is greater human happiness and well-being. For this, the rejection of war is necessary and we believe that man can overcome the tendency towards war. Peaceful coexistence between countries and different social systems can and will be achieved. This is essential.

Lange of Poland:

1. Planning first introduced in the USSR and later in various other countries is the proven technique for achieving rapid progress in development. Competitive rates of growth of the capitalistic and socialistic countries reveal the characteristics of the latter. Planning speeds up the all-too-slow development of countries.
2. New trade relations with aid-receiving countries must not be such as to put the recipients in a new form of colonialism or colonial-like dependence.
3. Aid to the underdeveloped countries must be taken out of the cold-war framework.
4. Disarmament is essential to establishing a favorable climate for aid to underdeveloped countries. If achieved, it will set free resources of considerable magnitude which could be applied in part to the economic development of the less-developed countries.

Miscellaneous quotations

1. Mateyev (Bulgaria) Flexibility is necessary; one cannot be too dogmatic.
2. Korobov (USSR) We do not claim our system is perfect and we are working towards its further improvement.
3. …… (Poland) The difficulties facing the adoption of a mixed economy may not be insuperable.
4. But contrariwise: an unidentified five-minute speaker from Czechoslovakia The developing countries will be confused by attempting a mixed economic growth.

The Swiss Typhoid Epidemic

An unexpected happening in Switzerland in 1963 added excitement and a serious reporting responsibility. It focused on an outbreak of typhoid fever which quickly developed into a full-blown epidemic.

My first year as the USA Science Attaché in Switzerland was coming to an end when suddenly the whole of Switzerland was awakened from months of comparative serenity by an outbreak of typhoid fever at Zermatt. The charming little town with the Matterhorn as its neighbour was overflowing with tourists, mainly skiers, from throughout Europe, the USA, etc. It soon became evident that an epidemic of considerable magnitude was under way.

Reports of this outbreak of type E *Typhus abdominalis* (typhoid fever), originating in Zermatt, began to appear in Swiss newspapers in early March 1963. These infections and most of the reported later ones were probably contracted between February 16 and 20. By the time the epidemic had run its course, more than 300 cases had been confirmed among the 8,000 or so persons then in Zermatt. The total number of Zermatt cases in Switzerland and abroad, as of April 30, was approximately 347 inclusive of three fatalities.

The disease, beyond doubt, was water-borne. The Zmutt river, the raw water source, was heavily contaminated with *E. coli* and enterococci. Overflow of a sedimentation tank some 500 yards above the raw water intake of the water-treatment plant was probably the most important source of contamination. Many Italian workmen were employed at the time of the epidemic in a major construction project in the Zermatt area. Italy has long been known as a country with a high incidence of typhoid fever. Fecal and urinary waste, improperly disposed of, contaminated the watershed above Zermatt. There were those who, for good reasons, considered the Italian workmen to be the source of the infection. Professor Grumbach, however, pointed out that the E type of *Typhus abdominalis* has never been found in Italy. Other possible sources of lesser importance have been suggested. Chlorination of the filtered water (rapid sand filters) was frequently inadequate; faulty technical installations sometimes caused interruptions in the chlorination process.

Federal regulations require that control of an infectious disease epidemic is a cantonal, not a federal, responsibility. In this case the canton of Valais, in which Zermatt is located, was unprepared for such an epidemic. The number of hospital beds and the supply of personnel were totally inadequate for an epidemic of the present dimensions. Professional personnel were brought in from other cantons and soldiers of the army sanitary corps with all necessary equipment were brought in. An emergency hospital was also set up.

As a result of complaints by the Medical Society of Valais on March 24 that adequate precautions were not being taken to confine the epidemic, the Hotel Association of Zermatt announced on March 26 an immediate closure of all hotels, associated restaurants and related facilities until all of the bacteriological, epidemiological, and sanitary measures were completed.

The Federal Government, embarrassed by the bad publicity resulting from the epidemic, responded generously. Swiss citizens, as well as citizens of foreign countries, who had contracted typhoid fever from the Zermatt epidemic were invited to enjoy a three-week vacation in Switzerland at Swiss expense. Transportation by Swiss Air and or the Swiss railways to the chosen holiday resort and return would also be provided without expense to the guest. Employees of the Zermatt hotels and restaurants who suffered in the epidemic were also given appropriate recognition and reimbursement of financial losses.

The above account, interesting because of the scope of the epidemic and of the exhaustive studies that were carried out, is based on reports by Reinert T. Ravenholt, M.D. (epidemiologic consultant DF , PHS), Meinrad Sch r, M.D. (Professor of Public Health and Preventive Medicine, University of Zurich), Harold Clark and Leland McCabe (US Public Health Service), Professor Grumbach (Head of Medical Microbiology, University of Zurich), and Arnold Sauter, M.D. (Head of the Swiss Public Health Office). As the Science Attaché at the USA Embassy in Bern, I also submitted reports to the US Department of State (March 22, March 26, April 2, April 12, and April 19). My file of official reports and numerous press clippings pertinent to the epidemic is in the Luck section of the Stanford University archives.

Swiss History and Science

Finally the two years of service as the Science Attaché came to an end. I learned that I would be expected to prepare a report on science in Switzerland and to indicate to the State Department what its Science Attaché had been up to during his tour of duty. I labored over that report for two years. It became so obese that the Department felt obliged to approve its publication as a book[3]: photocopies of the manuscript 100 or so for interoffice distribution would have made unreasonable demands upon the filing space available to recipients.

I fell completely in love with Switzerland, her people, and their institutions, tempered though my affection was by recognizing that "all is not gold that glitters." I later found myself immersed in writing a general history of Switzerland. I have been so fascinated with the subject and have loaded the manuscript with so much trivia and detail that any professional historian would probably be aghast in its presence. The history of preceding centuries was difficult enough to encompass, but the twentieth century posed problems that, to me, were insuperable. In short, a retrospective view of 50 or 100 years may be required to understand current events and discuss them intelligently. So what was the solution In 1975 I discussed the problem with a number of friends in Switzerland. Out of our conversations emerged a volume, *Modern Switzerland,* in which 27 Swiss, possessed of the necessary expertise in different topical areas, cooperated in authorship.[4]

INTERNATIONAL CONFERENCE ON HISTONES Late in 1963, on a brief leave of absence, I attended an international conference on histones in San Diego, California. I was asked to present an introductory paper on the history of research on the basic proteins of nuclei.

[3]J. Murray Luck, *Science in Switzerland* (Columbia University Press, New ork, 1967, 419 pp).

[4]J. Murray Luck, Lukas F. Burckhardt, and Hans Haug, Editors, *Modern Switzerland* (Society for the Promotion of Science and Scholarship, Palo Alto, CA, 1978, 515 pp).

The Basic Proteins of Nuclei

Many years ago, 75 to be exact, David Starr Jordan, the first President of Stanford University, entered upon his duties. He was perhaps the most famous ichthyologist of his time. He described more fish than many of us would imagine could exist. And the bibliographies of his numerous papers were richly sprinkled with mistakes. He had a fabulous memory, so good that names, dates and biographical or bibliographical details of people or fish, as the case may be, were not always committed to paper but stored away in his retentive brain. His retrieval system, however, was not faultless. I know that one of Jordan's colleagues, Professor Harold Heath, once took him to task while the two of them were aboard a ship, leisurely inspecting their catch. "Dr. Jordan, why are you not more meticulous and accurate in the writing of your papers our memory is remarkable but not infallible and I cannot understand why you rely upon it so heavily. our bibliographic entries are frequently wrong an incorrect volume number or page and even the text details of a fish as described by you or drawn by memory from someone else's papers are not always accurate." Jordan's reply was typical: "Heath, while some poor devil is correcting these mistakes, I can be describing another fish."

I suppose there comes a time in every area of scientific investigation when those pursuing research must pause for breath, take note of their mistakes, determine their position (or as some of us in the jargon of Government have learned to say, "assess their posture") and try to reappraise, in their ever-changing frameworks, the directions of their studies. Scientists now tend to describe their fish too fast and perhaps to superimpose errors on other errors. That is why this present Conference, which James Bonner so wisely organized, is such a good idea. It provides a welcome opportunity, of which we have had very few, to pause, to breathe, to reflect, to look at the map and to figure out where we are and whither we are bound.

In the time allotted to this postprandial exercise, I would like to call to mind a few of the early students of the cell nucleus. I was tempted to say nuclear chemists but to do so would be to trespass upon the terminology of another fraternity. One could start with Miescher, but to establish a pedagogical lineage, I shall go back somewhat earlier. First to Hoppe-Seyler, 100 years ago the uncrowned king of biochemistry (1). He was born Ernst Felix Immanuel Hoppe on December 26, 1825 the tenth child of the pastor and superintendent Ernst Hoppe. Both of his parents died when he was a young boy and he grew up in the home of Dr. Seyler, husband of his oldest sister. ears later (1864) the relationship was formalized, he was legally adopted by the Seylers and thereafter used the name Hoppe-Seyler.

He had his early schooling, through the gymnasium, in an orphanage in Halle. The educational standards were high, the rules were strict, and the environment was spartan in all respects. Meat was provided only twice a week and clothing for the boys was uniformly rough and coarse. Life in this school exercised a decisive influence in shaping the future of the young man. Perhaps he even deserves the credit, currently given to Kennedy, Kennedy, and Kennedy for discovering the long-walk therapy against anything that ails you. He and his friend Jahn, the great father of gymnastics, used to walk

many miles together Jahn warming up for the exercise by walking from Freiburg in Thuringen to Halle a mere 30 kms. With all of this came a great love for the mountains he was an expert mountain climber and a deep attachment to the outdoors. With a pharmacist in Halle, he used to go on plant collecting expeditions and is credited with discovering in the Riesen mountains a new species of fern. Indeed, it was this finding that first brought his name to public attention.

In later years he used to vacation on the Bodensee (Lake Constance) and was very competent in sailing. His last scientific publication reported on the distribution of absorbed gases in the water of the Bodensee and its relationship to the plant and animal life of the lake. This followed upon earlier work with C. Duncan on the respiration of fish at different depths in the lake. His love of plants and his friendship with the Halle pharmacist led him, while still a boy, to carry out chemical experiments on plants and later to study the composition of plant ash. His love of the mountains developed in him an interest in geology and several papers in this field were published.

When he finished gymnasium in 1846 he was admitted as a medical student in Halle and there he studied for two semesters and was properly initiated in chemical research by Steinberg, the Professor of Pharmaceutical Chemistry. In Halle he would have remained were it not for a hiking trip in the Riesen mountains in the fall of 1847. He met, by chance, an Ernst Heinrich and Edward Weber with whom he soon developed a close friendship. By them he was persuaded to continue his studies in Leipzig which he did, often visiting the Webers, three of whom brothers were professors in the University. All of them, but especially E. H. Weber, Professor of Physiology and Anatomy, had a profound influence on the young Hoppe. In later years he was fond of describing the work he did as an assistant to W. Weber, Professor of Physics, on the transmission of sound in water. This involved deep underwater diving in which Hoppe with a tube in his mouth was sometimes forgotten while still submerged. On returning to the surface, the overimmersed Hoppe would find his absent-minded employer in animated conversation with an acquaintance.

Hoppe remained for five semesters in Leipzig. He then went to Berlin where he finished his medical studies, publishing his dissertation with E. H. Weber on the composition of chondrin and receiving his certification as a physician in 1851. After a year of migratory study, mountaineering and travel in Prague, Northern Italy, and Vienna, he took his state examinations in obstetrics and practiced medicine for a year or two. After another two years of service in the University, he accepted appointment as Prosector in Virchow's new Institute of Pathology. Here he directed the work of the chemical laboratory and gave a series of lectures on chemistry and physiological chemistry for doctors. His students and research associates grew rapidly in number and thanks to Virchow's influence and great interest in Hoppe, a second assistant was appointed. Hoppe was promoted to professor *e traordinarius* in 1860 and one year later moved to Tubingen, where in a short time he became *ordinarius.* It is evident that he was a stimulating teacher and, in association with Strecker and later with Fittig, was highly regarded for his lectures, carefully prepared experiments, and demonstrations in inorganic chemistry, organic chemistry, toxicology, and physiological

chemistry. The physical facilities available for his work were very poor but this did not dampen his enthusiasm.

However, in 1872, Hoppe-Seyler was invited to the chair of physiological chemistry in the newly founded University of Strasbourg. He accepted with characteristic enthusiasm and for eleven years occupied quarters in the medical school building. The facilities were not completely suitable but in 1883 or so a new building was erected, according to his design, for instruction and research in physiological chemistry. This was the first of its kind in Germany and can well be regarded as a landmark in development of the science as an expanding discipline in its own right. Here he gave lectures, and conducted practical courses in physiological chemistry, toxicology, forensic chemistry, metabolism and nutrition, and hygiene. He attracted a great many students. Of them all, I propose to mention only Miescher and Kossel, of whom I shall have more to say in a moment. His great textbook on physiological and pathological chemistry which first appeared in 1858 ran into many editions and was translated into "all modern languages." Every analytical method and every experiment described in this book and in its many revised editions was developed or checked by Hoppe-Seyler personally a laudable practice which our many writers of present-day laboratory manuals might well emulate. His name is also indelibly associated with Hoppe-Seyler's *eitschrift f r Physiologische Chemie,* which he founded in 1877, and with the 150 papers or more on a great diversity of topics, which he published during his lifetime.

In his 70th year, while again vacationing on the Bodensee, as he had done for 20 years or more, he was suddenly seized by a fatal heart attack and died on the 10th of August.

And now we come to one of Hoppe-Seyler's students F. Miescher (2), whose research in Hoppe-Seyler's laboratory constitutes a fitting introduction to this Conference.

Johann Friedrich Miescher was born in Basel on August 13, 1844. Within the Miescher family there is a rich intellectual tradition. His father, whom we shall call Miescher I (1811 1887), was Professor of Pathology and Physiology in Basel from 1837 to 1844, and again from 1850 to 1871 as Professor of General Pathology and Pathological Anatomy. In the interim he held a professorship in Bern which was really the *Heimatstadt* of the Miescher family. Two grandnephews, descended from two brothers of our Miescher (Miescher II), are professors: Ernst Miescher, Professor of Physics in Basel, and Peter Miescher, a Professor of Medicine in New ork University. An uncle on his mother's side was the well-known anatomist Wilhelm His, Professor of Anatomy and Physiology in Basel from 1857 to 1872 a man who exercised a remarkable influence on Miescher, perhaps more decisive than that of Hoppe-Seyler or Carl Ludwig.

The young Miescher almost entered upon the study of theology but, fortunately for science, was "saved from the burning" and studied medicine instead. He pursued his studies in Basel and G ttingen and qualified in 1868. His father advised him to go into practice, perhaps as an ear specialist a newly developing field, and one in which he probably had a certain amount of interest, for from his youth the son was hard of hearing. But Miescher II had inherited the genes of his father and was much more interested in scien-

tific research and theoretical studies. So we find him in 1868 in Tubingen studying general chemistry for a semester in the laboratories of Wohler and Strecker. Somewhere along the way he developed an interest in the chemistry of the cell nucleus. His uncle, His, was eager that Miescher should study biochemistry as a tool for a better understanding of histology. Apparently Miescher selected the nucleus for study because it was the least known of the cell constituents and this was the problem he brought for study to the laboratory of Hoppe-Seyler.

One suspects that Hoppe-Seyler was not particularly enthused by the proposed investigation but he does not appear to have discouraged Miescher. However, it is not clear why Miescher did not soon abandon it all. For he used pus cells as his starting material which he obtained by washing them from the bandages of patients with suppurating wounds. The difficulties attributable to the stench from the bandages and clumping and slime formation of the cell suspensions would have discouraged any but the most determined. The details one must omit. He did succeed, however, in isolating nice glistening nuclei from which, with alkaline extraction and acid precipitation, he obtained two fractions *die ich einstweilen ohne weiteres Pra udiz als losliches und unlosliches Nuclein bezeichnen will* (3). His soluble nuclein would now be recognized as a crude preparation of DNA. What first intrigued Miescher and, later, many others was the high phosphorus content. The work was ready for publication in the fall of 1869 but Hoppe-Seyler, to whom the manuscript was sent, was frankly skeptical. He withheld publication, with Miescher's full approval, until 1871 by which time he had himself repeated every essential portion of Miescher's research. Apparently, Miescher, always dubious about the accuracy and the quality of his own investigations, deeply appreciated Hoppe-Seyler's caution. Late in 1869, Miescher went to Leipzig to study physiology under the great and dramatic Carl Ludwig. He remained almost a year, refraining from initiating some research on conduction in bone marrow a problem which Ludwig was eager to have studied. In 1871 he returned to Basel and in 1872 assumed the Professorship of Physiology hitherto held by his uncle, Wilhelm His, now newly appointed to a chair in Leipzig.

In Basel, eager to continue his studies on cell nuclei, he turned with enthusiasm to salmon spermatozoa. At that time, salmon were abundant in the upper Rhine, and Miescher, encouraged by his uncle, found in the spermatozoa excellent material for his work. He again isolated DNA and with it a nitrogen-rich base, as he thought quite simple in structure, which he called "protamine." From the unripe testis he isolated a "nucleoalbumose" which he assumed to be the precursor of the protamine. It was left to Kossel, however, a few years later, to show that Miescher's protamine was a protein, and that his nucleoalbumose apparently belonged to the class of proteins to which Kossel had given the name "histone" (4).

Miescher's studies were, of course, chemical. His uncle, His, interested the nephew in the fascinating problems concerned with the spawning migrations of the salmon the loss of fat, the atrophy and "liquidation" of muscle, the failure of the fish to eat while making the long ascent up the fresh water streams and, coincident with the process of "liquidation" (as Miescher described the events), an increase in the weight of ovaries or testes to 25 per-

cent of the total body weight. His pursued histological and morphological studies on the tissues of the migrating fish while Miescher carried on the chemical. This, as Needham has pointed out, was one of the first and most fruitful collaborative studies in the history of chemical embryology. It exposed a wealth of problems stemming from the apparent partial liquidation of some organs and the migration of their components to the developing ovary or testis.

Perhaps we are inclined to think that the work I have mentioned thus far constitutes the beginning and the end of Miescher's scientific studies. But, if so, we would be gravely in error. It is true that his papers were few in number for his life was short, and he had very little technical assistance (one quarter of a Diener), and in keeping with his very deep convictions and intense motivation he was determined to do everything with his own hands. It is not generally known, for example, that Miescher was probably the first protein chemist to recognize the amphoteric properties of proteins. In a letter to Wilhelm His in May, 1876, he wrote (5): "The thought always occurs to me that the proteins are really both strong acids and strong bases, which possess a neutral reaction only because of an inner neutralization. If one mixes sodium chloride with protein there must occur protein chloride, sodium proteinate, and protein-proteinate. Different proteins have different affinities, and even the insoluble proteins are not unreactive."

And as Verzar has pointed out so well (2), Miescher's scientific curiosity also led him into studies of respiration, of the spleen, and of high-altitude physiology. He was the one who first proved that the regulation of respiration was by chemical means and that carbon dioxide is the stimulating agent. As andell Henderson expressed it, "the brilliant Swiss physiologist Miescher of Basel had assigned first place to carbon dioxide."

Miescher sensed that oxygen lack, or tissue hypoxia, was behind the "liquidation" processes observed in the spawning migrations of the salmon. The cause of the oxygen depletion was not hard to explain; the great skeletal muscles of the fish were almost empty of blood. But where had the blood gone Then it was that Miescher made his important observation on spleen function. In May or June when the ovary or testis was approaching maturation, the spleen increased in size some 15- to 20-fold and after spawning returned to a mere 1 2000 or less of the body weight its so-called normal size. The enlarged spleen was found filled with blood, unusually rich in red cells. Why the splenic reservoir filled with blood from the muscles was not clear to Miescher although today the blood emptying of the musculature is commonly associated with a lack of sexual hormones.

In another aspect of Miescher's interest in respiration, we find him exploring the problem of adaptation to high altitudes. With the help of several colleagues it was possible to confirm the finding of Viault, which had but recently been published (1890), that the number of circulating red cells increases with increase of altitude. Miescher extended the work to experimental animals (as well as man) and was able to show that the stimulus to red cell formation observed at 850 meters altitude was noticeably enhanced at 985 and 1,050 meters. It was tempting to associate this enhanced red cell formation in a very simple way with the reduced partial pressure of oxygen in the inspired air. But Miescher was aware of the difficulties in so simple an expla-

nation. At the same time he saw in the whole process "the finest and most interesting regulatory device known to physiology."

Miescher was seriously ill during the later phases of these studies and it was from his sick bed that he was obliged to follow the work. His end was a tragedy. In the spring of 1894, in his 50th year, he was suddenly seized by a most florid type of tuberculosis. He went to a sanitarium in Davos but the disease was severe, progressive and unresponsive to high-altitude therapy. Though he observed the progress of the disease objectively, he did not give up hope until in the summer of 1895 he was asked by his university to retire from his professorship. He died on the 26th of August.

A little must be said about Miescher's personal characteristics. He was an introvert and, perhaps because of this, very critical of his own research. In some ways there was an inner insecurity; he was never quite certain that his findings were accurate, that the evidence was sufficient, that he had proved his point. To be doubly sure, he did most of his elementary analyses carbon, hydrogen, nitrogen and phosphorus himself. He was myopic and hard of hearing, physical defects that could easily accentuate his introvert tendencies. Like his father, he was very musical and there were those who regarded his musical talents to be as highly developed as his scientific.

It was in his laboratory, however, where he really lived. Until a new laboratory, the Vesalianum, was constructed he had only two rooms and part of a public corridor for his work. Apparatus and time were also lacking. It is said that when plates were missing from the laboratory, he would draw upon his household supply of Sevre porcelain which his wife would then resolutely seek to retrieve. The preparation of his lectures was always a very difficult task for him and required an unusual amount of time and effort. He was not an accomplished lecturer like his colleague Bunge whose well-rounded and explicitly definitive lectures were a pleasure to medical students. But to the few who had imagination and a real sense of scientific curiosity, Miescher's lectures had a great appeal.

Such demands upon him left little time for contemplation and active research. He spent many busy hours in the laboratory. When nucleic acid was being prepared he came to the laboratory at five in the morning and worked in an unheated room late into the night. As he wrote to his uncle, "No solution may stand more than five minutes, no precipitate more than one hour, before being placed in absolute alcohol." He was well aware of degradative changes that might otherwise ensue. To him there was a tremendous sense of urgency in all that he did and to his laboratory work he gave the highest priority. It was even said that on the day of his wedding, someone had to look for him in the laboratory to make sure that he arrived at the church at the appointed time.

Miescher was, unquestionably, one of the great physiologists and biochemists of his time. He antedated Kossel as the real founder of research on the chemistry of the nucleus. The studies which Miescher had so well initiated made a great impression upon Hoppe-Seyler who suggested to Albrecht Kossel that he continue the work. But first a few biographical notes about Kossel (6).

Albrecht Karl Ludwig Martin Leonhard Kossel was born in Rostock on September 16, 1853, as the oldest brother of seven sisters. His father, Al-

brecht Kossel, was the Prussian Consul. He went to the gymnasium in Rostock and entered the newly founded University of Strasbourg in 1872 to study medicine. Among the most famous of his teachers was Hoppe-Seyler who engaged Kossel in 1877 as an assistant. Six years later, Kossel was called to Berlin to succeed Baumann as director of the Physiology Institute and was appointed a professor ordinarius in 1887. In 1895 he was called to Marburg where he became Director of the Physiologisches Institut. In 1901 he moved to Heidelberg where he remained until his death on July 5, 1927. In 1910 he received the Nobel prize in medicine in recognition of his work on the chemistry of the cell nucleus. On the invitation of Johns Hopkins University he visited the USA in 1911 and lectured in many American cities.

The fundamental investigations of Friedrich Miescher formed the starting point for Kossel's studies. His first paper "On the Chemistry of the Cell Nucleus" initiated an impressive series of publications which ended 50 years later in a "Developmental History of the Basic Proteins," published posthumously (7). One week before his death he completed the manuscript of his monograph on the protamines and histones. During his very productive years he discovered the histones, rediscovered the protamines, and laid a solid foundation for the future in his structural studies on the nucleic acids. The nucleic acid bases, as well as the basic amino acids of the histones and protamines, were among his principal interests. When silver salts were almost impossible to obtain during the turbulent years of monetary inflation he turned to the Badische Anilinfabrik for a supply of aromatic nitrocompounds as possible amino acid precipitants. Out of this approach came the introduction of flavianic acid (dinitronaphtholsulphuric acid) as the ideal arginine precipitant; also a virtual abandonment of his silver-baryta procedure for precipitating the hexone bases.

Kossel's school developed the theory that protamines are made up of two molecules of basic amino acids (principally arginine) to one of monoamino acids. He was never able to determine, as he had hoped to do, whether the basic amino acids were sequentially segregated from a similar clustering of the neutral amino acids or whether a two to one recurring sequence was to be found in the protamines. On the basis of rather scanty evidence he favored the former. He was convinced that protamines and histones were developmentally related; both arose, in his opinion, from muscle protein which wasted away by the metabolic shedding of monoamino residues during the spawning migrations of the salmon and other fish. The unripe testicle, he was confident, contained histone in the cell nucleus and this protein by a progressive simplification during the ripening process, became the protamine of the mature spermatozoa. Whether or not this theory would hold together in the face of what we now know, or think we know, about protein synthesis is another matter.

Another theory of Kossel's which would hardly be accepted today is that histones are actually complexes of protamines with other proteins. "If one adds a solution of protamine to a solution of albumen or protein the liquid remains clear. The subsequent addition of a little ammonia produces a precipitate and this possesses all the characteristics of histone" (8). And then the generalization, "A protamine is a base and binds protein only in alkaline solution to form a basic protein, histone" (8).

Kossel had many students who engaged in research on histones and protamines, under the direction and with the encouragement of the master. The names of Lilienfeld (who first prepared thymus histone), of Huiskamp, of A. P. Mathews, of Dakin, and of Kutscher, for example, are known to most of us. Also well known among the early investigators is Ivar Christian Bang (9) who from 1904 until his death in December 1918, was professor ordinarius of medical and physiological chemistry in the University of Lund. Bang was not a member of the Kossel school and, indeed, engaged in several skirmishes in the pages of Hoppe-Seyler's *eitschrift* with Kossel. He is probably best known for his contributions to clinical chemistry, especially in the development of several analytical methods and in the application of new concepts and techniques to blood and urine analysis. He died quite suddenly in his 50th year, else he would, undoubtedly, have contributed much more to the science he loved so dearly. Bang's papers on histone and nucleohistone, at least seven in number, suggest meticulous attention to details in preparation of the products and in testing their properties. He stated, rather surprisingly, that Lilienfeld's method (1894) for preparing thymus nucleohistone was so well known (by 1900) that the substance was in commercial production (10). But the method, Bang insisted, did not even give a nucleohistone. It yielded, so Bang claimed, a nucleoprotein that was histone-free. Actually the papers by Lilienfeld, Huiskamp, Bang, Malengreau, and others in the period 1894 to 1904 or so make repeated mention of nucleoprotein, nucleohistone, histone, parahistone nuclein, leukonuclein, nucleoalbuminate, nucleoalbumose, plastin, etc. To straighten out the terminology, in the light of what we now know, is quite a fascinating little exercise. Incidentally, the word nucleohistone was coined by Lilienfeld in 1892 and was applied to the material which was extractable with distilled water from leukocytes or minced thymus and precipitable from the aqueous extracts with acetic acid (11).

In this description of the early histone chemists, I have done scant justice to Kossel's associates and to his contemporaries. Beyond seeking refuge in what is known as the exigencies of space and time, I can only plead that I have been quite unsuccessful in finding any biographical information on such interesting investigators as Carnoy, Huiskamp, Lilienfeld, Malengreau and Plosz.

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In 1964 I was invited by the Austrian Biochemical Society to give a lecture in Vienna. The paper was not submitted for publication.

I returned to Stanford in 1964, confident that my life as a science attaché had come to an end. But it was not to be so. The State Department sent me to the US Embassy in London for two months in 1967 and to our Embassy in Stockholm (1970) for a similar period to serve as the acting science attaché during temporary absences of the regular appointees. I remember well some of the experiences in Stockholm. The most distressing occurred during the first few days of my arrival. Jerome K. Holland, the newly appointed Ambassador to Sweden, was a black and a remarkably competent individual with whom it

was a pleasure to serve. On his arrival, however, there was a demonstration in which there were many participants who shouted repeatedly, "Nigger, go home " The ambassador took this without complaint and passed it over as if nothing had happened. It was not long before he was well regarded by officialdom in Stockholm and by others who had occasion to meet him.

Since 1964 I have returned to Switzerland annually, for a month or so, to study in the National Library, where an enormous collection of works on Switzerland, wherever published, plus stacks of newspapers, journals, and reference materials are to be found. I owe a debt of gratitude to Dr. Raetus Luck (unrelated to me), the Vice-Director of the Library, for his interest and frequent help. These annual visits continued until 1986.

Out of all of this there finally emerged, late in 1985, a volume entitled *History of Switzerland.* The book was reviewed as follows.

Luck Book Traces 100,000 ears of Swiss History

A Stanford professor emeritus of chemistry has completed what may be the only comprehensive history of Switzerland to appear in the English language during this century.

J. Murray Luck's 887-page *A History of Switzerland From Before the Beginnings to the Days of the Present* (The Society for the Promotion of Science and Scholarship Inc., 1985) retraces 100,000 years of Swiss history, beginning with the Neanderthal cave-dwellers who disappeared from Switzerland during the last Ice Age.

The book continues with descriptions of the primitive lake-dwelling cultures on the shores of Lake Zurich, occupation of the country by Roman troops and civil servants, the introduction of Christianity and feudalism, the formation and growth of the first Swiss Confederation during the 13th and 14th centuries, the Reformation and religious wars, the invasion of Switzerland by the armies of revolutionary France, and the birth of the new nation after the Congress of Vienna.

Of particular interest is the description of the development of the Swiss commitment to perpetual neutrality, which, with only two major violations, has continued unblemished for over 300 years.

The second half of the book is devoted to the 20th century, with special sections on population, public health, transportation, communication, industry and agriculture, taxation, banking, education, the justice system, the International Red Cross, national defense, energy, the environment, the Swiss woman, and cultural activities.

Also included are 80 pages of black-and-white photographs showing Switzerland of the past and present, plus numerous charts and maps.

"It is my hope that this book will contribute, primarily to the English-speaking world, a greater knowledge of Switzerland and an appreciation of her unique position and responsibilities within the family of nations, of which she is a small but very important member," the author notes.

Luck served as scientific attaché at the US Embassy in Bern, Switzerland, from 1962 to 1964. His book, *Science in Switzerland,* appeared in 1967.

> He was also the editor of *Modern Switzerland* all Swiss in authorship that was published in 1978. In autumn quarter 1983 he conducted a sophomore seminar at Stanford on Swiss neutrality.

The book was also formally presented in Switzerland in June 1986 at The Castle in G mligen. This was done as a result of a proposal by our good friends, Vinzenz and Michaela von Tscharner, owners and occupants of the G mligen Castle.

I . SCIENCE, TECHNOLOG , AND FOREIGN AFFAIRS

In 1963 the Foreign Service Institute of the Department of State (in Arlington, Virginia), in collaboration with the Office of International Scientific and Technological Affairs, organized a program of lectures designed to bring to the attention of foreign service officers the various discoveries in science and technology which were believed to have an appreciable impact on foreign policy. The participants in these programs were, in general, young officers in preparation for service abroad as political officers in various embassies. Initially, the programs were of three or four weeks' duration. It was ultimately agreed that such courses were too long.

Starting in 1966, the plans were reorganized to provide for two courses each year, each of five days' duration. I was invited to serve as the organizer of the session to be held from October 16 to 20, 1967. I certainly did not feel at ease insofar as selecting the speakers and issuing the invitations, but I happily received indispensable help from Bill Taft of SCI and John Reed and John W. Bowling of the School of Professional Studies in the Foreign Service Institute. The theme of the program was to strive for increased competence in foreign service officers through knowledge and understanding of the role of science and technology in molding the political, economic and social forces of the day, and in shaping the world of tomorrow.

The Conference of

The 1967 program is described herein in detail.

SCIENCE, TECHNOLOG AND FOREIGN AFFAIRS
October 16 20, 1967
Room 1007, Foreign Service Institute

MONDA , OCTOBER 16
9:00 a.m.
INTRODUCTION
Mr. John H. Stutesman, Jr., Dean, School of Professional Studies, Foreign Service Institute, Department of State
9:30 a.m.
SCIENCE, TECHNOLOG AND FOREIGN AFFAIRS: GENERAL INTRODUCTION
Dr. J. Murray Luck, Course Chairman
INTERNATIONAL COOPERATION IN SCIENCE AND TECHNOLOG
Dr. Luck

1:00 2:00 p.m.
READING PERIOD
2:00 p.m.
SCIENCE AND TECHNOLOG IN FOREIGN POLIC
Dr. I. I. Rabi, University Professor Emeritus, Columbia University

TUESDA , OCTOBER 17
9:30 a.m.
PROBLEM OF PRIORITIES IN NATIONAL SCIENCE PROGRAMS
The Honorable Emilio . Daddario, Congressman from Connecticut
1:00 2:00 p.m.
MILITAR APPLICATIONS OF SCIENCE AND TECHNOLOG
Dr. Finn J. Larsen, Principal Deputy Director of Defense Research and Engineering, Office of the Secretary of Defense

WEDNESDA , OCTOBER 18
9:30 a.m.
SCIENCE, TECHNOLOG AND LESS-DEVELOPED COUNTRIES
Dr. Herbert ork, Professor of Physics, University of California, La Jolla
1:00 2:00 p.m.
READING PERIOD
2:00 p.m.
NUCLEAR ENERG AND FOREIGN POLIC PROBLEMS
Commissioner Gerald F. Tape, Atomic Energy Commission

THURSDA , OCTOBER 19
9:30 a.m.
SATELLITES FOR TELECOMMUNICATIONS AND WEATHER
Mr. James E. Webb, Administrator, National Aeronautics and Space Administration
1:00 2:00 p.m.
READING PERIOD
2:00 p.m.
WORLD FOOD AND WORLD POPULATION
Dr. Ivan Bennett, Deputy Director, Office of Science and Technology, The White House
7:00 p.m.
SUBJECT OPEN
Dr. R. Revelle, Center for Population Studies, Harvard University

FRIDA , OCTOBER 20
9:30 a.m.
SCIENCE, TECHNOLOG AND FOREIGN AFFAIRS
Mr. Herman Pollack, Director, International Scientific and Technologic Affairs, Department of State
1:00 1:30 p.m.
READING PERIOD
2:00 p.m.
REMARKS AND DISCUSSION

Dr. Donald R. Hornig, Special Assistant to the President for Science and Technology, The White House
4:00 p.m.
DISCUSSION AND CRITI UE
Dr. Luck
4:45 p.m.
CLOSING REMARKS
Ambassador George V. Allen, Director, Foreign Service Institute, Department of State

Twenty-three foreign service officers participated in the program with lively and relevant questions and comments following each address. I gave the Monday morning introduction as well as an address on "International Cooperation in Science and Technology." Both are presented below.

Morning Introduction, October 1967

The distinguished speakers who are bringing to our attention various problems in science and technology that impinge upon foreign affairs are listed in the program. They describe to us what is happening on the frontline in science and technology in a number of selected areas. There are, however, a number of gaps. I trust you will permit me to bring two or three of these to your attention.

One of these concerns the island of Aldabra. Here we have a real can of worms in which the biologists of the USA and the UK are fighting it out with the military in both countries. Science, foreign affairs, and military policy are hopelessly entangled. Aldabra is an atoll, 21 miles long, located about 260 miles northwest of Madagascar. The USA Department of Defense and the UK Ministry of Defence had been planning to develop Aldabra as an airfield and staging area to meet strategic requirements in the 1970s.

Although the UK and the USA propose to be partners in the military development of Aldabra, much depends on Britain's East-of-Suez policy. With the loss of Aden, other airfield sites and staging areas are being sought in the Indian Ocean. Under a joint agreement signed on Dec. 30, 1966, three other islands were named as sites that would be available for use by either party: the Chagos Archipelago, Farquhar Island, and Ile des Roches all in the Indian Ocean. The Anglo-French Variable Geometry aircraft, now cancelled, had been expected to use Aldabra by the mid-70s. The Labour party in the UK is subject to considerable pressure to scale down its commitments East of Suez and the outcome of this debate will certainly affect the decision on Aldabra. Donald Zinn (Rhode Island University) suggested (July 7, 1967) that the facilities might be placed on Tanganyika or Madagascar by contract with the governments involved. But why the hassle

So we come to the point of view of the biologists who, through the Royal Society and the National Academy of Sciences, have been girding themselves for a real battle to eliminate the threat, inherent in the plans of the Department of Defense and the Ministry of Defence, against the unique biological resources of Aldabra. What are the resources Essentially, a most interesting fauna and flora which came by immigration across the sea: Aldabra

is of volcanic origin and was never linked to a continental land mass. The ecosystem is necessarily simple and lends itself readily to study. Such oceanic islands are especially useful for the study of evolution because they tend to encourage the development of flightless varieties of birds and insects to which flying out to sea proves dangerous. On Aldabra is to be found the Giant Land Tortoise which, as a surviving natural population, may be found only on Aldabra and the Galapagos. A number of endemic species of land birds also occur as well as the last-of-the-line survivor the flightless rail. It is one of the last remaining havens of the sacred ibis and a possibly unique flamingo. Seabirds, particularly frigates, and the pink-footed booby nest on the island in considerable numbers. About 10 of the 170 plant species on the island are found nowhere else.

All of these are threatened. The airfield itself, on South Island, would probably wipe out the breeding and browsing ground of the giant tortoises. The frigates, incidentally, would pose a danger to aircraft in that they hover between 50 and 3,000 feet in the air, thus putting them in the flight path of planes. Side threats to the biota would result from aircraft noise, sewage disposal, insecticides, the bridging of East Channel, and the introduction of people, cats and dogs (at present the human population is only 100). The Academy and the Royal Society "have urged their governments to exert every effort to eliminate this threat of incalculable damage to one of the world's unique resources for scientific investigations."

As has been said: "Biologists are…aware that the physical alterations produced by technology can bring about unknown, far-spreading, and often destructive, changes in the web of life that is stretched so thinly over the surface of our planet. Our technology has outpaced our understanding; our cleverness is growing faster than our wisdom." (*Science,* Vol. 155, 24 Feb 1967, editorial page). The conservationists should not be discouraged. In 1871 Charles Darwin and others pioneered in a similar, and successful, effort to prevent commercial development of the island.

A second area of interest concerns whaling and fisheries. The regulation of fisheries in international waters has been the subject of bilateral and multilateral agreements for many years. The purpose of such agreements is clear. When technology advanced to such a point that sea-going canneries came into being, overfishing became a real hazard and the agreements in question have required more and more punch, and more and more political teeth. I know little about these agreements in detail and I only wish to emphasize the point that advances in technology that contribute to overfishing certainly have a very real impact in the field of foreign affairs.

A comparable situation exists in whaling. There is an International Whaling Commission to which the governments of Japan, the USSR, and Norway, among others, subscribe. Catch limits are now imposed on blue whales in Antarctic waters and the humpback whale in the Northern Pacific is now completely protected for at least another three years. The International Whaling Commission unfortunately does not have the sanction of international law: it depends on voluntary cooperation. Nor can it impose national quotas and an inspection system is totally lacking. This is clearly a case where technology has outrun foreign policy. We can catch and process whales more rapidly than we can develop international agreements and ef-

fective controls as instruments and means of regulation. But the International Whaling Commission in 1970 had a budget of only about 20,000 per year (840 from USA), so what can it really hope to accomplish

Morning Address, October 1967
"International Cooperation in Science and Technology"

Politics have an impact on Science and Technology. Thus the continuing Arab-Israeli crisis, the closure of Suez, and the extortionate demands of the Arabs greatly stimulate efforts to find oil (and gas) in other parts of the world. And, as we shall see, science and technology have an impact of their own on global politics.

Because the scope and purpose of this seminar may not be transparently clear from its title, I would like to convey to you my own thoughts on what we should try to do during the five days we shall be together. In a tentative outline of the course, submitted to me some weeks ago, it was proposed that I should introduce the subject matter by giving "a very brief economic, social and political history of the world in terms of…." I know that you will forgive me for not rising to the challenge implicit in this suggestion, which I am sure was written with somewhat of a tongue-in-cheek delight. We should explore with the leadership and guidance of our distinguished guests the points of impact of science and technology on foreign policy and on the decision-making processes of government that determine our relations with other nations. For this to be as fruitful as we would like it to be, we may find ourselves talking more about the science and technology of the future than about the science and technology of 1967. What is important in policy-making is several-fold:

(a) The ideal or the optimal, the world as we would like it to be in communication, in transportation, in production, in the wisest exploitation of our natural resources, and in the attainment and maintenance of a maximum of harmony and understanding between the peoples of the world. Incidentally, if anyone wishes to bring the concept of the optimum down to earth, try relating it to a specific problem for example, the optimum population of a stated region, or of a small country such as Switzerland.

(b) The practical or the attainable, the world as it is likely to be. Here we should explore the shape of things to come, merely by a projection of present trends and by reasonable guesses of what will emerge from the science and technology[1] of 1967 leads us into what the forecasters would call a surprise-free future. The fact that it is surprise-free does not diminish its importance, for a future that appears to be free of surprises to a biologist may not be so free of the unexpected to the physical scientist. And what are plausible possibilities to most scientists may not be without their surprises to those of us whose training and experience have kept us away from frogs, banana flies, and atoms. Certain it is that our speakers will alert us to those areas in international relations that may become sensitized or inflamed by present trends in science and technology.

[1]Francis Bacon in England was probably the first to distinguish between basic and applied science (i.e. technology): The former increases our understanding of nature and the latter our power over it.

(c) The possible but the unpredictable the world as it might be if various breakthroughs in science and technology came about. For example, what would be the consequences in the world of the future if cancer or cardiovascular disease or both were to be conquered Or if the nuclear fusion process were to be harnessed and rendered amenable to development for peaceful purposes. Or if the great subterranean sources of thermal energy locked in the core of our planet were to be effectively tapped for use at the surface. Or if we could induce controlled mutations in microorganisms such that strains could be produced at will which would be capable of catalyzing, within reason, almost any desired chemical reaction. Or drugs that improve memory or the rate of learning. And so on as far as our wildest dreams will carry us.

Now what do we mean by a surprise-free future into which we may be led by a straightforward projection of present trends If we select, quite arbitrarily, some target date such as the year 2000 to which we fix our predictions, we almost certainly mean a world of over 6,000 million people with a perceptible shift in the relative population load towards Asia, Africa and Central and South America. We can well anticipate a continuing increase in the speed of aerial and surface transport of people and of things: more sonic booms, more noise around our airports, much higher levels of investment in the new generation of aircraft, sometimes requiring international cooperation, such as the Anglo-French Concorde, and the Anglo-French-German air-bus projects. Communication facilities for the transmission of information will rapidly increase: one or perhaps more large regional or world satellite systems such as Intelsat will emerge. These examples, selected at random, surprise no one, are realistically predictable, and constitute some of the components of a surprise-free future. However, one caveat must be introduced: these predictions will only come true if present trends continue a necessary hedge when talking about, for example, the aircraft noise and sonic boom problems or the world population 100 years from now, let alone in the year 2000.

Despite the explosive nature of any growing process which has reached its logarithmic phase of growth, one can probably assume that the world of 2000 A.D. will be richer in similarities to the world of 1967 than in differences. For food we shall still be principally dependent on agriculture, for clothing on fibers (natural or synthetic) and for housing on such familiar building materials as concrete, clay, wood, plastics, and metals. Transportation will still be by train, by car, by bus, and by air. We shall probably move faster and there may be appreciable quantitative shifts between private and corporate or governmental ownership of the means of transport. We shall still breathe oxygen, exhale CO_2, and drink watery fluids though our atmosphere may be slightly richer in CO_2 and our drinking water may be reprocessed from aqueous wastes, polluted waters, and from the oceans. And, by way of disagreement with the fanciful predictions of Marshall McLuhan, I rather suspect that the wheel and the highway will still be with us.

Sir Solly Zuckerman, not willing to look ahead some 30 or 40 years, wrote in 1965 that over the next 10 or 15 years he can “foresee nothing emerging as revolutionary as radar, nuclear weapons and nuclear power, guided weapons and ballistic missiles, communication satellites, or high-speed computers.”

But what about the unpredictables, the breakthroughs Are they really unpredictable To me, the point is not even debatable but there may still be room for a bit of an intellectual contest. The fact of the matter is that the forecasters in science and technology the serious practitioners of the art have a miserably low batting average. J. B. S. Haldane, encyclopedic though he was in his grasp of science, concluded in 1924 that in the future when our fossil fuels will be depleted, and our hydroelectric power sources fully exploited, we would have to turn to the wind and the sun for additional sources of energy. But how could anyone have soundly predicted forty years ago that nuclear energy could and would be successfully exploited I will admit that some of our greatest science fictioners, such as H. G. Wells and Jules Verne, once in a while "hit the jackpot" and forecast something that really happened. Although Wells predicted in 1914 the eventual manufacture of atom bombs, his crystal ball and those of other soothsayers failed so often that we invariably attach a value of zero to their predictions: for the same reason that gargantuans sixty feet tall are physically impossible, so we need have no fear that any of H. G. Wells' rats, the size of tigers, will drive us into extinction. We need only go back into the past and, with all the virtues of hindsight, appraise man's competence in forecasting: A for his efforts and zero for his attainments.

There were no seers with such ultravision that in 1865 they could predict that by 1900 electricity would be generated for the masses from thermal or mechanical (hydro-electric) sources, and that the internal combustion engine with its great potential for the development of industry and transportation would be with us; or in 1925 could have foreseen the discovery of antibiotics, of nuclear energy, of rocketry, and the incipient conquest of space, of radar and its tremendous civilian and military applications, and of the new science of radio astronomy all in 35 years or even less. In 1898, Sir William Crooks in an address before the British Association for the Advancement of Science predicted that exhaustion of the world's reserve of nitrates, then rapidly in progress, would spell the end of agriculture and ultimately of the species. et only a few years were to pass before the means was discovered of fixing atmospheric nitrogen and of putting the new fixation processes at the service of agriculture.

If you have followed me thus far you may be concluding that any sane and cautious man would refrain from such dubious ventures into the future. Incidentally, I was really fascinated when I heard of the caution displayed by a prospective traveller who never before had ventured through the heavens on a plane. The incident to be related occurred shortly after a bomb exploded in a plane above or near Denver with very tragic consequences. "What are the chances of there being a bomb on the plane " asked our cautious friend. "Well, the industry and the insurance companies have tried to calculate the odds," replied the agent. " ou need have no fear, the chances of such a happening are less than one in a million." "The odds may seem good to you, but not to me," said the cautious one. "Well," replied the agent, "there is a simple solution. When you board the plane, carry a bomb with you, for the chances of there being two bombs on a plane are of the order of one in a million million."

Now all of this brings us to a peculiar paradox. Despite all of the colossal mistakes, the misjudgments, the seeming inability of man to peer into

the future, we must have the courage and the plain audacity to attempt the impossible.

Clemenceau (the French Prime Minister) pointed out that "War is too serious to be left to the generals." This reflects the professionalism and isolation of the military establishment. "Until recently the military was suspicious of scientists and technological advance." (S. Zuckerman)

In fact, the future is the world in which we live; the present is nonexistent for it is instantly absorbed by the past. We must seize upon the future and try to figure out what science and technology will do to us and to our environment within the next 30 or 40 years. And this is largely because decision-making in economics and in politics is never as productive when given over to the solution of crises as when the future is tentatively revealed to us and we are able to fashion alternative solutions to the critical problems appearing on the horizon.

"By reacting to crises instead of anticipating or avoiding them, the Government has fallen behind in a difficult game." (Luther Carter).

This is so-called "old stuff" to those in the military establishment for it is the sort of exercise through which they must constantly go: What sort of weaponry will our enemies have Indeed, who will be our enemies What kind of knavish tricks will they be up to And what kind of supersophisticated defences can we dream up against that new generation of weapons which we can now only dimly foresee

Can we go one step further and force the breakthroughs Can we mold the future These are important questions and I rather suspect that we shall return to them from time to time. We know perfectly well that they cannot be answered one way or the other without hedging.

In 1934 a British government scientific committee was assigned the task of advising how air attacks could be countered. They soon relegated the death ray to the realm of fantasy but the chairman, Sir Robert Watson-Watt countered with the suggestion that it might be possible to detect aircraft by radio waves. In a second paper he set forth the principles upon which radar is based. (Zuckerman)

At the time of World War II through a heavy investment in the physical sciences and an extraordinary success in rallying the universities and scientific institutions to the cause, the federal government did indeed force a scientific and technological breakthrough in the field of nuclear energy which, since the war, has opened great new vistas before us. Partly inspired by this success, our Congress, after setting up the National Institutes of Health, has appropriated very considerable sums of money for the conquest of cancer, heart disease, and other illnesses. But the victory in this kind of a war is not yet in sight and there are those who with good cause insist that the duration of the campaign will not be shortened by making the money even more abundantly available than at present. The bottleneck, they insist, is not the lack of money but great gaps in our basic knowledge in the biomedical sciences.

As was mentioned earlier, our main concern will be with the impact of scientific discovery and technological development on foreign policy. With the help of a few examples and some hindsight I would like to put forward several illustrations.

1. During the administration of President Eisenhower, a committee was appointed by the President to explore the various ways in which this country could most effectively make its resources available to help the emerging nations and developing countries solve the great problems with which they were beset. The chairman of this committee was General William Draper, Jr., at one time coordinator of the Mutual Security Program in Europe. When the Draper Committee submitted its very excellent report in early 1960, President Eisenhower expressed his warm approval of all the recommendations save one: Namely, that our government "assist countries, on request, with plans to deal with rapid population growth, and support studies and appropriate research to meet the challenge." The committee certainly had in mind the pill, recently discovered, and possibly certain intrauterine devices, either of which could be of very great help to any country that tried seriously to initiate a national program of population control. The President's comment was brief: This is a very personal matter, it is not a responsibility of government. It is rather a task for philanthropic, charitable, and educational foundations. But times do change and it is of some importance that our foreign policy began to take on a more benign and sympathetic hue in matters of this sort under President Kennedy. The use of US government funds for such purposes in foreign countries was finally approved in April 1967. Some of you may recall that the Johnson administration announced a few weeks ago that 1.3 million dollars of aid would be extended to India when so requested for the purchase of condoms and pills for ovulation inhibition all of this in response to the expressed desire of the government of India to implement a national program of family planning. This is a timely example of the impact of a scientific discovery on foreign policy and as a by-product, an illustration of the transition within our own day of an important human concern from the private into the public sphere.

Some of the most striking and dramatic examples come from the world of space and from nuclear science. When Sputnik I was orbited in October 1957, it is fair to say that the world shook and Washington trembled. There were several immediate effects, one of which is quite germane to our central theme. Congress, disturbed by the fact that State had been unable to alert the legislative branch to what the Russians and, for that matter, other nations were up to in science and technology, promptly flayed out in all directions, and demanded action. Under such a stimulus the science attaché program in the State Department was reactivated and expanded and science attachés, responsible to International Scientific and Technological Affairs (as the office is now called), were assigned to several of our more important embassies.

As for nuclear science, one is forced to relate events in the field of foreign policy to the atom bomb. Its purpose was to bring an end to the Pacific phase of World War II and to compel Japan to surrender. This foreign policy objective was achieved. Since then the civilian and military exploitation of nuclear energy has been rich in foreign policy problems. For example:

(a) We are determined to minimize the possibility of atomic bombs becoming accepted as conventional items in a nation's arsenal, thereby inviting the risk of a world holocaust being sparked into flame by some trigger-happy and thoroughly irresponsible person such as some of those who are forcing themselves into positions of power throughout the developing world. Our

policy is to cooperate with friendly nations in controlling the diffusion of know-how and the distribution of critical materials essential for atomic bomb assembly. The nonproliferation treaties that we seek to negotiate are based on this objective. But note that an effective Non-Proliferation Treaty has to deal with both military and peaceful explosions since similar installations are used for both. Incidentally, to make a hole 350 feet deep and 1,600 feet wide required a 100 kilo-ton charge. Three hundred such explosions would be required to excavate the proposed canal across the Central American isthmus (Asimov).

(b) We have been very successful in cooperation with other nations in achieving an international accord against upper-atmosphere testing of atomic bomb assemblies, as witness the Test Ban Agreement of 1963 signed by the nations of the world except France and China. Note that the accumulated tonnage of nuclear explosions has been doubling every three years since 1945. The fallout problem was becoming of serious concern the world over and there were those who were convinced that myelogenous leukemia, induced by ionizing radiation from radioactive strontium, would become as widespread as the common cold but as deadly as bubonic plague. Switzerland, with typical caution, continues to test periodically, and frequently, samples of soil, water, milk, vegetables, fodder, etc. from collecting stations throughout the country to keep a watchful eye on the status of fallout. Since the Test Ban Agreement went into effect the atmospheric burden of radioactive material has begun to lessen.

(c) The disposal of radioactive wastes, a problem of no small magnitude, is not without its foreign policy aspects. These wastes cannot be dumped capriciously into the oceans without inviting a rash of problems that stem from the possible effect of ionizing radiation on fish, shellfish, and other edible products from the sea. Every nation with an important ocean-fisheries industry could be upset by the careless dumping of radioactive wastes just as San Francisco and the Bay Region could be if all the raw sewage and industrial wastes from the Golden West were to be discharged into San Francisco Bay.

I referred to Sputnik I but not to the impetus that it gave to our space research programs. Here we find ourselves in an area which is probably richer in problems of international concern than any other segment of science and technology. For example:

(a) In weather forecasting, the Tyros and Nimbus weather satellites, together with a world network of well-instrumented high altitude balloons, are beginning to provide us with such a body of information that our friends in the world's weather bureaus talk with increasing optimism of improved batting averages in the business of weather forecasting. Our policy here is to cooperate to the utmost with all who will join in the world network of data collecting.

(b) Weather control is another matter: dissipation of fog; control of precipitation (rain, hail, snow); suppression of lightning; modification of hurricanes. If we ever succeed in pushing the clouds around or in inducing rainfall when and where we want it we shall open a Pandora's box of trouble. How can we ever decide when and where the rain should fall Who will make the decisions What kind of international agreements in such a troublesome area

are even remotely possible Perhaps we shall have to be content with a multilateral agreement not to tamper with the weather, or to restrict our activities to a world program strictly experimental, to increase the rainfall in a selected arid region, or to be content with the very important task of trying to break up hurricanes while they are in the early formative stages. Any progress that science and technology may make in weather control is rich in both beneficent and inflammatory possibilities as far as foreign relations are concerned.

(c) Telecommunication by satellites. I assume that Mr. Webb will have much to say on this subject. Some of us hope that the world system, now virtually controlled by the Communications Satellite Corporation, will evolve into one with control and responsibility distributed over a number of participating nations. And, as you know, it is a foreign policy objective to seek a single world system, with all nations cooperating, rather than a group of regional systems or two or three competing world systems, politically oriented and politically inspired.

Finally, we might select an example from the biomedical sciences. I am sure that everyone here will recall the tragic consequences that arose from the use of thalidomide, a sedative, by women in Europe during the first few weeks of pregnancy. The recognition of this drug as the causal agent of the serious birth defects which were appearing in Germany in 1963 was slow in coming about. Thanks to the acuity and alertness of Dr. Herman Chinn, then our deputy science attaché in Bonn, this country was warned in time of the suspicion that was beginning to be directed against thalidomide as the possible causal agent of phocomelia and other embryopathies. Well, so much for the science side of the coin.

Now we turn it over to see what it has to do with foreign policy. As a matter of fact, the thalidomide story stimulated a great deal of searching of the soul by the Federal Drug Administration and the pharmaceutical industry. Undoubtedly it was responsible for the amendments of 1963 to the existing body of legislation that governed the importation of drugs from abroad. I know that at one time we demanded of the foreign pharmaceutical industry the right to inspect the process of manufacture of any drug which was proposed for export to this country. We also spelled out most meticulously the experimental and clinical tests to which such drugs would have to be subjected before they could be approved for sale in the USA. This, you will agree, is very much in the area of foreign policy and international relations. I was the US science attaché in Switzerland at the time that those particular amendments were proposed and I recall vividly the vigorous objections of the Swiss drug industry. For it is in the very nature of things, almost enshrined in an industrial Bill of Rights, that no one, not even a Swiss, may pry into the workings of a Swiss industry. We had a comparable hassle, though pitched at a lower key, with the foreign watch industry when we became concerned over the dangers of ionizing radiation and required that the luminous dials of watches and clocks sold in this country be painted with something other than chemicals such as those containing radium which fell into the category of dangerous emitters of radiation.

Finally, lest they escape mention by others, I think we should turn our attention to a number of areas of international cooperation in science which present some special points of interest:

(a) Antarctica. At the present time some twelve nations are cooperating in Antarctica in a very active program of scientific research in biology, cartography, geology, geomagnetism, glaciology, meteorology, oceanography, geophysics and upper atmosphere physics. The programs are worked out through SCAR, the Scientific Committee on Antarctic Research, which consists of representatives of the participating nations. SCAR in turn is a committee of the International Council of Scientific Unions. The Antarctic Treaty of 1959 to which the 12 member countries have subscribed permits the use of Antarctica for peaceful purposes only. The cooperation of the participating nations and of the scientists concerned is at a high level and is an outstanding example of international cooperation for peaceful purposes. Since no new claims or enlargement of existing claims to territorial sovereignty may be asserted while the Treaty is in force, some of us may be permitted to wonder whether the existing harmonious relations would be maintained if some natural resource of substantial economic value were to be discovered in the great no-man's land which is now shared in common.

About 60 scientific projects are scheduled at Antarctica during the 1967 68 summer season. Their cost is about 7.7 million, according to the National Science Foundation, which funds and administers the US Antarctic research program. Among this year's efforts at Byrd Station is a mile-and-a-half vertical drilling project, which may yield information about the earth's climate for the past 30,000 years. Samples extracted from the hole at various depths will be analyzed to determine rates of snow accumulation, temperature variations, rate of deposition of meteoric particles, and the time-dependent composition of the earth's atmosphere (through analysis of air trapped in the ice). Results will be compared with those of a similar project completed last year at Camp Century, Greenland.

Congressman Daddario recently called for consideration of an "early warning system" to appraise us of the potential dangers of certain technologies. If this call is heeded, as I hope it will be, we can be better prepared to cope with the problems posed by our advancing technology. The system could perhaps even be extended to provide useful forecasts for the foreseeable future. I would think that a distinguished committee, drawn from the natural sciences, the social sciences, and industry, could be impaneled about every five years to explore our technological and scientific future. This could satisfy the need for expert opinion on the directions of science and technology so far as they can be foreseen, within acceptable time limits and without a permanent "watchdog" group. After all, technological forecasting is much more sophisticated than it was in 1937, and we should take advantage of the new techniques. My only concern is whether the five-year cycle would be frequent enough.

Speaker John W. McCormack in an address before the Panel on Science and Technology, January 24, 1967, convened by the House Committee on Science and Astronautics Science Policy, expressed the opinion that the application of Science and Technology to the problems confronted by governments, must be increasingly international in outlook. "It is a practical recognition that the problems are bigger than any one nation: that all of us must work together for our common good and our common survival."

Before the 1966 meeting of a certain panel, Senator Humphrey referred to an important gap "a gap between public policy and advancing science and technology. It is in government that we must face the task of closing the gap…. It is only in recent years that we have really understood the close relationship between public policy at the governmental level and science and technology."

The Conference of

In 1968, the Foreign Service Institute again asked me to serve as Chairman of the class on science, technology and foreign affairs and to participate in the organization of the schedule. Again, the course was offered to acquaint foreign service officers with the scientific and technological aspects of foreign policy issues and to increase their awareness of the opportunities afforded by science and technology for achieving foreign policy objectives. The program (May 6 10) may be described as follows.

SCIENCE, TECHNOLOG , AND FOREIGN AFFAIRS
1968 Program

MONDA , MA 6
9:15 a.m. 9:30 a.m.
INTRODUCTION
Dr. J. Murray Luck, Course Chairman
9:30 a.m. 10:30 a.m.
The Honorable Herman Pollack, Director, International Scientific and Technological Affairs (SCI), Department of State
10:45 a.m. 12:15 p.m.
Dr. Eugene G. Kovach, Mr. Robert F. Packard, and Mr. Donovan . Zook, SCI
1:30 p.m. 3:00 p.m.
Dr. Kovach, Mr. Packard and Mr. Zook
3:15 p.m. 4:45 p.m.
Mr. Reginald G. Voysey, Scientific Attaché, British Embassy

TUESDA , MA 7
9:30 a.m. 11:30 a.m.
Dr. Charles S. Sheldon II, Acting Chief, Science Policy Research Division, Legislative Reference Service, Library of Congress
3:00 p.m. 4:30 p.m.
Dr. Edward Wenk, Jr., Office of Science and Technology, The White House

WEDNESDA , MA 8
9:30 a.m. 12:00 p.m.
The Honorable James E. Webb, Administrator, National Aeronautics and Space Administration
2:30 p.m. 4:30 p.m.
Dr. J. Murray Luck

THURSDA , MA 9
9:30 a.m. 12:00 p.m.
Dr. Alvin M. Weinberg, Director, Oak Ridge National Laboratory, Oak Ridge, Tennessee
2:30 p.m. 4:30 p.m.
Dr. Ivan L. Bennett, Jr., Deputy Director, Office of Science and Technology, The White House

FRIDA , MA 10
9:30 a.m. 12:00 p.m.
Dr. William T. Pecora, Director, Geological Survey
1:30 p.m. 3:30 p.m.
Dr. H. Bentley Glass, Vice President, State University of New ork at Stony Brook
3:45 p.m. 4:45 p.m.
Class Discussion

The scheduling included time for questions and comments by members of the class.

I remember that Mr. James Webb, Administrator of NASA, asked me, as the Thursday session was about to get under way, how long he would be expected to speak. I replied that this was up to him but that other speakers had limited their remarks to about one hour so that plenty of time would remain for discussion. Mr. Webb then commented on this with much vivacity by stating that "I have never given a talk of an hour's duration," adding that "it would be impossible to do so since I have to get back to my office to fire 10 percent of my staff or to arrange a five-day schedule with only four days of pay.[2] It emerged, however, that the Webb speech continued for some two hours with the audience fascinated by the speaker's delivery and knowledge of the subject.

I was asked to give the afternoon address on Monday, May 6. The address appears here under the title, "Science Policy."

Seminar on Science, Technology, and Foreign Affairs, Monday, May 6, 1968
General Introduction
"Science Policy"

I propose to turn our attention this afternoon to various questions pertinent to Science Policy. I shall introduce my remarks by quoting from an address by the distinguished British chemist, Lord Todd, who was speaking on the need for a science policy in the United Kingdom.

"A scientific policy is vital to us since, especially in a small country like ours with relatively few natural resources and an already over-

[2]Most of the agencies of the Federal Government were suffering budgetary reductions due to an alleged shortage of federal funds.

> large population, it is on the strength of our science and technology that our economic future depends: we live on the success we can achieve in selling our goods in the highly competitive arena of international trade. But it is not so easy to formulate in detail a scientific policy, and it is still less easy to operate it successfully in a parliamentary democracy, a majority of whose citizens know little or nothing of science and are thus unaware of the extent to which it impinges on every aspect of national life."

While Lord Todd implies that a science policy is necessary because the UK is small, it may equally well be argued for the reasons given by Lord Todd that a science policy is just as necessary for a large country such as ours.

What we really mean by a policy for science is by no means easy to explain, as Lord Todd points out. However, the expression "science policy" is to be found repeatedly in the torrent of words that flow from Washington, London, Paris, Bonn, and elsewhere. Every major capital in the developed countries world over is the center of a science policy industry which devotes itself to the constant redefinition of the responsibilities of government to science and of science to the affairs of government. Within the framework of the present we seldom think of science policy as being anything else.

This term, however, includes more than may first appear. It too often connotes only a policy limited to the needs of science per se, and excludes the effects of science and technology on the full spectrum of national policies in such disparate fields as agriculture and industry, defence, education, and domestic and foreign political affairs. Maximum exploitation of scientific opportunities requires programs that combine concern for the growth of science itself and provision for the rapid, deliberate application of its fruits to human welfare. That is the substance of science policy in the full sense, as denoting consideration of the interactions of science with policy in all fields. In this sense, a nation's science policy is the same kind of thing as its economic policy, or its foreign policy. The idea of an explicit national science policy is new because science has only recently taken on major public dimensions. To say that a government needs an articulated science policy is simply to note that there has devolved upon that government a major and continuing responsibility to make choices about issues that involve science.

The Organization for Economic Cooperation and Development has long been interested in science policy and is to be credited with this excellent definition of the term. The examination of the policies of government towards science has accomplished a great deal in impressing upon the more developed nations the importance of science in national affairs. Hence it may surprise one to note that several conflicting points of view prevail:

(i) Science policies are nonexistent.
(ii) Science policies are everywhere among the peoples of the world: they are universal.
(iii) The relationships between science and government are too complex, and policy questions concerning science must be resolved by ad hoc decisions.

(iv) Science policies are necessary and governments should lend themselves more assiduously to their formulation.

To simplify the presentation I propose to use the word science quite comprehensively. In the context of this address it will include the natural and physical sciences, the pure and the applied, basic research, applied research, and the transfer of any findings of practical import into their technological development and exploitation. Engineering as such, or technology, will only be singled out for specific mention when distinctions must be made. Nor will any serious attempt be made to distinguish between basic science and applied science. The interface between the two is so blurred and the transition from one to the other is so gradual that it would be futile, at least for our purposes, to insist upon a description of their qualitative differences. Also, I shall conceive of science policy as a formulation by government of the choices it must make on all major issues involving science as a conspicuous component. Indeed, this is the usual framework within which science policy discussions are cast.

The first question, not so naive as it may first seem to be, is whether government has any responsibilities at all towards science. In the Middle Ages the responsibility of the civil authority was basically dictated by the ecclesiastical authority which said, in effect, that science was bad. It was a new kind of learning that worked upon the minds of men by discovering truths that could not be reconciled with dogma. It fostered incredulity when intellectual and social stability allegedly required the unquestioning acceptance of authoritarian positions: the geocentric theory of the universe; the flat earth; the origin of life by spontaneous generation etc. etc. The responsibility of government was clearly negative and the suppression of science and of the inquiring mind was the fashion of the day.

Today it is axiomatic that science is good though its applications may be either good or bad; further that the economic strength of a country is directly related to the national investment in science for it is upon this foundation that its agricultural and industrial development must rest. It is easy indeed for scientists to think of science as somewhat of a sacred cow. The moneys allocated for its support are sacrosanct: they may be increased the faster the better but never diminished. This sacred cow belief numbers among its disciples not only our scientists and technologists but a significant proportion of the general population. Many high school students know ( ) that the quality of man's physical and biological environment varies directly with the quantity and quality of the world's science. Much of his human environment the very difficult problems of man's relationship to man, of the nature of thought, of learning, of motivation, of behaviour is allegedly so heavily penetrated by experimental science that, given the money and a few crash programs, all of the answers in all of their beauty and all of their glory will be revealed to us a very naive and widely held belief.

The great discoveries of the past few decades in science encourage us all to believe that the scientific harvests of the next few decades will be just as bountiful. This implicit faith of the layman in the potentialities of science places a heavy responsibility upon the scientist. In fact, he is usually thrown upon the defensive if he stresses to an audience of taxpayers the cultural val-

ues of science and the inner satisfaction that stems from discovering something new such as the presence of epsilon *N*-methyl lysine in histone, a new species of the lily family, or a new variety of the common toad. This faith in science and its relation to human welfare places a corresponding responsibility upon government for the science of which we speak the science of 1970 could not live up to the expectation of the people without the abundant support of government. That the man on the street expects the impossible the cure of cancer by 1975 and summer vacations on Mars by 1980 is almost irrelevant.

If then it be true that science has so much to contribute to human welfare we should invest heavily in science, but how heavily Currently the USA expends about 16 billion dollars annually on R D. This is about 80 dollars per capita or 2.5 percent of the gross national product. Two-thirds of the total is derived from the federal government and about one-third from industry. Is this expenditure too much, too little, or about right Of course, nobody knows; the question is unanswerable at the moment for it falls into the same class of imponderables as, for example, "what is the optimum population of the USA " Realistically, the 16 billion dollars seems to be as much as can be squeezed at present from Congress and industry. As for the 2.5 percent figure, I am sure you will agree that there is nothing magical or mystical about it even though the OECD and its member countries have chosen to accept 2.5 or 3 percent of a country's GNP as a good target figure on which they might focus their aspirations for science budgeting.

The first stage in the formulation of a national science policy is commonly held to be the attainment of a consensus among the decision makers that the country's expenditures on R D shall be not less than a stated percentage of the GNP, hopefully 2.5 or 3 percent. Characteristic of such a policy is the implicit belief that any country that expends this much of its GNP on science will be doing all that can reasonably be expected of it in bringing the fruits of science to bear upon the health and welfare of its people. There are at least three reasons why this quantitative approach is inadequate and unrealistic. First of all we have no knowledge whatsoever concerning the optimum: to the scientist 2.5 percent may be good but 5 percent would be better. Secondly, the budgeteers and the decision makers in government are in no position to order the allocation of intragovernmental contributions. The four billion dollars of in-house funds presently expended for science by American industry is quite a tidy sum and quite an appreciable proportion of the country's total R D. In some countries, the industrial expenditure for science is more significant than that of government and in such cases the argument gains added strength. Finally, there is a large and important segment of science policy that, mercifully, involves no funding though it is largely submerged by other segments that require heavy financial support.

This brings us to the necessity of priorities. It is obvious that we cannot spend at the same time billions on atomic energy, billions on defense, hundreds of millions on giant accelerators, billions on space and billions on solving the world food problem. The requests of the big spenders such as the DOD, AEC, NASA, NSF, and HEW, are typically inflated. The problem consists in defining priorities and in making the necessary commitments with the realization that, depending upon political and other pressures, some

projects will be treated generously with funds appropriated in excess of requests and others will be slashed in whole or in part. No matter what the spenders may hope to achieve, the sources of income are characterized neither by infinite elasticity nor by the expansive properties of a gas, and this imposes severe limits upon the extent to which income may be stretched or its volume expanded.

In some instances a project under consideration requires international cooperation for its implementation; for example, exploitation and development of the resources of the oceans such as minerals in the ocean floor and control of ocean fisheries and whaling. Sometimes the contemplated projects are clouded in obscurity; for example, requests by underdeveloped countries (the have-nots) for aid from the USA, the UK and other countries that are seemingly financially secure and desirous of helping the less fortunate members of the world community of nations. In February 1963 I participated as a USA delegate in a conference in Geneva, organized by the United Nations, and designed to cover all aspects of science and technology in relation to problems confronted by the less developed countries (the United Nations Conference on the Application of Science and Technology for the Benefit of the Lesser-Developed Areas), better known as the UNCAST Conference. I have described this *in e tenso* above. Political problems were to be excluded from the deliberations but they crept in nonetheless. This may serve to illustrate the fact that consideration of national or regional problems in science and technology cannot escape a penetration of politics and the role of government.

Apart from the biomedical sciences, government has become involved internationally in other policy questions generated by the advance and applications of the physical sciences. A long familiar one concerns the legislative approach to the high level explosion of nuclear devices and the fallout of radioactive fission products. On this we reached an international understanding and banning of such explosions, much more easily than some of us would have anticipated. What we shall do domestically and internationally about sonic booms is still before us as an unsolved problem in science policy.

Next, we must remind ourselves that expenditures for science and technology usually focus on the procurement of hardware and the salaries of staff. But this is only a part of the problem that confronts government. The support of science and technology through government grants for basic research or for mission-oriented projects spawns quite a number of sequelae. More and more scientists and engineers must be trained — recall that NASA, when estimating its manpower requirements some years ago, reported that 100,000 PhDs and highly-trained engineers would be needed to staff its programs. The demands of recent years call for the strengthening of our graduate schools, the expansion of our science and engineering faculties, and, inevitably, enlargement across the board of our total university facilities — buildings, equipment, and staff. The graduate divisions of our universities are fed by the undergraduate divisions, which in their turn must next be expanded to meet the demands of the graduate schools — and so it goes. If the manufacturers of PhDs and engineers are urged, in the national interest, to produce, for example, an extra 1,000 per year — let us say from 6,500 up to 7,500 in science, mathematics and engineering — it follows, as night follows day, that the

freshman classes in our institutions of higher education would have to be increased by about 50,000. This little calculation assumes, of course, that there would be no lowering of admission standards into the graduate schools, that attrition in one form or another (especially as MA and BA dropouts) could continue to take its heavy toll, and that instruction in science and mathematics could not wisely be increased in the graduate divisions without proportionate increases throughout the undergraduate curriculum. It is equally apparent that any program of this magnitude would have a formidable impact upon the university infrastructure: a massive salvage program would be needed to rescue the high school dropouts the many who perish before graduation.

Within the framework of science policy this example serves to remind us that the wave motions generated by a seemingly modest request for an increased output of PhDs (or the equivalent) in science, mathematics and engineering may reach the dimensions of a tidal wave by the time the Bureau of the Budget receives the full impact of the proposal.

In 1966 the total of federal obligations to universities and colleges was a little over three billion dollars, but the country's total expenditures on education at all levels, from the cradle to the graduate school, and from all sources, was reported to be 44.8 billion dollars. The extent to which society will be able to accept the increased expenditures on education that may face it as a result of the postulated tidal wave of the near future is a serious problem.

We talk of equality of opportunity. But in so doing we must recognize the essential inequality of people and their great genetic heterogeneity and variability. This can only mean that formal education must provide, within limits, individualized programs that will permit each to develop to the maximum of his potential his inherent competence.

Social changes and even political changes may be expected as the future opens before us. Man himself may change. We cannot assume that everything else, except man, is in a state of flux. In 500,000 years or so the size of the human brain, under powerful selective pressures, increased from 500 cc. to 1,500 cc.; no noticeable change in the last 100,000 years. Mental illness, schizophrenia and many other illnesses may have large genetic components. Half of our hospital beds are alleged to be taken up by schizophrenics.

A very noticeable change is to be found in the composition of our population; an increasing percentage of the living is to be found among the aged in which are many of the socially unproductive and the more dependent members of society. Hence our concern with the population crisis here and, most noticeably, in several underdeveloped countries such as India. Note that the conquest of infectious diseases and of infant mortality has given us the population explosion, world hunger, and localized foci of overcrowding. Government has long since taken a stand on suicide and euthanasia. It is against such practices, though I suspect that, as in the fairly recent past, euthanasia will again become acceptable because it is an obvious means of helping to maintain population at a reasonable level. And yet, in seeking answers to the overpopulation problem we also strengthen our efforts to clean up the environment and rid society of the enemies of our species, thereby clearing the way for more and more people. We wipe out the rats, the pathogenic bacteria, the virus diseases, agricultural pests, and poisons of all kinds indeed, the ene-

mies of our species, whatever they are and wherever they are to be found. These are very costly programs, but even so there is hardly a country whose plea for help in environmental improvement would be denied were it to seek our help in matters such as these. We have already taken a position against the use of poison gas and of resort to biological warfare. We might well ask whether government should condone in warfare the destruction of crops and vegetation through the use of defoliating agents.

I have not exhausted mention of the problems and projects that confront governments with ever increasing expenditures in science and technology of a magnitude that staggers the imagination. But figures of such a size are still arbitrary. Government is forced to establish its priorities and to do what it can on many fronts of potential expenditure. Any scientist concerned, for example, with the defense services of his country could show many ways in which they could be multiplied. In this kind of activity every view that counts is an expert's view and every expert is expert about something different. When we mention the multiplication of expenditures, we must also bear in mind the adage that is so much to the point in Big Science "if it works, it's obsolete."

In speaking of expenditures for defense, we should recall the advice of President Eisenhower, himself a general of note. In his valedictory address of 1960, Eisenhower is reported to have said that "3-1 2 million men and women are directly engaged in our defense establishment. We annually spend on military security more than the net income of all United States corporations. We must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The problems are too important to leave to the generals. Only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals so that security and liberty may prosper together."

To this sound advice, and from a general at that, one should add the words of Sir Solly Zuckerman: "the needs of defense are putting a stamp on the pattern of tomorrow's scientific knowledge and in the trends of today's technological developments."

Fortunately for all of us, an understanding of the social and political consequences of technological innovation does not require an understanding of the detailed scientific principles involved.

As I indicated at the beginning, science policy pertains in part to the choices that must be made by government on all issues involving science that come before it for decision making. Since science is fast becoming all-pervasive in the world of human affairs, science policy in its extension reaches into our lives just about as far as the government itself reaches with its deeply penetrating arms. Political policy, economic goals, and social objectives within government have all entered into matrimonial relationships with science. ou may insist that this is a little too much of a good thing, but if so, it is only a reflection of the fact that government reaches farther and farther into our daily lives, our pocketbooks and our personal activities a situation that will certainly become worse and worse as the population of the earth increases to unpleasant, if not unbearable, numbers.

I mention all of this to indicate how truly formidable is the task of collecting the bits and pieces and wrapping them all into a neat package entitled

"Our National Science Policy." Perhaps when the last word is said the most we can hope to achieve, if sketched broadly, is a pious declaration of intent.

Science Policy on a Local Level

I have rarely been interested in matters of public policy as conjured up by our representatives in the government. However, an issue came to my attention that focused sharply and directly upon those of us in Menlo Park whose residential property backed up against the San Francisquito creek. Such an issue arose in a public hearing that was held by the local planning commission, at which the public was invited to introduce their comments on the proposal of Stanford University to develop, for residential purposes, 42 acres on the university side of San Francisquito creek. I attended the public hearing and urged rejection of the university's application for development of the area in question.

Public Hearing, November 3, Palo Alto Planning Commission

While reading much of the Environmental Impact Report concerning Stanford West, I came upon page 331 headed "Any Adverse Environmental Effects Which Cannot be Avoided if the Proposed Plan is Implemented." I read this with considerable care and became convinced that implementation of the plan, as presently conceived, should not be permitted. One need hardly read more than page 331 to come to this conclusion.

I urge rejection and denial of the University's application with a great deal of regret, for I am well aware of the University's desire to satisfy the needs of students and staff for more housing. Beyond this commendable desire is the urgent need of the University to increase its revenues by wisdom, precedence, and regard for human values in exploitation of its principal resource land.

And now I ask your indulgence while I draw your attention to specific aspects of the proposed development. First of all, the creek. The University proposes a setback of 90 feet from the top of the bank. No grading or development would be done in this no-man's land between the creek and the peripheral housing. On turning to Appendix C, Figure 3 on page A-39, I notice that reference is made to a 2:1 slope from the ends of the creek bottom to the points of intersection with the natural ground above. Why "To indicate the maximum expected erosion potential." Think of what this means. In many sketches, the creek bank is vertical (p. 90). Erosion will certainly continue during seasons of heavy rainfall and greatly increased flow of water in the creek and depth of the stream. Erosion in some places may wear the bank down to the 2:1 slope that is predicated. When this happens, the top of the bank retreats some 30 feet or so as indicated on Figure 3.

This means much more than the washing away of earth. Within that 30-foot strip are many eucalyptus trees, some of them over 100 feet in height (p. 103) and some of the largest perilously close to the bank. Two huge and magnificent specimens are only 5 feet (base of trunk) from the top of the bank. These are a tremendous hazard for they will certainly fall when the creek decides that their time has come and they will fall into the creek or across the

90-foot setback. Hence, were the development allowed to proceed, the setback should be at least 130 feet from the top of the bank or 100 feet from the line where the 2:1 slope intersects the ground above.

With an estimated population of 3,700 for 1,275 living units there will be many children. The creek, especially when in flood, is like a magnet in its insidious power to draw children and others to the edge of the bank for a good look. This danger has not escaped the attention of the planning consultants who propose to "eliminate existing pathways down the creek banks and by maintaining the growth of poison oak" (page 4). On p. 107 we read that the continued growth of poison oak is to be encouraged to protect the creek banks from degradation due to excessive use by children. The poison oak would discourage access to the creek bottom. Is there an alternative es. Construction of wire fencing 30 feet back from the edge of the creek. This is a much more humane, though less beautiful, deterrent than poison oak.

Will the University be content with 1,275 living units on its 46 acres I doubt it. There is an alternative plan presented (pp. 335 338) which would permit 1,640 living units and an increase in the population burden from 3,700 to 4,700. This could be achieved, we learn, by erecting five-story buildings along the creek instead of the lower structures proposed in plan A or B. What a horrifying prospect I refer to Alternative 1, pp. 335 and 336. To obtain affordable housing a stated objective of the development I suspect that the temptation to maximize the number of living units will be almost irresistible.

I have nothing to say about the traffic problems engendered by the plan and the place of automobiles in the scheme of things. However, I cannot escape the conclusion that the consultants have greatly underestimated the magnitude of this problem and the increase in traffic that will create terrible traffic jams at peak hours.

As for the quality of life within Stanford West, it is hard to believe that the development will achieve anything to enrich the lives of the inhabitants. The whole plan is ill-conceived, and so saturated with many adverse and faulty concepts that I strongly and respectfully urge the Palo Alto City Council to withhold approval of the proposed project. I regret to so recommend but I have been a close neighbor of the creek for over 40 years and I am fully aware of its eccentric and malicious behavior and also deeply concerned about the impact of the proposed project on those who live within its boundaries. Those of us who live on the other side of the creek would have our privacy and our peace and quiet invaded by monstrous and unsightly buildings across the creek and the noise and turmoil engendered by 3,700 to 4,700 people.

. POSTLUDE

RETIREMENTS

In 1964 I retired from the diplomatic service in which I had served as a science attaché from 1962 to 1964. The officers and staff of the embassy served as hosts for a very enjoyable luncheon served in one of the restaurants in Bern.

In 1964 I also retired from Stanford University and became designated as professor emeritus. At a meeting in New ork in the fall of that year, my research students and several others gave me a sort of farewell party at which I was presented with an album containing letters and amusing illustrations from my students. They also gave me a beautiful and very comfortable reclining chair in which I have reclined almost daily since its reception. The department of chemistry, as was then their custom, arranged for an informal but very pleasant luncheon which was served in the chemistry building.

In 1967 or 1968 I retired as Editor-in-Chief of Annual Reviews Inc. In recognition of that occasion, the editors of the various Reviews gave me a volume of letters to witness their pleasure that a new Editor-in-Chief would be taking over. The Board of Directors recognized the event by generously having my portrait painted and mounted in 1971 in the conference room of Annual Reviews (artist M. A. Walburn, 1971).

The directors of Annual Reviews and Eugene Garfield of the Institute for Scientific Information (ISI) agreed to fund jointly an award for competence in reviewing the award in turn to be administered by the National Academy of Sciences. An article, descriptive of the award, appeared in Number 18, *Current Comments,* May 3, 1982, and was written by Eugene Garfield, Director of the Institute for Scientific Information. The text of the article follows.

> Luck Award
>
> On April 26, 1982, the National Academy of Sciences (NAS) presented the 1982 James Murray Luck Award for Excellence in Scientific Reviewing to Victor McKusick, William Osler professor and director of the department of medicine at Johns Hopkins University School of Medicine, and physician-in-chief at Johns Hopkins Hospital.
>
> The award is named for the founder of Annual Reviews Inc., James Murray Luck, who served as that organization's editor-in-chief until his retirement in 1969. Luck remains on the editorial committee of the *Annual Review of Biochemistry,* which he started in 1932. He was also present at the awards ceremony.
>
> Jointly sponsored by ISI and Annual Reviews, the award carries a 5,000 honorarium, and is administered by the NAS to honor outstanding

authors of scientific reviews. To my knowledge, its inception in 1979 made it the first award of its kind.

The importance of well-written review articles is recognized but needs constant reiteration. I have pointed out in the past that many review articles become milestone papers in their fields. I have even proposed that review writing be considered a profession unto itself. But until recently, reviewers rarely received formal recognition for their contributions to science. The cosponsorship of the NAS award by ISI and Annual Reviews is intended to encourage more scientists, especially younger ones, to write more and better reviews.

The field of the James Murray Luck Award rotates annually. The first award recognized an outstanding reviewer from the life sciences. G. Alan Robison, University of Texas at Houston, was honored for his series of reviews on cyclic AMP. In 1980, a reviewer from the physical sciences, Conyers Herring, Stanford University, received the award for his reviews in solid-state physics, now known as condensed matter physics. The third award recognized a reviewer in the social sciences, John S. Chipman, University of Minnesota, for his surveys of international trade theory and other aspects of economics.

This year the award was again given to a reviewer in the life sciences. McKusick was cited by the Academy for the "preparation of rigorous and comprehensive reviews which have stimulated and guided the entire field of human genetic research in both its basic and clinical aspects."

In 1981, William Kaufmann (Bill), after serving eight years as Editor-in-Chief of Annual Reviews Inc., decided that the time had come for his retirement. The reasons for his contemplated retirement need not be discussed here. I do want to mention, however, that a luncheon by the staff of Annual Reviews was given in his honor to recognize the splendid service he had given to the company. I have taken the liberty to include a copy of the remarks that I made on that occasion.

Re Bill Kaufmann's Retirement from Annual Reviews in 1981
Luncheon Remarks by JML

Dear Bill,

There are many who would like to bid you a fond farewell and to express their gratitude for all you have done for Annual Reviews. A few are here today but many others are separated by miles and miles, or they are never hungry on a Thursday.

I had the pleasure of meeting you years ago when you were running the Freeman Company. Personally, I have benefitted on many occasions from your advice, your constant friendship, and your help in many matters in part involving the launching of SPOSS. To Annual Reviews you have been a real asset, enriched by your warm and friendly personality, your many contacts in the world of publishing, and the good relations you have maintained with editors, prospective editors and all who are here today.

To some, your departure from Annual Reviews will be interpreted as a retirement, motivated by other demands upon your time or your age. The fact is you are quite a young fellow a term I use deliberately because a Swiss friend writing to me always uses the salutation, "Dear old fellow Murray." Of course, Bill, you are getting older who isn't The aggregate age of the group around this table increases by 30 years every 365 days. But don't seek comfort in the old adage "with age comes wisdom." It is anything but true. Of course, you get to know the answers but nobody asks you the questions. I'll tell you what comes with age: loss of memory, loss of your teeth, drooping armpits, and pains in your joints. Loss of memory: our friends will find you telling the same joke half a dozen times in half a dozen days to the same person. Pains in your joints: Keep away from all such joints. Retirement is the answer to all of these troubles. ou and I have retired many times from something or other. Every time you retire from something you gain a little more of that precious thing called freedom and with it an opportunity to embark upon something else equally foolish or equally pleasant. I must tell you of an incident indicative of a fate that may befall you as age begins to strike. A few days ago I was in the post office on Cambridge adjacent to the California Avenue Co-op's parking lot. A young woman from the Co-op whom I had never before seen outside the store entered when I was about to leave. "Helen," I said, "what in the world are you doing here " "Oh, I just came over to pick up the old mail." "Well," I said, "here I am, ready and waiting." But I was rebuffed. oung fellow Bill, you would have been seized at once and carried off to who knows where.

And so, Bill, may I propose to you a toast: "Many more years of happiness and good health and may your shadow never grow less." ou will be deeply missed and never forgotten.

[Note added November 1990: Annual Reviews Inc. was very fortunate in persuading Bill to return to his former post. This he did in August 1983 to the unstinted pleasure of all concerned. His competence in discharging the various responsibilities that are his has certainly been noteworthy.]

BIRTHDA S AND NATURAL DISASTERS

On October 17, 1989, at 5:04 p.m., the San Andreas fault in the vicinity of Watsonville to Oakland experienced a tremor of considerable magnitude (7.1 on the Richter scale), some 83 years after the very destructive earthquake of 1906. The effects of the 1989 quake were focused on approximately the same areas as the 1906 tremor. The buildings of Stanford University, which suffered greatly in 1906, received less disastrous effects in 1989 although at an estimated cost to the University of 200 million dollars for the necessary repairs.

Three days later, as the 90th anniversary of my birth was almost at hand, I was honored by a very festive gathering in the Stanford Faculty Club (undamaged by the severe tremor three days earlier), followed on October 21 by a symposium on "Communication in Science" (speakers: Dr. Donald A. B.

Lindberg, Dr. Donald Kennedy, Dr. Daniel E. Koshland, Jr., Mr. Robert Maxwell,[1] and Dr. Richard Zare). The hosts for these festivities were the Departments of Chemistry and Chemical Engineering at Stanford (represented by the Industrial Affiliates Organization), and Annual Reviews Inc. Guests of the festivities included the entire staff of Annual Reviews Inc. and the eight local members of the Luck family. I do not know how many invitations were extended, but approximately 150 participated in the banquet on October 20. On that occasion I was presented with an album containing many letters and cards which had been received by the sponsors in response to an appropriate request in the letters of invitation (signed by William Kaufmann). John S. McNeil and William Kaufmann masterminded the Friday evening program which included a few remarks by my son and daughter and by Winslow Briggs (representing the Annual Reviews Inc. Board of Directors). My grandson, Edward Nicholas Luck, six years of age, participated unexpectedly. After I had spoken for about two minutes, he came to the podium and whispered to me "Dyeda, make it short " This sage advice was picked up by the microphone which was nearby; the entire audience heard it all and laughed heartily.

As these reminiscences come to a close (today is 22 October 1991) I must draw attention to a devastating fire that swept through the hills above Oakland possibly the greatest catastrophe in the history of California unless it be the terrible earthquake of 1906 that almost destroyed San Francisco and did untold damage along the San Andreas fault The fire, still burning, commenced on Saturday, October 19. At this moment, it appears to be contained, having burned several thousand houses and a number of apartment buildings. It was a choice residential area, which, with ravines and steep hillsides covered approximately 1,600 acres. At least 25 lives were lost and hundreds of people, having lost their homes, sought refuge in a number of emergency quarters provided by schools and other public buildings. The property loss is estimated at 1.5 billion as a minimum and several billion more if all losses and costs incurred by the city and county be included.

CONCLUSIONS AND AFTERTHOUGHTS

I believe it to be true, and hence irrefutable, that everything that has a beginning must have an ending. These reminiscences began many pages and many years ago. Because it is now October 23, 1991, and I am this day 92 years old, the time has come to declare the reminiscences at an end. If something of moment happens in the future and I am still "hanging in there," I hope I shall be permitted to add another page or two.

[1]Mr. Maxwell failed to show ( )

Something of moment did indeed happen. I refer to a post-Thanksgiving series of traffic accidents, November 28 and 29, 1991, on Interstate Highway 5 near Coalinga, California. Approximately 200 automobiles, including trucks, vans, and miscellaneous motor vehicles, suddenly faced by a stiff wind and clouds of dust or earth that reduced visibility almost to zero, crashed into each other. The line of wrecked vehicles was reported to be three miles long. Approximately 20 to 25 people were killed and many others were hospitalized in what was described as the worst traffic accident in the history of the USA. Most of the people involved were returning from Thanksgiving Day festivities.

In February 1989, a family photograph was taken. We decided to do it again, this time on November 17, 1991. An enlargement of the best of the group pictures (8″ × 12″) was prepared for each of the adult participants: Edward Eugene Luck (our son), Nadya O'Connell (our daughter), Lorraine Calta, and ourselves. Included in the group were our grandchildren, Edward Nicholas Luck (8 years old) and Natalie Calta (7 years old). Many more pictures (4″ × 6″) 23 in all were taken.

In January I wrote a long letter to my grandson, Edward Nicholas. Call it "Rules of Conduct."[2] I hope he will read and appreciate it the sort of advice that any grandfather would like to pass on to a grandson whom he loves.

With Eda as the driver, we have taken our grandson from time to time to the California Academy of Sciences in San Francisco and once or twice to a few other places, including the Rosicrucian Museum in San Jose. We "horse around" often and play chess once in a while. We bought a lovely puppy (Black Labrador) for him which he named Lassie Elizabeth (one year old, April 1, 1992). The puppy lives here (101 San Mateo Drive) because the property is large with plenty of free space. Edward comes frequently to play with her; and the two of them chase each other around, to the obvious pleasure of both.

At the age of 17 an event of world-wide importance made an indelible imprint on my memory which, it seems, can never be forgotten. I refer to the Russian revolution whereby in March or April, 1917, the Tsarist government

[2]In doing this I was probably influenced by the remarkable "Rules of Civility and Decent Behaviour in Company and Conversation" by George Washington, who, when fourteen or fifteen years of age, wrote them out 110 in number in his boyish handwriting. It is the earliest and possibly the most interesting of Washington's manuscript books. The date, written in by Washington himself, is 1745. The original author of the Rules is a subject of controversy. It is a book within a book, namely in one that appeared under the title "Forms of Writing," the Rules being in a separate section "Rules…Conversation." The book had been gnawed at the bottom by Mount Vernon mice before it reached the State Archives. Nine of the 110 Rules suffered somewhat but the subsequent conduct of the mice was probably not improved. The edition of the Rules that I read appears under the authorship of Moncure Daniel Conway and was published in 1890 by Chatto and Windus (Picadilly, London, Ballantyne Press, 180 pp.).

was violently overthrown and replaced by a Communist dictatorship that seized the power of government on November 7, 1917. Lenin, recognized as the principal leader of the movement, resided in Switzerland for quite some time before leaving for Russia, with thirty radical Russian immigrants, in a sealed train in early April 1917.

The violence exercised by the Communists, as they endeavored to entrench themselves in power is almost incredible. The Royal Family (Tsar Nicholas, the Tsarina, the two daughters, and the young Tsarevich) was seized and finally taken to Ekaterinburg ( ) where they were executed by a firing squad. Within Russia, ordinary people were treated with terrible brutality. In 1926, at Stanford University, I enjoyed the services of Ivan Gregorovich Eudin as a research assistant. He escaped from Russia shortly after his parents were tortured in his presence and finally shot. Ivan's wife, a real scholar, with unusual competence in the English language, received employment as a translator of Russian documents in the Hoover Institution. They met each other in England to which she had escaped and soon thereafter made their way to California.

But now, as we move on some 70 or 75 years, into the early 1990s, we find that most of the Communist governments in Europe and western Asia are rapidly disintegrating. It was late in 1987 when a solidarity movement in Poland, initiated by a general strike in Gdynia, ignited the fuse that led to the overthrow of Communist governments. A series of events in the two or three years after the beginnings led conclusively to the end of the Communist dictatorship in Poland. Within another ten years the Communist governments in Europe and western Asia, with few exceptions, were replaced by governments that were struggling towards democracy. Many of us who have lived through the years of Communist power can hardly believe that the past is dead. Liberty is restored and the basic privileges and responsibilities of a free people are rising to the surface.

All of this, the rise and the fall of Communist governments, has not directly involved the author of these reminiscences but anything so global in its impact has an inexplicable but subtle effect on every thoughtful person. In my own case, I suspect it has heightened my hatred of violence in human relations.

And so, we now come to the end of these reminiscences, or almost so. I cannot conclude without expressing my gratitude to the many whose friendship has enriched my life during these long years. The list is incomplete for I am here omitting, or am I , those who have been mentioned in preceding pages. The following names are in random order:

William Reich (Bill) and Ted Rudow. Bill is a long-time friend who shares with me a common interest in the overpopulation problem. Along with him and Ted Rudow, I was enabled to meet in San Francisco a wealthy Swiss American who in 1985 donated some thousands of dollars to SPOSS to cover much of the manufacturing cost of my *History of Switzerland.*

To continue: Al Meister, Winslow Briggs, Mark Rosenzweig, Sidney Raffel, Donald Svedeman, Rick Peterson, Mary Glass, Jo Ann ueen, Ruth Severance, Esmond Snell, Paul Boyer, Jim Howell, Josh Lederberg, and Eugene Garfield, all of whom are or were associated with Annual Reviews, Inc.

Others with whom I have enjoyed many years of friendship are Walter Lohnes, Peter Stansky, Lukas Burckhardt, Maurice Jaccard, Ernst L scher, Ken Murray, Linus Pauling, Eugene Farber, Garrett Hardin, Herb Tabor, Harry Mosher, Jim Coleman, and George Pfeiffer III.

Finally I add the names of a small group of family friends, Eugene and Veronika Agee, Arthur Geise, Lotty Aebi, Mary and Ronald Hilton, Marguerite Saegesser, Susan Schroeder, André Harj, Carol and Donald Kupke, Alphonse Frey, Joe and Marianne von Ah, Marina and Michel Boudart, Paul and Lyda Boyer, René Bryssinck, Ruth and Roy Cohn, Jean and Donald Koskinen, Hans Ubrich Winzenried, France and Hans Martin Winzenried, Ann and Stuart Svedeman, Gail and Bob Drewes, "Freddie" and Bob Elliott, Kay and Denis Brown, Adele and Woody Frey, Shirley and Tony Felsovanyi, Marcus Krupp, Ann and Michael Polom, Dorothy and David Glick, Madeline and Charles Gambony, Mignon and Henry Kellerman, Mary and Douglas Leihy, Judith and Peter Mueller, Francis and Bill Reich, Kathy and Kurt Steiner, Suzanne Schoch, Michaela and Vinzenz von Tscharner, Vera and Nicholas Wade, Sophie and Harden McConnell, Mary and Henry Taube, Pat and Jim Collman, Bill Bonner, Lillian and Eric Hutchinson, Pat and Dick Eastman, Johan and Doug Skoog, Barbara and Bill Johnson. I apologize to others whose names cannot be recalled by my aging brain.

What does a writer of reminiscences remember For many of us, whose intellectual stature is quite ordinary, our memory cells are packed with trivia except for happenings of global (or national) importance in which we were caught up as active participants or as outside onlookers. Throughout the many years in which I have been blessed with survival, I have been engaged in much that is trivial but have been very much of an onlooker on current events of world-wide or great national interest.

I have tried to exclude from these reminiscences wars and violent revolutions that seem to be always with us somewhere or other. I have already mentioned (pages 217 ff) a few happenings: disasters, unfortunately, but also the great counter-revolutions of the late 1900s that ended the communist governments and restored the elements of democratic rule.

August and early September 1992 shall long be remembered in theUSA because of catastrophes that must be regarded as among thegreatest in our national history: forest fires that ravaged the timberlands of Calaveras and Shasta counties in California; the terrible hurricane (Andrew) of August 24 25 in which tempestuous winds and great landward surges of the ocean did damage

in the many billions of dollars to southern Florida and Louisiana; the Hawaiian Islands,especially Kauai, were struck by a second hurricane (Iniki) in early-September, the resulting damage far exceeding anything experienced in the past. Of course, lives were lost in both hurricanes but the total was quite small relative to the magnitude of the storms.

The 23rd day of October, 1992, is fast approaching. I shall celebrate ( ) the 93rd anniversary of my birth. It is a good time to declare that these reminiscences hath ended. If the well-known gentleman with a scythe will postpone his dreaded visit to my bedside somewhat longer the happenings of the near future may call for another paragraph or two. Otherwise, this is at last The End.

AFTERWORDS

J. Murray Luck, Ph.D. (Cam)

Born:	October 23, 1899	Paris, Ontario
Died:	August 26, 1993	Menlo Park, California

Survived by:

Wife:	Eroeda S. Luck
Son:	Edward E. Luck
Daughter:	Nadya L. O'Connell
Grandchildren:	Edward Nicholas Luck Natalie Jane Calta Gregory Preyss
Niece:	Merle Howes

Many friends and colleagues all over the world.

A Memorial Service for J. Murray Luck

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Order of Service

Organ Prelude		Christian Elliott
Invocation		Don MacInnes
Prayer		
Solo:	'O Worship the King'	Margie Lawrence
Readings from Scripture		Don MacInnes
Solo	'Rock Of Ages'	Margie Lawrence
A Time of Remembrance		Don MacInnes William Kaufmann John McNeil Harry Mosher
Solo:	'Old Man River'	Doug Lawrence
Closing Comments and Prayer		Don MacInnes
Benediction		

Eighth Day of September
Nineteen Hundred Ninety-Three
Two P.M.

Participating in Service :

Christian Elliott, Senior Organist,
Menlo Park Presbyterian Church

Rev. Donald MacInnes, Associate Pastor,
Menlo Park Presbyterian Church

Margie Lawrence, Associate Minister of Music and Worship,
Menlo Park Presbyterian Church

Dr. William Kaufmann, Editor-in-Chief, "Annual Reviews"

John McNeil, Publisher and Secretary-Treasurer, "Annual Reviews"

Dr. Harry Mosher, Professor Emeritus of Organic Chemistry,
Stanford University

Doug Lawrence, Minister of Music and Worship,
Menlo Park Presbyterian Church

Menlo Park Presbyterian Church
950 Santa Cruz Avenue, Menlo Park, California
September 8, 1993

Memorial Service

DON MacINNES: We are here this afternoon as family, as friends, as neighbors, as colleagues. We come to pay tribute and to express our appreciation for the life of James Murray Luck. I'm Reverend Don MacInnes, one of the associate pastors here at the Menlo Park Church. On the platform with me are Doug and Margie Lawrence, our ministers of music, and you'll be hearing from them later. At the console is Christian Elliott, our senior organist. Speaking in the service are Drs. William Kaufmann and Harry Mosher, and we'll hear from them in a moment.

INVOCATION PRA ER: The Eternal God is our refuge and underneath are the everlasting arms. Let not your hearts be troubled; neither let them be afraid. Let us pray: O God, how great Thou art, the Lord of hope, the conqueror over death, the hope of the faithful, our help in every time of trouble, today we lift our thoughts, our minds, our hearts, our voices in adoration and praise. Help us now to wait upon Thee with reverent and believing hearts and in these moments speak to us of eternal things, that through our understanding and the comfort of Scriptures, the spoken word, the music, the peace of Christ's presence may be ours, we may be lifted up into his light through Jesus Christ our Lord, we pray. Amen.

Each one of us, without exception, appreciated Murray Luck in an unique way. This brilliant and extraordinary man has been a memorable part of each of our lives in so many rich and positive ways. It will come as no surprise to you that Murray planned with some precision the service we are experiencing this afternoon. With careful thought, with important revisions, he crafted this time together. With wit and charm, he has brought us together in remembrance of a most remarkable life. A traditional hymn of the church speaks of Murray's understanding of Almighty God, "our maker, defender, redeemer, and King. Let your hearts be lifted as we worship the King.

MUSIC: "O Worship the King" solo by Margie Lawrence

Across the centuries, God has affirmed his love and his care for us, significantly through the witness and testimony of Christian Scriptures. Listen to God, speaking to us now in these words. First from the Old Testament, the very familiar cadences of the Twenty-Third Psalm:

SCRIPTURE readings by Don MacInnes

Then, a specific request of Murray's, selections from the fourteenth chapter of St. John's account of the gospel. Just after our Lord had said, "A new command I give you, love one another; as I have loved you, you must love one another," he spoke these words of assurance and comfort:

SCRIPTURE

It is the same Lord Christ who has been, is now, and forever shall be the very rock upon which we stand, in fact, the Rock of Ages.

MUSIC: "Rock of Ages" solo by Margie Lawrence

I think you will agree with me, if ever there was a twentieth-century Renaissance man, J. Murray Luck was that man. From October 23, 1989, to August 26, 1993 a span of ninety-four years this giant among us was at the task of exploration, of discovery, of research, of teaching, of encouraging, of launching, of serving, of advancing, of writing, of publishing, of improving. all in the advancement of human knowledge and the improvement of human existence. A true humanitarian. Murray Luck saw his scholarly and his practical endeavors as a contribution to the common weal, to the enhancement of human life and to the building up of human society. Always, he was teaching, teaching. Even now, his mortal remains will be teaching through Stanford medical research.

Murray arranged that three men, distinguished in their own fields and cherished colleagues, should share from their own minds and their own hearts this afternoon. Professor Harry Mosher will begin the tributes. Dr. William Kaufmann will speak for Mr. John McNeil and for himself. Following these presentations, Murray's family very much want to hear from you, you who knew, loved, respected Murray Luck across the decades. With a portable microphone, which I will have, you will be able to share what is in your heart. Then with music and with prayer we will bring this memorial time to a close. Dr. Mosher.

HARR MOSHER: First of all, I am honored to have been asked by Murray to make this presentation. We are all gathered here to celebrate the life of and our friendship with J. Murray Luck and to reflect upon his life. We also honor him by our presence here. Each of us has his or her own memories of Murray and his family, and I will share a few of mine, coming from our association together in the Stanford chemistry faculty.

It has always been easy to remember Murray's age. He was born in the last year of the last century. He grew up in Ontario, Canada. His father was a blacksmith and in some way Murray earned his way into the University of Toronto, where he received his first training in university. At Toronto he received the prestigious 1851 Exhibition scholarship to attend Cambridge University in England, which he did from 1922 to 1926. He was a biochemistry research scholar in the laboratories of Sir Gowland Hopkins and J. B. S. Haldane, the famous professor of physiology as well as a philosopher. From Cambridge, Murray went back to Toronto for a short while, and then came to the Chemistry Department at Stanford University in 1926. So Murray was at Stanford for twenty

years before my generation of chemistry faculty arrived on the scene in 1946 or '47, after World War II. We are all here today each of us has many similar recollections of Murray as a good friend over the subsequent forty-six years, of Murray working in the basement laboratories, working in his office, and stopping and having short conversations with us.

Murray was the oldest emeritus professor in chemistry, and I understand he may have been the second oldest emeritus professor in Stanford University. He was a very kind, considerate, and thoughtful colleague. His comments were always carefully considered, persuasive, and respected. And he was always the perfect gentleman. In our conversations together, I learned that, as a boy growing up in his small town of Paris, Ontario, he regularly attended the Methodist Church. Then, while at Cambridge, he was greatly influenced by the philosophy of the Society of Friends, the uakers, especially impressed by their cooperative organization and their non-violent anti-war beliefs. This facet of Murray's character certainly shines through in his lifelong accomplishments. Murray played a key role in the establishment of the co-op movement in Palo Alto, which resulted in the group of co-operative grocery stores which we all call the Co-ops, and he was an organizer of the Peninsula Housing Association, which was conceived as a cooperative venture for the development of Ladera. After he got it started, it was taken over by a commercial real estate developer. Murray was always proud that no one lost any money in this whole operation. He was also one of the founding group which was responsible for the very successful Stanford Credit Union. And so, you see, Murray's activities were much wider than the teacher and research professor whom we knew at the University.

In 1935 he wrote his book, *The War on Malnutrition and Poverty*. It was probably this book which led to the lectures which he gave on the world population problem that turned out to be so very controversial. Murray was a 50-year member of the American Chemical Society; he and Eda regularly attended the monthly meetings of the local section. His involvement in many national and international conferences, symposia, scientific societies and especially his founding and sustaining contribution to the *Annual Review of Biochemistry* led to his international reputation that was certainly responsible for his major occupation after retiring from teaching.

In 1962 he was appointed by the State Department to be the Scientific Attaché to the US Embassy in Bern, Switzerland. He moved to Bern with his family, where they lived for two years. He revisited Switzerland for a month or so every summer for many years. This assignment and his follow-up studies led to three major books. The first was *Science in Switzerland*, published in 1967; the second was *Modern Switzerland*, which was an edited volume published in 1978; and, finally, *The History of Switzerland*, published in 1985, which is the definitive English-language book on this subject.

I am expressing my personal gratitude as well as that of many others when I thank Eda Luck as well as Murray for being included over the years in their family of friends who were annually invited to help them celebrate Russian Orthodox Easter. Eda's support of Murray is a model of a devoted wife and mother dedicated to her family, and we all love her for it.

Murray was beloved by his colleagues and is remembered by all of us with deep respect. He was a person with a life fulfilled. He has gained this world's immortality by his many good works, and he has gained that of the worldwide scientific community for founding the *Annual Reviews* series.

We once talked of this very event that's going on right now and which we know will come to each of us one day. Murray said to me, "Say what you wish, I will be otherwise occupied." Murray has now earned this peace that he has well deserved with his fulfilled life.

Thank you.

DON MacINNES: Thank you very much, Dr. Mosher. Dr. Kaufmann, from *Annual Reviews.*

WILLIAM KAUFMANN: ou'll have to imagine me, first, as John McNeil. Although he would have loved to be here, he couldn't because of a prior commitment, on other important *Annual Reviews* business. So let me briefly introduce John, borrowing the words of Murray Luck, who speaks of John in his book, *Reminiscences*, in more than one place. Murray writes, "I must mention, first of all, John McNeil, who has been with the company since February 1962, when he was appointed Business Assistant to the Managing Editor. In mid-1968 John left us for a period of service in the administrative offices of the University of Hawaii Medical School, stolen away by a former colleague who was the editor of the *Annual Review of Medicine and Pharmacology*. John returned to *Annual Reviews* in October 1972 as Business Manager, later promoted to Publisher and Secretary-Treasurer. He and I worked closely together from his initial appointment in 1962 until my retirement in 1967." Murray concludes, "I doubt that the company could have found anyone else who would have served *Annual Reviews* as loyally and competently as John McNeil."

Now, with that introduction I want to read the letter that John wrote. The letter is addressed to Murray, but John's prefatory remark is, "Many of us knew James Murray Luck as Dr. Luck, Murray, Professor Luck, etcetera. For the last twenty years, I knew him by the name of "Jake," and so it is to Jake that I address this letter.

JOHN MCNEIL: Dear Jake: Do you remember our first meeting in 1954 It was at the Co-op Market early one Saturday morning. As you drove your Buick into the parking lot, the word quickly spread throughout the store that

Dr. Luck might be coming into the store. The no-nonsense reputation you achieved during the Co-op's formative years remained legendary. We watched you park your car and walk into the store. To my surprise, you headed directly to checkstand 1, where I just happened to be stationed that morning.

As you approached, a number of thoughts raced through my mind, and the one that bothered me the most was that Eda had probably mentioned to you that I frequently set aside items she intended to purchase. The first time I did so, she looked at me as if I'd lost my mind. When I quietly explained that the items were going to be featured as loss leaders the following week at a fraction of the normal price, a smile replaced her frown. It was this behavior of mine that caused you to visit the market that Saturday morning and to thank me for taking an interest in your family's economic well-being. When you left the store, many of the clerks rushed to my checkstand to find out the reason for your visit, I informed them that it was to thank me for something I had done for the family.

Seven years passed before I had any further encounters with you. In December 1961, you interviewed me for a management-training position at *Annual Reviews*. The interview commenced promptly at 9:00 a.m. on a Saturday morning. ou attempted to put me at ease by explaining a bit about *Annual Reviews, Inc.*, and I guess the blank look I had on my face at various times during the explanation caused you to question whether or not I knew what you were talking about. ou will have to admit that your references to nucleic acids, protein chemistry, the Academy of Sciences in Moscow, Maruzin in Japan, Martinus-Nijhoff in Amsterdam, the National Science Foundation, Nobel laureates, etc., were a wee bit beyond that which I had experienced up to that time in my life. What a relief when you brought out that tin of home-made chocolate chip cookies (I believe made with walnuts) that Eda makes and they're legendary, all of those cookies.

ou stopped talking about all of those topics about which I had little or no knowledge, and we began an enjoyable discussion about food and the grocery business. As the interview approached noon, you asked me what I had learned at San Jose State that would be of greatest benefit to a prospective employer. I had just completed an Industrial Management course, and I informed you that I had learned that a good manager could pay his or her own salary and benefits by implementing operational and procedural changes that would achieve significant cost savings. The smile on your face indicated to me that I had said the right words, and my knees stopped knocking together. Before we concluded the interview, you told me that *Annual Reviews* was prepared to offer me the job of management-trainee on a trial basis if I were interested and to advise you within two days if I intended to accept the offer. Despite my not having understood half of what you said about 'this and that' during the interview, I decided to accept.

I was somewhat intimidated by you during the initial period of employment. Do you remember the time you sent me off to Washington, DC, to renegotiate a contract with the National Science Foundation to permit the continued translation of Russian entomological articles into English I had only been in the employ of *Annual Reviews* for a couple of months when you suggested I handle the negotiations. ou did, however, assist with the travel plans and suggested that the red-eye night flights were most suitable because I wouldn't have to spend as much time away from the office and there were cost savings over daytime flights. ou also suggested that it was only a short, refreshing walk from the downtown airport bus terminal to the Roger Smith Hotel. ou failed to mention that Washington, DC, isn't the most refreshing place to walk when weather conditions are hot and humid. The clerk at the Roger Smith Hotel, after looking at my bedraggled condition, allowed me to use a shower in a room that was being cleaned, as my room would not be ready for a couple of hours.

After a refreshing shower and a change into fresh, dry clothes, I set off on my walk to the National Science Foundation and the luncheon meeting with Rita Lupina, the contracting officer. I remembered your warning about the expense of using taxis and, despite Ms. Lupina's urging that we take a taxi to the restaurant, I explained to her that I had been flying all night and needed to work out a few kinks in my body, so preferred to walk, if she didn't mind. We walked to the restaurant and back to the National Science Foundation. Rita thanked me for the light lunch and the refreshing walk and told me that, based on our brief meeting, she was going to recommend the contract be renewed, as she was convinced that the other interested vendors would not be able to handle the project as economically as *Annual Reviews*.

The next morning Rita informed me that *Annual Reviews* would indeed be awarded the contract, and I prepared to return to California. When I got back to *Annual Reviews* and reported to you the outcome of my visit, you didn't even get mad when I told you I had spent 1.75 for a taxi from the hotel to the downtown bus terminal. I guess the Washington trip was a test, as after that you expanded my list of challenges and suggested that I find a way to increase international sales, reduce accounts receivable, accelerate delivery of foreign shipments, reduce printing and binding costs, and so on. ou continued to challenge me throughout our 31-year working relationship.

My only regret is the one challenge that was not fulfilled, which was the one to go roller-blading together in Golden Gate Park this summer, after you got feeling a bit better. Since that challenge was only made in June, I'll forgive you.

Knowing you has, as I've told you many times over the years, been one of the most rewarding experiences of my life. I'll miss your wise counsel and friendship. Love, Jack.

WILLIAM KAUFMAN: Now, with thanks to John for his heart warming words, I will now speak for myself.

To Eda and all of the Luck family, I bring greetings, condolences, and good wishes from the extended *Annual Reviews* family and the publishing community worldwide, especially the local publishing community of which Murray was such an active and esteemed member in his last twenty years. We must all mourn our own personal loss, as Reverend MacInnes noted earlier, but today we are here to celebrate and pay tribute to a great life.

I am acutely conscious of the honor Murray bestowed on me in asking that I be one of the speakers on this occasion. I can think of any number of distinguished scientists, administrators, scholars, publishers, writers, business people, relatives, family members and others to whom this high honor should have gone. But I can also say it could not have been given to anyone who would treasure and cherish it with more respect and appreciation and deep affection. Perhaps that is what Murray had in mind.

In August 1992, I was his companion on a trip to Corvallis, Oregon, for the editorial committee meeting of the *Annual Review of Phytopathology*, which had been founded in the early 1960s while Murray was still Editor-in-Chief, and that was some thirty years after he had started the *Annual Review of Biochemistry.* On our hour-long drives to and from the airports in San Jose and Portland, we had time and privacy for some personal and serious talk about life and death and speculation about the future, as well as reflections about the past. Our serious talk was relieved from time to time as we both recalled and even rendered, sometimes solo and sometimes in more or less harmonious duets, the Sunday School songs we both remembered in amazing detail from our respective rural childhoods, his in Ontario, Canada, and my own in upstate New ork. It was so characteristic of Murray to leaven any matter, however serious, with his special brand of humor, civility and good will and wit and have a bit of fun while he accomplished something important.

During the first half of 1993, Murray spent many weeks putting the finishing touches on his book of reminiscences, which he had written primarily for his family. It was typical of his foresight and thoughtfulness that he arranged that each person he had asked some months in advance to speak at this memorial service should be given a copy of his *Reminiscences*. And it was just as typical of him that he did not make any suggestion as to what he might want to have said on this occasion. As Harry Mosher just reported, Murray had told him, "Say what you wish. I will be otherwise occupied." But he did have firm ideas about the music, and you've already heard some of that and will hear some more.

Even though Murray intended that his *Reminiscences* be primarily for his family, I must say that I have found them very interesting in many ways, and valuable well beyond the immediate family circle. I trust the Luck family is go-

ing to allow *Annual Reviews* to make copies of his book available to the wider readership that I believe exists for it.

By the way, I know that there's not time to name all the people to whom Murray would like to give thanks for the work they've done, but I have to single out one again, lifting some words from his *Reminiscences* themselves. He was always generous in his praise for people that he worked with who had helped him in various ways, but the one quote I want to use from among many in his book is this one: "From the beginnings of this project [the *Reminiscences*], I have enjoyed the unstinted cooperation of Judith Mueller, Administrative Secretary to *Annual Reviews*. Without her encouragement and her active weekly participation in preparing this material for publication, it probably would have died in its infancy." So, Judy, thanks from all of us.

It is most tempting to read further excerpts from the *Reminiscences* now, but obviously there simply isn't time. Furthermore, the good news is that we still have available a number of copies of the autobiographical prefatory chapter that Murray wrote for publication in 1981 in Volume 50 of the *Annual Review of Biochemistry*. When we go out to the reception, you will find a big box of envelopes, such as this, that have three items in them. One is a copy of that prefatory chapter entitled "Confessions of a Biochemist." We had reprinted it for a symposium honoring Murray's ninetieth birthday at Stanford in 1989. That symposium, co-sponsored by *Annual Reviews* and the Industrial Affiliates Program of the Departments of Chemistry and Chemical Engineering, was held on October 20-21, memorable dates for those of us who were here that week and enjoyed if that's the right word the 7.1-magnitude earthquake at 5:04 p.m. on October 17. One effect of the earthquake was to cut down the size of the expected attendance, and that's how come we have a number of copies of this reprint left over today. I think we had 150 people there and had expected about 300. Anyway, in this envelope, along with the reprint of Murray's marvelous "Confessions," which begins with a photograph of him taken at about that time, you'll find another reprint, which includes a short essay on "Scientific Biography," by Joshua Lederberg. He is the Chairman of the *Annual Reviews* Board of Directors and he wrote this piece as an introduction to Volume III in the series of collections of autobiographical chapters from the various *Annual Reviews,* a series that Murray himself initiated in 1965, called "The Excitement and Fascination of Science." That monumental two-volume work, published in 1990, is dedicated to Murray. The third item in the envelope is a business reply envelope addressed to the James Murray Luck Fund at *Annual Reviews*. Many people have called to ask what they might do to help commemorate Murray's life and contribute to something, and I'm happy to report that the Board of Directors of *Annual Reviews* approved setting up of a new James Murray Luck Fund this spring. The purpose of the Fund is to arrange for distribution of the *Annual Reviews* to needy libraries, individual scholars,

and other qualified research facilities in former Soviet Union countries, Eastern European countries, Third World countries, where the needs are great. The first such shipment of books a total of 1642 volumes was just airlifted to Moscow on September 1, where the staff of the Library of Natural Sciences of the Russian Academy of Sciences will sort, separate, and address the volumes for redistribution there. We hear from our editorial committee members, editors, and others who travel abroad what desperate needs there are for the sorts of good information that they can find in the *Annual Reviews* but can't afford to buy. I know that Murray would have been delighted with this news.

As many of you know, there is an award presented every year at the U.S. National Academy of Sciences annual meetings in Washington in honor of Murray Luck. It's an award for scientific reviewing co-sponsored by *Annual Reviews* and the Institute for Scientific Information in Philadelphia.

There's so much more I would like to say, but I've already used up my allotted time and, of course, as Harry Mosher said, no amount of time today would make it possible to do full justice to Murray Luck.

In the early pages of his reminiscences, Murray outlined his general themes and purposes. He wrote, "These reminiscences give me an opportunity to reflect upon some of the major interests I have pursued and in which I believe I have made some modest contributions," and he lists four items: (1) economic and financial cooperation, consumer cooperatives, cooperative housing, credit unions; (2) teaching biochemistry to generations of university students and founding the *Annual Review of Biochemistry* (the first of many such reviews); (3) population overpopulation; and (4) industrial peace the swift solution of employer employee confrontations, strikes, a negotiating technique which should be tried elsewhere, with every hope of achieving industrial peace by avoiding strikes and lockouts.

In closing, I quote Murray again. On the final pages of his *Confessions*, he speaks of his life as a biochemist, professor, and publisher as a full and rewarding one, and he ends by saying, " I have greatly enjoyed almost everything in which I have engaged, and have had the lasting pleasure of association with many students and others in teaching, research, and other activities. Should one ask for more "

Murray Luck's life story is well worth knowing and remembering. It is the story of a long life of service to others rather than to himself, the story of an eventful, productive, disciplined, useful life a life that mattered.

MacINNES: Thank you very much, Dr. Kaufmann, both for speaking for John McNeil and for yourself and, I think I can safely say, for many of us if not all of us.

This is the time for impromptu sharing, those among us here in the congregation this afternoon. I have a hand-held microphone who will begin

EDWARD LUCK: I'm Edward Luck, Murray's son, I believe his only son. For about the last twenty years I have had the very special pleasure of having lunch with my dad almost weekly. In the course of those many lunches, I got very close to his irreverent sense of humor, his iconoclastic view of institutions ”the bigger, the worse” but I was always impressed by his kindness to his people and his total absence of mean thoughts or ideas, words directed against others. He had an enormous amount of fun in his life. It was quite infectious.

In the last year or so of his life, he had some ideas that I would call, perhaps, obsessive. He was very interested in making certain that this memorial occurred as he wished. There was a tree in my parents' yard that he really felt should be cut down, and the tree is still standing. But in the last month or so he let go, I think, of all worldly things, in a sense. He would sit in the backyard, really untroubled by the tree, and untroubled by the memorial service that was now going to take place perfectly, and no longer worried about his books or whether the weeds needed to be chopped down. And I learned that he was seeing, for the first time in his life. He commented on the way the wind felt, the shape of a leaf, the way the birds would dance about on the lawn getting worms, and he was completely consumed by these visions. I guess I wondered to myself, why is it that we wait so long until we can see So he taught me something about real vision.

He rarely used the term “love.” And it wasn't because it was something he didn't feel I know he felt it greatly. He felt an enormous amount of love for my mother, my sister, his grandchildren. And again, towards the end of his life, the last few months, he became more comfortable with expressing his love for people. And I think that was the second great lesson he taught me, that it's really never too late to tell someone that you love them. He speculated a little bit about what was happening in the future for him and, of course, had the presence of mind to write us all letters, which are “Not to be opened until I have left for the great beyond and the eternity of the future.” I won't read the whole thing not that it's boring, or anything like that; it's really quite interesting but there is one short sentence in it about love, and I think it's the way I remember my father:

“It is hard for me to believe that death is the end of all. Perhaps there's an eternity in which our experience, or something about us, continues on and on in unending love for one another.” I love you, Pop.

MacINNES: Is there someone else

OLGA LEISL: I'm Olga Leisl. I met Eda when she arrived in the United States. I believe I am the first person to greet her here, and we have been friends ever since. When she married Murray, my daughters were supposed to be flower girls at the wedding, but they got sick, so I missed the whole wed-

ding, the whole ceremony, but that didn't stop our friendship. I'm godmother of her daughter, and my husband was godfather of Edward. Five generations of my family are in her guest book. I wonder whether anybody can beat that.

MERLE HOWES: I'm Merle Luck Howes. I'm very proud to be here today to represent the Ontario nieces, nephews, and assorted cousins that, for various reasons, were unable to be here today distance being, I guess, one of the main ones, and age, and various other things. My dad was Murray's older brother. He married late. And he, too, was of the University of Toronto and I am of the University of Toronto. In Murray's last year on that campus he had some of the same staff and professors that at that time that were responsible for the discovery of insulin. It was duly recorded and spoken about in a recent book written on it by one of our Canadian historians, Murray and I both read that, just in the very last months of his life, and he had his thoughts about it and about being a student there that last year. I should say that I did not really get to know Murray until after my own mother and dad had passed on, but he had a great interest in family history, and I found that somehow I was inspired to be interested in family history, too. I enjoyed being what I came to think of as a "gopher" you know, you "gopher" this or you "gopher" that, or you find out this or you find out that. I'll just repeat, I'm very proud to be here representing his Canadian roots. Thank you very much.

GLEN BA : I'm Glen Bay, president of the Consumers' Society of Palo Alto, speaking in behalf of more than 35,000 co-op members that would not have had the co-operative alternative experience if it hadn't been for the work of Murray Luck. We think of you often. Thank you.

ARTHUR GIESE: When I first arrived at Stanford in 1929, I took Murray Luck's course in Biochemistry and I was always impressed by the elegant language in which he lectured. Later, I got to know him better because we shared an office. I was involved in teaching general biology, and he was in the front of the office where the supplies and records were stored, with the secretary, beginning work on the *Annual Review of Biochemistry.* I thought what a nice vision he had, because I'd asked him once what direction biochemistry was taking, and he said, "Well, we're trying to find out, by having people write reviews in an *Annual Review of Biochemistry*." Later he started the *Annual Review of Physiology* and I was invited to become one of the associate editors. I stayed with that for twenty-five years, during which time, of course, I had many contacts with Murray. I was impressed at the tremendous vision, along with the capacity to handle the business ends of things, because he planned so well to have the money accumulate to buy property, to build the building and house all of these *Annual Reviews*. And of course that is a memorial to him and his insight into the need for this type of reviewing of literature which, of

course, was bursting in all fields of science. So I think we scientists owe a tremendous debt to his dreams and his capacity to handle and develop them.

WARREN PEAK: I'm Warren Peak. I met Murray over a decade ago. I bought a house in Menlo Park, and location is supposed to be the big thing. My location happened to be across the street from the Lucks. No one could be blessed more than having such an opportunity. Not just Murray, but the whole family and their extended family that they welcomed me into.

My first sense of the Lucks was that if anybody was famous in that house it was Eda with her cooking, in particular chocolate chip cookies, and it's partly because Murray was always otherwise occupied, doing things other than talking about himself. My first recollection was in his battle with the front hedge, always trying to keep it straight and low. But over time, I learned a whole lot of things that he didn't speak about but that he simply acted upon. As we all sit here, we probably think about what are our recollections of Murray about what would we say if the microphone was in our hands. And the thought that came to me was the sort of cynical thought that good guys wind up coming in last, and to some degree Murray proved that both right and wrong. He was a good guy and he came in first in a lot of people's hearts and minds. But he now "lasts" in our hearts and minds.

MacINNES: My thanks, and I'm sure the thanks of the family, to each one of you who spoke. For each one who spoke, there are twenty or fifty who might have. May I suggest that following this service, you adjourn with the family to the garden court, which is the building just opposite the building we're in now. There is a reception which is planned and ready. There is an opportunity not only to visit among yourselves, but to speak to Eda and to Nadja and to Edward and other members of the family, including the niece who has come so far, from Ontario in eastern Canada, and to share what is in your mind and on your heart this day as we are paying our respects to this very incredible man. So please stay, enjoy the hospitality, the refreshments, and please share with each other and with the family. Just to make my point quite clear, Murray Luck wants you to do that.

Dr. Luck loved the Broadway song, "Old Man River," from *Showboat*, that great Broadway production. He once told Doug Lawrence that it represented to him both the passing of time and the faithfulness of God. For him there was something calming and peaceful in these familiar words.

MUSIC: "Old Man River" solo by Doug Lawrence

Murray Luck's life had an ebb and a flow about it, just as is true of every person's life. But for Dr. Luck is was mostly flow. Today we have remembered his tireless attention to detail and the beautiful way he even planned this serv-

ice. He probably did that so that for the rest of us we could see how the river of our own lives goes on and on through eternity.

Murray came to see me last winter. His purpose was to discuss and to plan this service. Characteristically, he sent this gift for me in appreciation for my assistance, and you recognize his definitive *History of Switzerland*. With family permission, let me read the inscription in his own hand, dated February 1993, to Reverend Don MacInnes: "In gratitude for his inspiration and guidance in programming an event to take place at some undetermined date in the future. Much as I should like to be present, I shall be prevented from so doing by another engagement of higher priority. With my thanks and best wishes, Murray Luck." Such wit and wisdom. Somehow, I believe that Murray Luck has been here today in spirit, and that his great heart has been greatly warmed by what has been said and done here this afternoon our tribute to this giant of a man who strode the earth for ninety-four years and now enhances the halls of Heaven. So let us pray:

We thank you, gracious and loving God, that we have been given the gift of sharing life with Murray Luck until this time, whose memory we shall forever cherish and whose good works live on in all who came within his influence. Draw us, O God, closer together in the bonds of love, memory, and gratitude, and support us all the day long until the shadows lengthen and the evening comes and the busy world is hushed, the fever of life is over, and our work is done. Then in your mercy grant us, as you have Murray Luck, a safe lodging, a holy rest, and peace at the last. So to the mercy of Almighty God we commend the soul of J. Murray Luck, committing him to you, Eternal God, in the sure and certain hope of life eternal. And now may the love of God, who gave life to us all, the grace of Jesus Christ to remove the sting of death and win the victory over the grave and bring the comfort of the Holy Spirit, who is able to strengthen you for the morrow, go with you now tomorrow and forevermore. Amen.

Acknowledgments

Throughout his *Reminiscences*, Dr. Luck has expressed his appreciation and gratitude to many individuals family members, friends, and associates. However, acknowledgments still remain to be made to them and to others who have been especially helpful to the editors in providing support, expert advice, photographs, and other information and materials essential for its completion and publication.

Judith Mueller, Administrative Secretary at Annual Reviews during the years Dr. Luck was working on the manuscript for this book, as well as on other complex writing projects, such as his monumental 1985 *History of Switzerland*, spent many hours each week over a period of more than a decade, serving as his faithful amanuensis, handling a vast amount of typing, filing, record-keeping and correspondence. Her dedication and encouragement to him went well beyond the call of duty, as have her continuing commitments.

Dr. Luck's niece, Dr. Merle Howes, whose assistance with gathering and checking family histories were invaluable to him, has continued to give generously of her time and knowledge in selecting and organizing photographs and in working with others to unearth genealogical and family data. Her son, Craig Howes, Director of the Center for Biographical Research at the Manoa Campus of the University of Hawaii, also reviewed portions of the manuscript and offered valuable suggestions for improvement. We are grateful to them and to the following members of the extended Luck families: Marion Belanger, Ruth Black, Herbert Field, Florence Luck, Bernice Luck Nesbitt, Harry and Muriel Luck, Jamie Luck, Sheldon Luck, Eileen Reed, Russell Smith, and Jean Weaver. The News and Publications Services Offices of Stanford University are the source of many of the pictures that include Dr. Luck. Because of space limitations, many of the photographs we gathered could not be printed. We apologize to anyone whose photographs may have been used without attribution (since we were uncertain about the source) as well as to those whose excellent photographs could not be included; we assure you that your contributions are appreciated. Whether or not used in this book, all of these materials will ultimately be found in the James Murray Luck Archives at the Stanford University Libraries.

Through the resourceful cooperation of Annette Faux, Assistant Librarian of the Colman Library, Department of Biochemistry, University of Cambridge, we were able to procure photographs of a number of Dr. Luck's associates and faculty members during his time at Cambridge University, which enhance his account of those important years in his early adult life.

Mark Larwood III, President of Consolidated Publications, Inc. in Sunnyvale, California, provided invaluable advice, as well as generously donating all costs of paper and printing. Czeslaw Jan Grycz, with the Poniecki Foundation

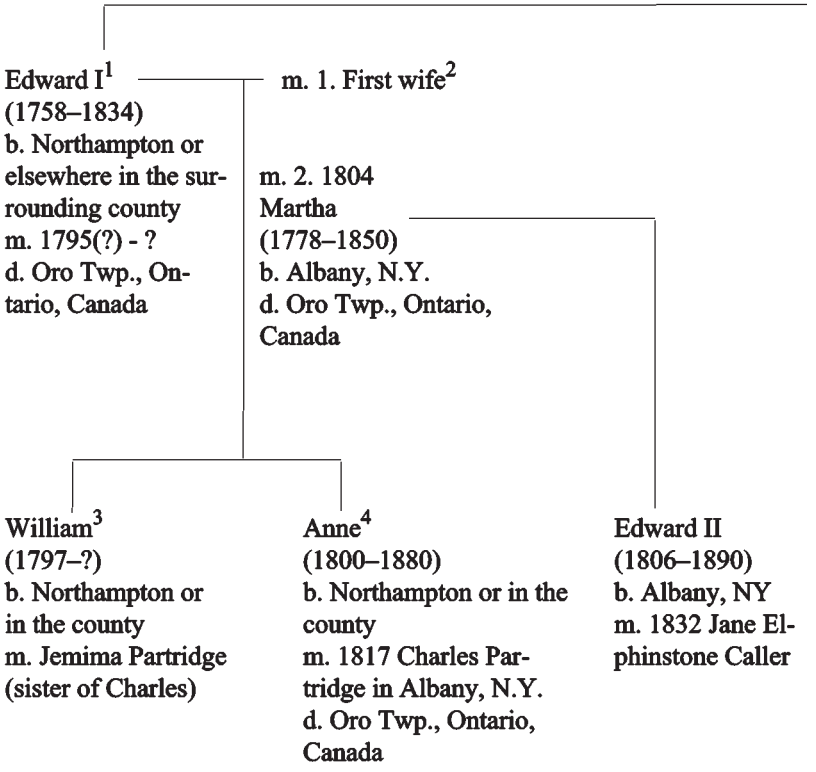
in El Cerrito, California, contributed the cover, title page, and front matter designs. Malloy Lithographing, Inc., of Ann Arbor, MI, the current printer and binder of Annual Reviews volumes, donated the binding. Connie Burton provided the photo layout and dust jacket designs. Dr. Janet Gardiner, Executive Officer of the Society for the Promotion of Science and Scholarship (SPOSS) provided essential information about its organization and publications.

We are especially grateful to Reverend Donald MacInnes, who presided over the Memorial Service that Dr. Luck had designed for himself in advance. Reverend MacInnes presented an audiotape of the service to the Luck family, and the tape was masterfully transcribed by Polly Tooker, thus making available to us the excerpts that conclude this book.

Finally, and not least, we thank Dr. Luck himself for having written this book at the urging of many of his friends, and for allowing the staff of Annual Reviews to use his manuscript as a trial run for the Company's first desktop publishing experiment with a book-length manuscript.

APPENDI 1: Luck Genealogy Tables

Luck Family Genealogy

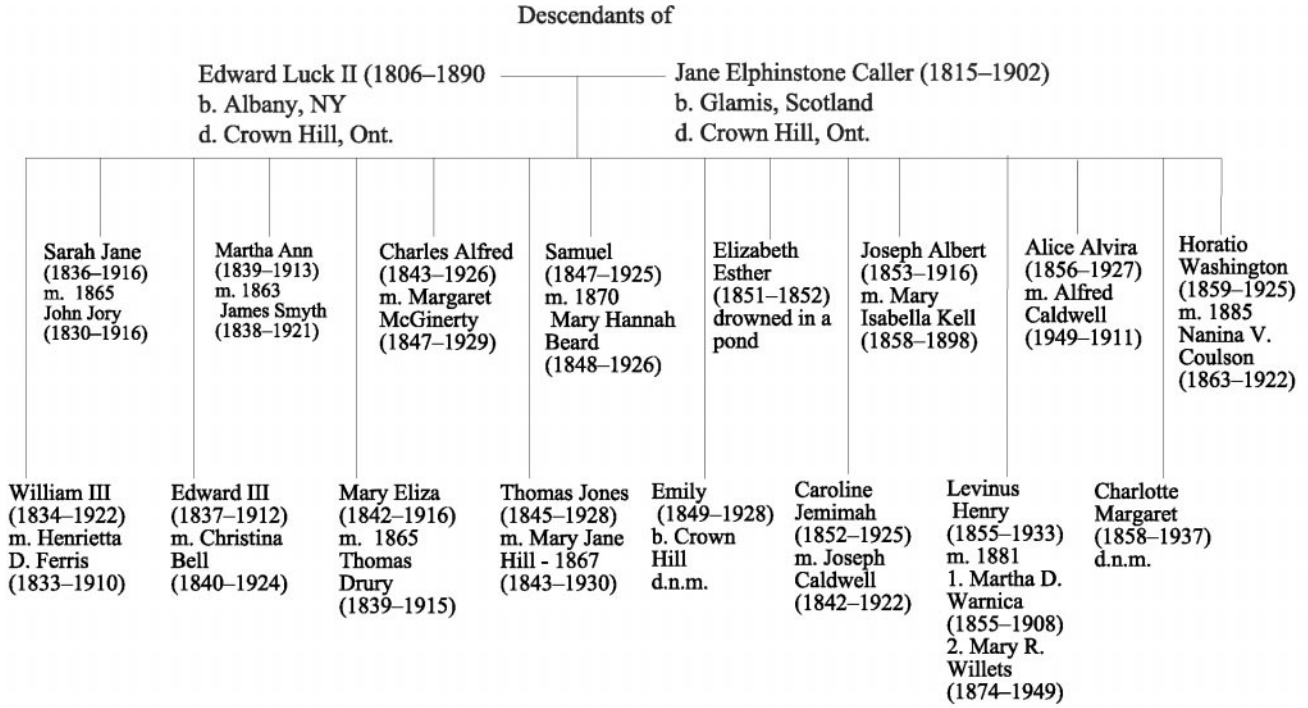


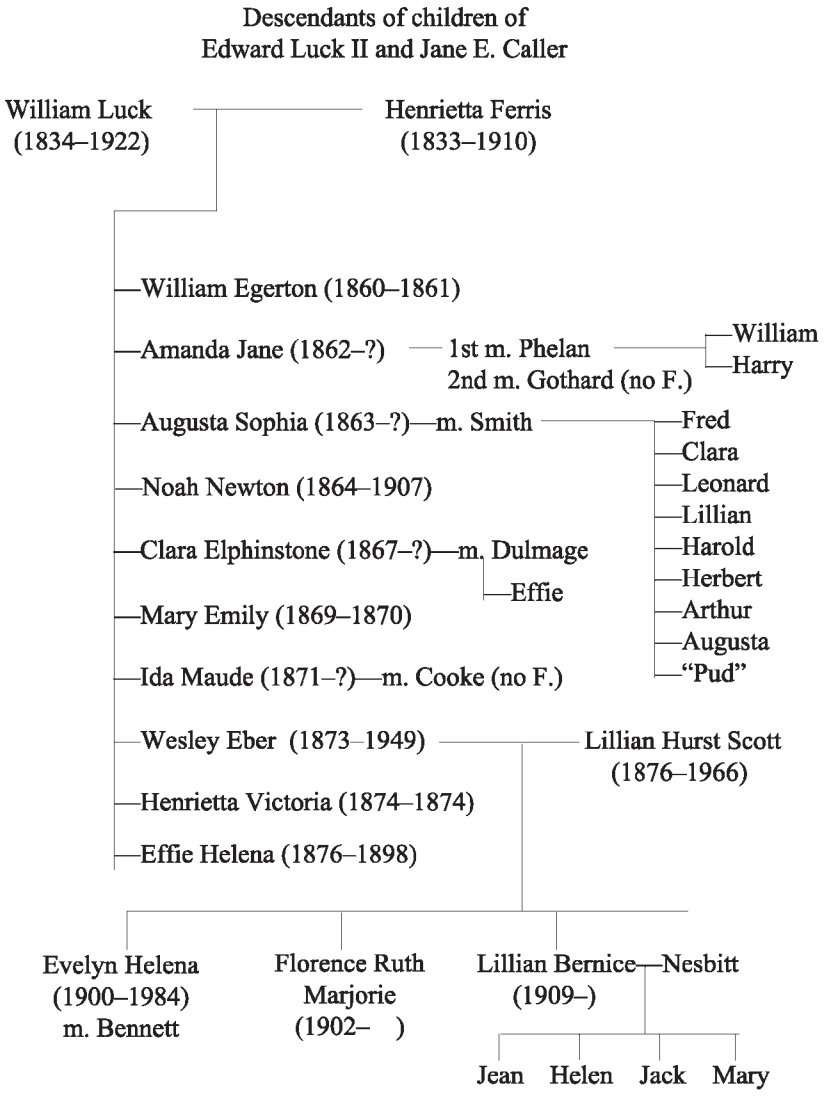
[1]Emigrated from England with wife and family to Albany, New York in 1803.

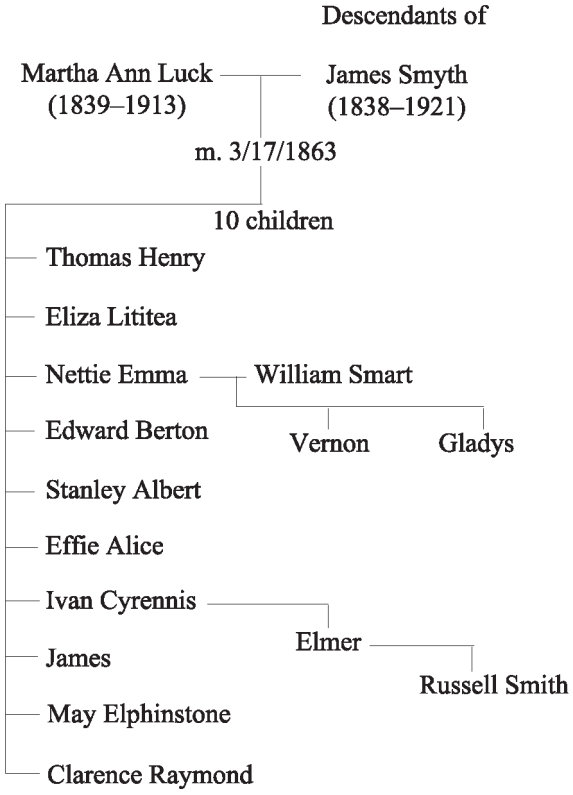
[2]In 1992, no record found of Edward I's first marriage in Northampton. The reco in Northamptonshire have not yet been adequately investigated.

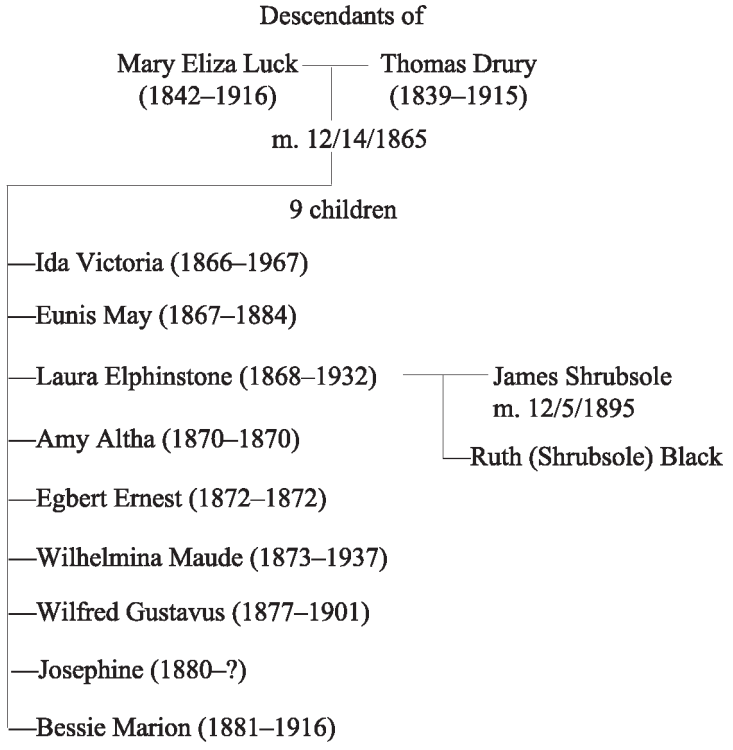
[3]Emigrated from USA to Oro Twp. in 1819. Second son, Edward II, followed 1820 with his father and mother.

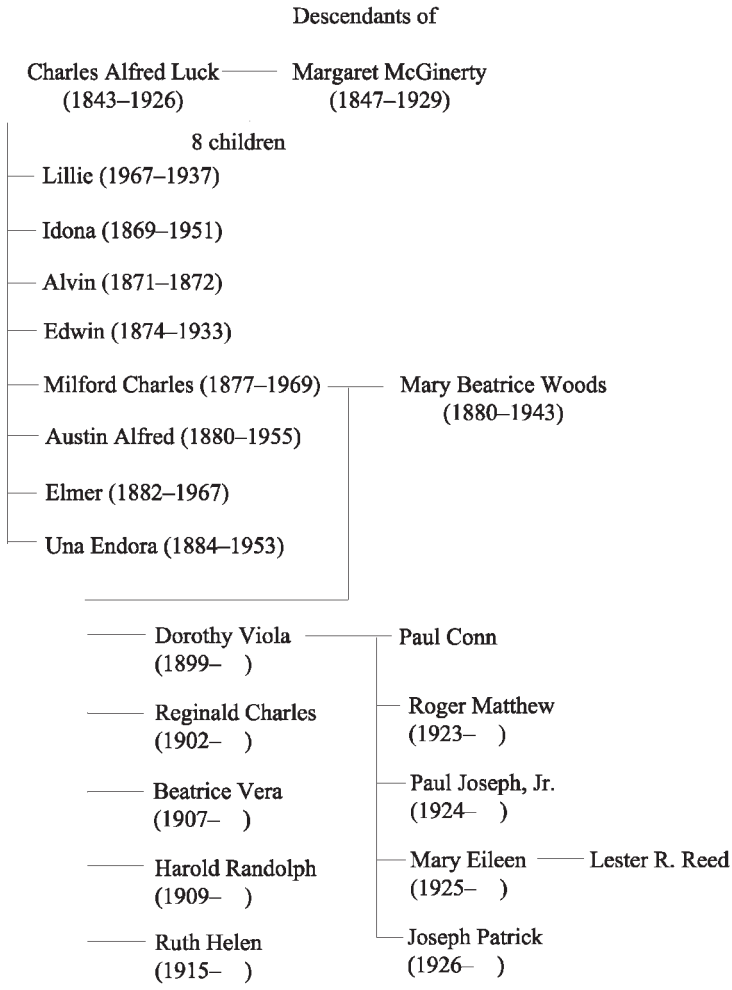
[4]Daughter Anne and husband also emigrated from Albany to Oro Twp. in 1820 a settled on a lot adjacent to the Lucks.

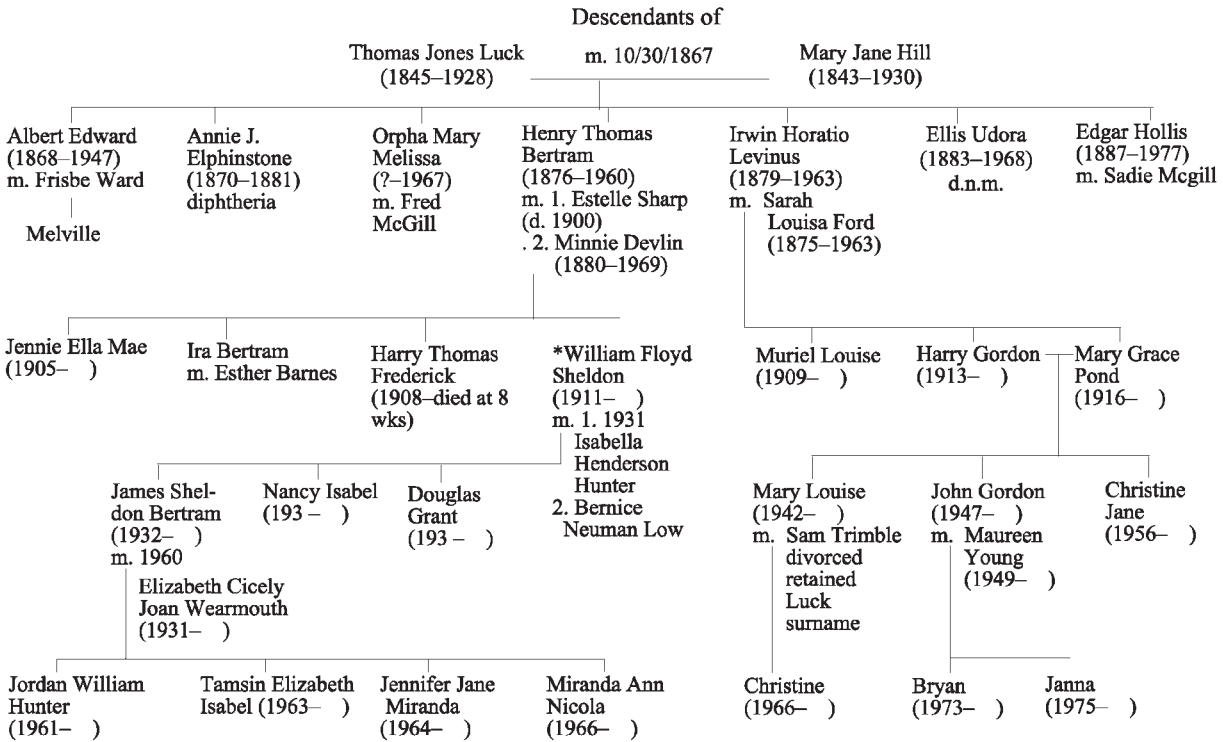

Descendants of
Edward Luck II (1806–1890
b. Albany, NY
d. Crown Hill, Ont.
Jane Elphinstone Caller (1815–1902)
b. Glamis, Scotland
d. Crown Hill, Ont.
Sarah Jane (1836–1916) m. 1865 John Jory (1830–1916)
Martha Ann (1839–1913) m. 1863 James Smyth (1838–1921)
Charles Alfred (1843–1926) m. Margaret McGinerty (1847–1929)
Samuel (1847–1925) m. 1870 Mary Hannah Beard (1848–1926)
Elizabeth Esther (1851–1852) drowned in a pond
Joseph Albert (1853–1916) m. Mary Isabella Kell (1858–1898)
Alice Alvira (1856–1927) m. Alfred Caldwell (1949–1911)
Horatio Washington (1859–1925) m. 1885 Nanina V. Coulson (1863–1922)
William III (1834–1922) m. Henrietta D. Ferris (1833–1910)
Edward III (1837–1912) m. Christina Bell (1840–1924)
Mary Eliza (1842–1916) m. 1865 Thomas Drury (1839–1915)
Thomas Jones (1845–1928) m. Mary Jane Hill - 1867 (1843–1930)
Emily (1849–1928) b. Crown Hill d.n.m.
Caroline Jemimah (1852–1925) m. Joseph Caldwell (1842–1922)
Levinus Henry (1855–1933) m. 1881 1. Martha D. Warnica (1855–1908) 2. Mary R. Willets (1874–1949)
Charlotte Margaret (1858–1937) d.n.m.
*All 16 children b. in Crown Hill


Descendants of children of
Edward Luck II and Jane E. Caller
William Luck
(1834–1922)
Henrietta Ferris
(1833–1910)
William Egerton (1860–1861)
Amanda Jane (1862–?)
1st m. Phelan
2nd m. Gothard (no F.)
William
Harry
Augusta Sophia (1863–?)—m. Smith
Fred
Clara
Leonard
Lillian
Harold
Herbert
Arthur
Augusta
"Pud"
Noah Newton (1864–1907)
Clara Elphinstone (1867–?)—m. Dulmage
Effie
Mary Emily (1869–1870)
Ida Maude (1871–?)—m. Cooke (no F.)
Wesley Eber (1873–1949)
Lillian Hurst Scott
(1876–1966)
Henrietta Victoria (1874–1874)
Effie Helena (1876–1898)
Evelyn Helena
(1900–1984)
m. Bennett
Florence Ruth
Marjorie
(1902–)
Lillian Bernice—Nesbitt
(1909–)
Jean
Helen
Jack
Mary

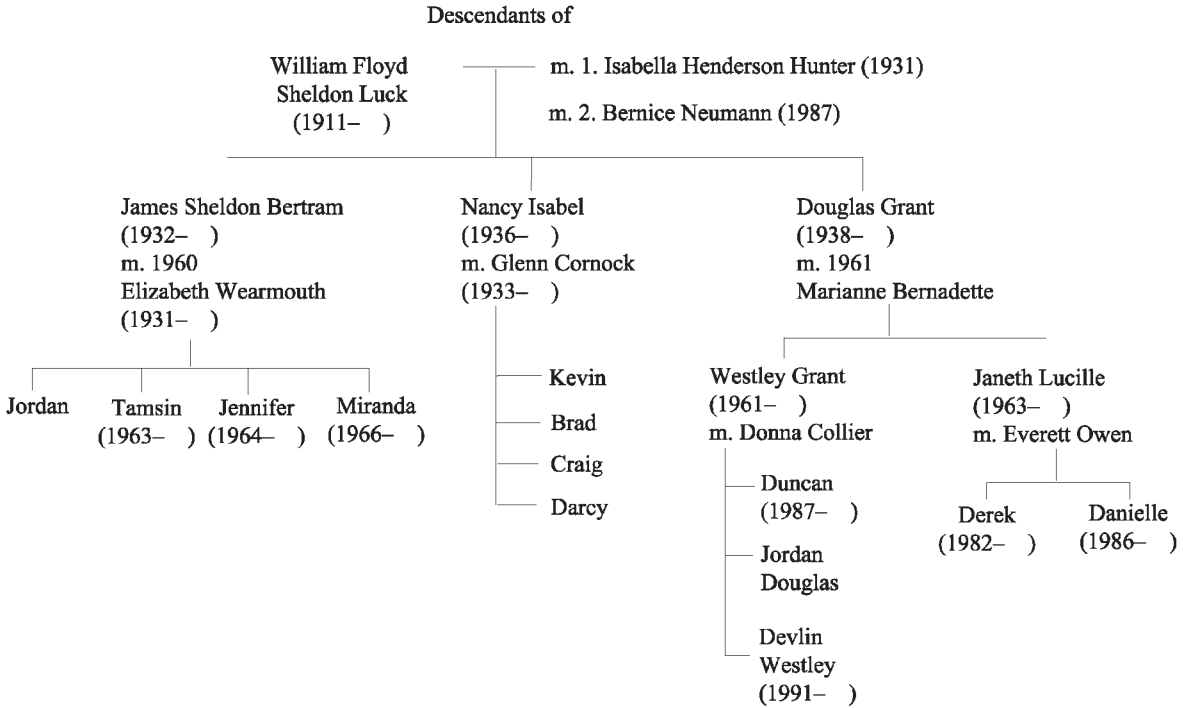

Descendants of
Martha Ann Luck
(1839–1913)
James Smyth
(1838–1921)
m. 3/17/1863
10 children
Thomas Henry
Eliza Lititea
Nettie Emma
William Smart
Vernon
Gladys
Edward Berton
Stanley Albert
Effie Alice
Ivan Cyrennis
Elmer
Russell Smith
James
May Elphinstone
Clarence Raymond

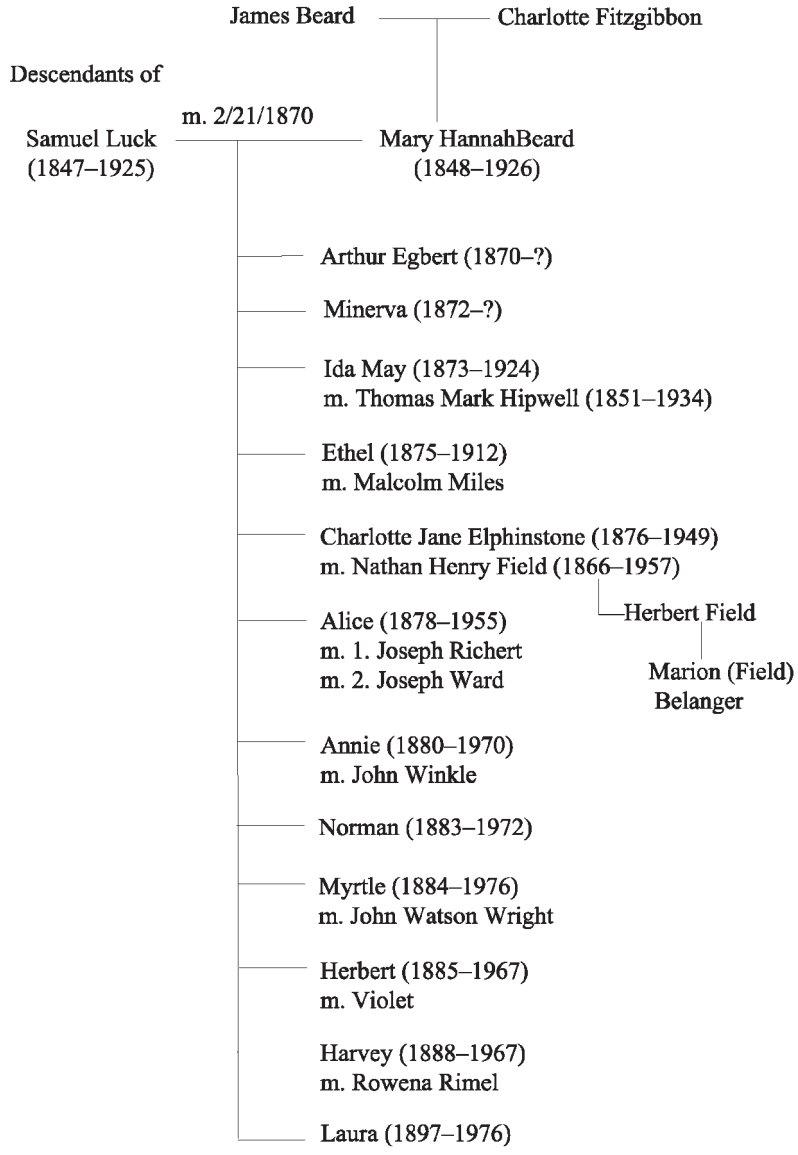

Descendants of
Mary Eliza Luck
(1842–1916)
Thomas Drury
(1839–1915)
m. 12/14/1865
9 children
—Ida Victoria (1866–1967)
—Eunis May (1867–1884)
—Laura Elphinstone (1868–1932)
James Shrubsole
m. 12/5/1895
—Ruth (Shrubsole) Black
—Amy Altha (1870–1870)
—Egbert Ernest (1872–1872)
—Wilhelmina Maude (1873–1937)
—Wilfred Gustavus (1877–1901)
—Josephine (1880–?)
—Bessie Marion (1881–1916)

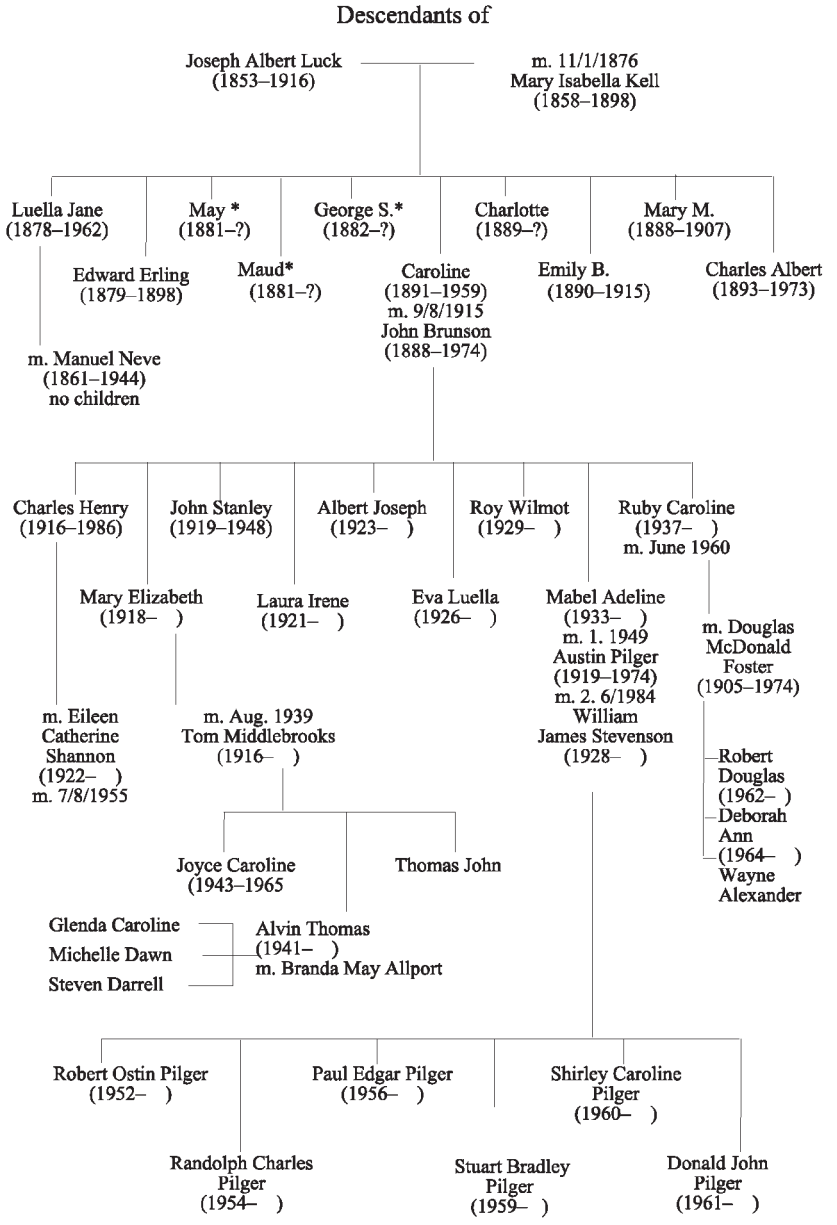

Descendants of
Charles Alfred Luck (1843–1926)
Margaret McGinerty (1847–1929)
8 children
Lillie (1967–1937)
Idona (1869–1951)
Alvin (1871–1872)
Edwin (1874–1933)
Milford Charles (1877–1969)
Mary Beatrice Woods (1880–1943)
Austin Alfred (1880–1955)
Elmer (1882–1967)
Una Endora (1884–1953)
Dorothy Viola (1899–)
Paul Conn
Reginald Charles (1902–)
Roger Matthew (1923–)
Beatrice Vera (1907–)
Paul Joseph, Jr. (1924–)
Harold Randolph (1909–)
Mary Eileen (1925–)
Lester R. Reed
Ruth Helen (1915–)
Joseph Patrick (1926–)



*See following page

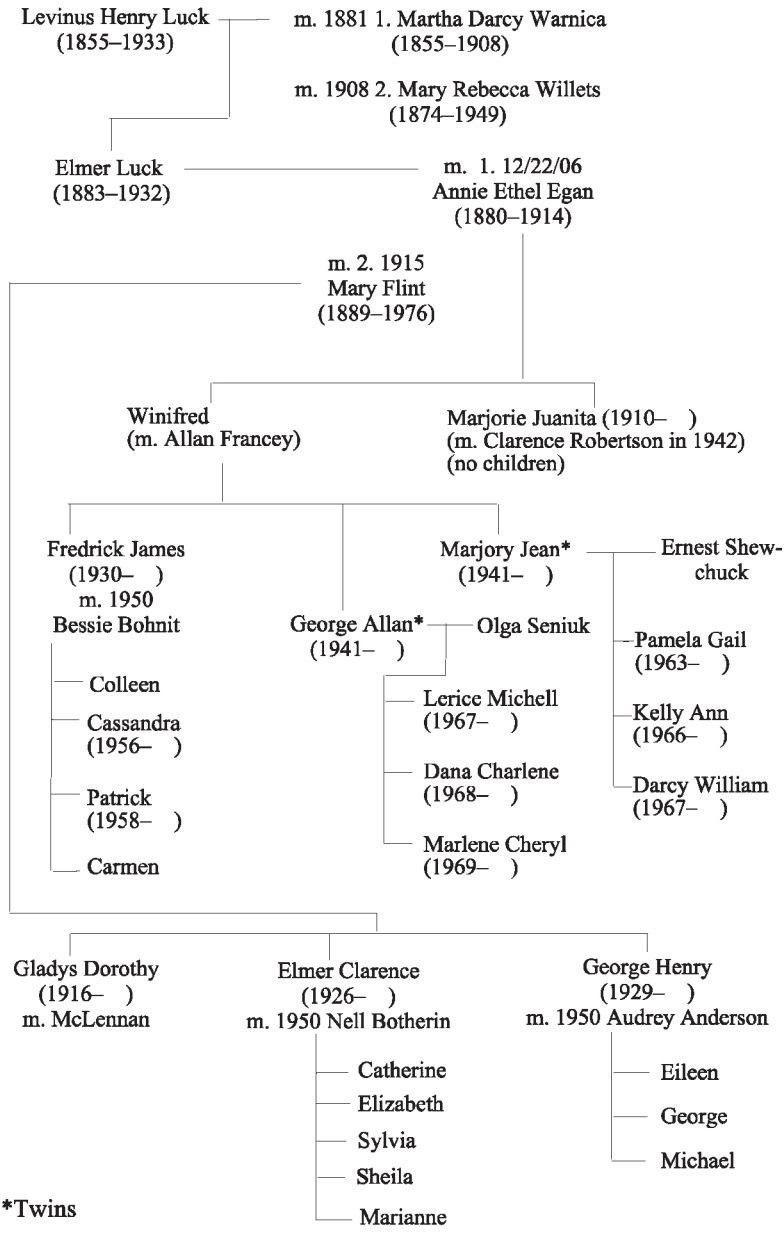

Descendants of
William Floyd Sheldon Luck (1911–)
m. 1. Isabella Henderson Hunter (1931)
m. 2. Bernice Neumann (1987)
James Sheldon Bertram (1932–) m. 1960 Elizabeth Wearmouth (1931–)
Nancy Isabel (1936–) m. Glenn Cornock (1933–)
Douglas Grant (1938–) m. 1961 Marianne Bernadette
Jordan
Tamsin (1963–)
Jennifer (1964–)
Miranda (1966–)
Kevin
Brad
Craig
Darcy
Westley Grant (1961–) m. Donna Collier
Janeth Lucille (1963–) m. Everett Owen
Duncan (1987–)
Jordan Douglas
Devlin Westley (1991–)
Derek (1982–)
Danielle (1986–)

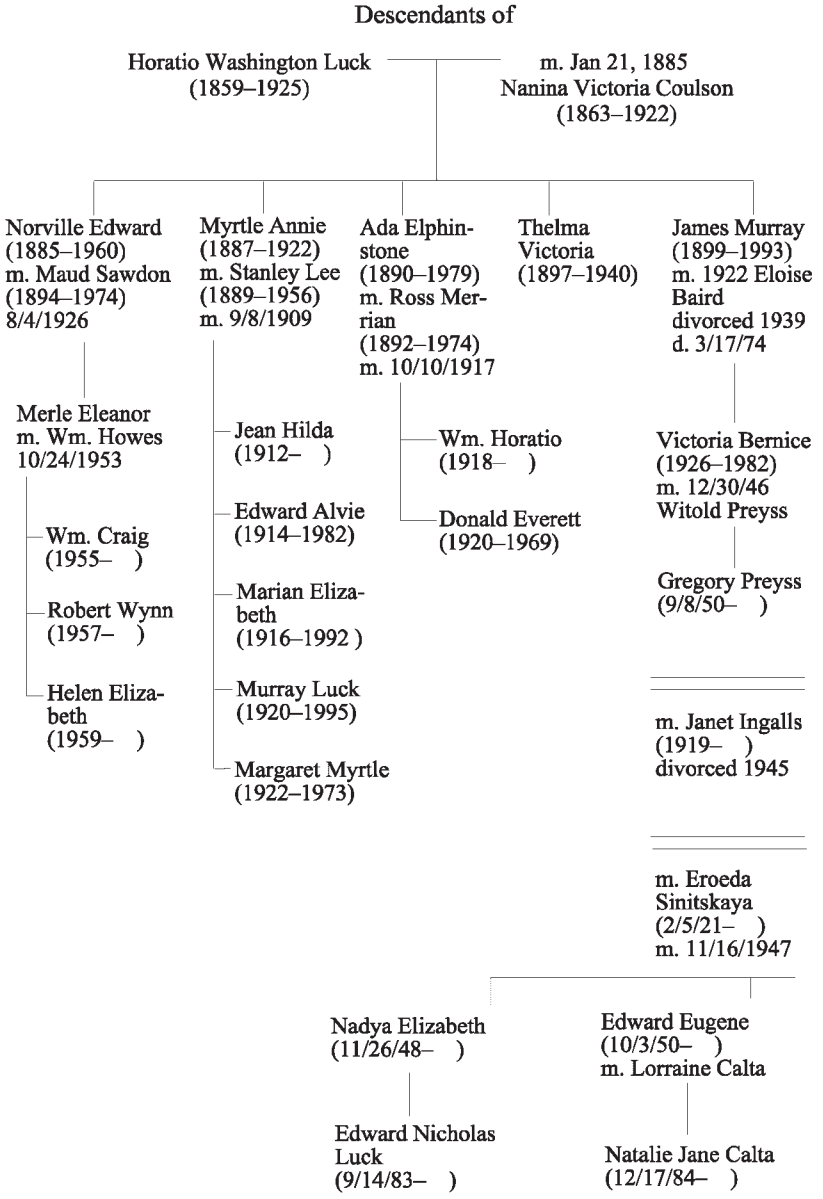

James Beard
Charlotte Fitzgibbon
Descendants of
m. 2/21/1870
Samuel Luck
(1847–1925)
Mary HannahBeard
(1848–1926)
Arthur Egbert (1870–?)
Minerva (1872–?)
Ida May (1873–1924)
m. Thomas Mark Hipwell (1851–1934)
Ethel (1875–1912)
m. Malcolm Miles
Charlotte Jane Elphinstone (1876–1949)
m. Nathan Henry Field (1866–1957)
Herbert Field
Marion (Field)
Belanger
Alice (1878–1955)
m. 1. Joseph Richert
m. 2. Joseph Ward
Annie (1880–1970)
m. John Winkle
Norman (1883–1972)
Myrtle (1884–1976)
m. John Watson Wright
Herbert (1885–1967)
m. Violet
Harvey (1888–1967)
m. Rowena Rimel
Laura (1897–1976)



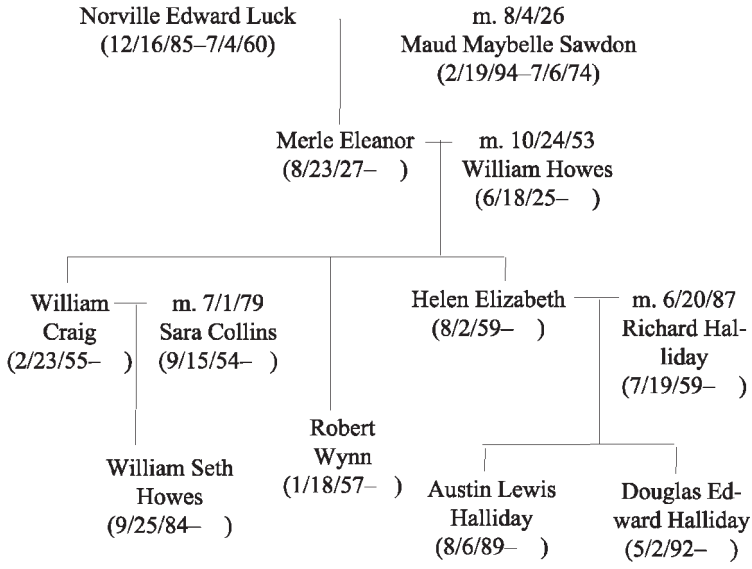
*Date given is an approximation

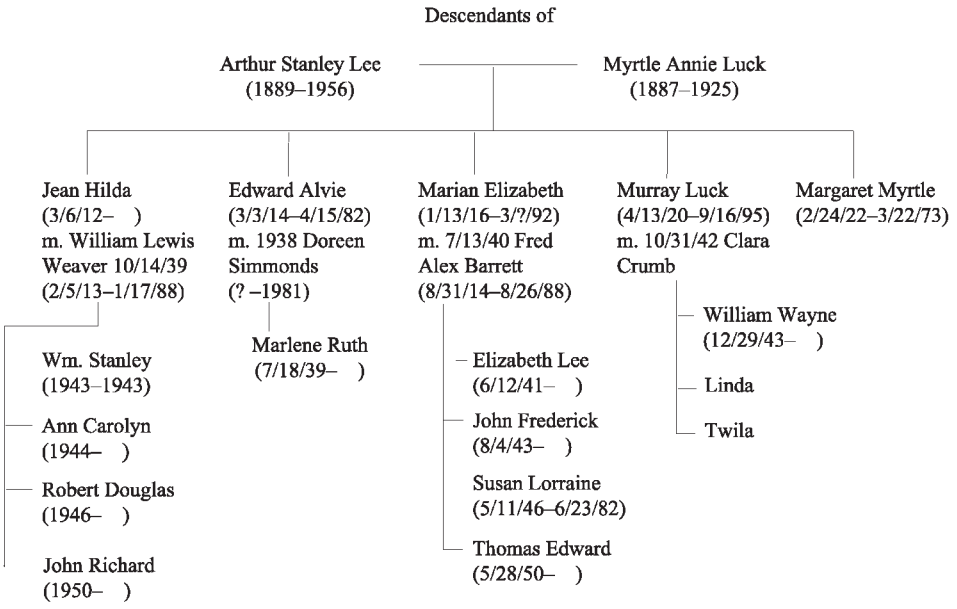
Descendants of Levinus Henry Luck

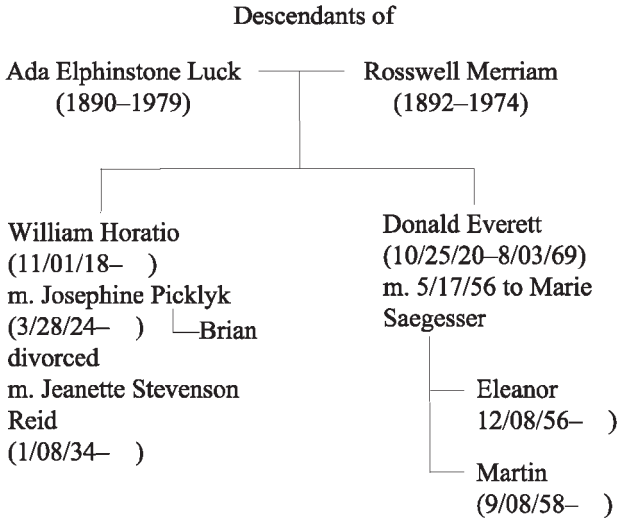



Descendants of
Horatio Washington Luck
(1859–1925)
m. Jan 21, 1885
Nanina Victoria Coulson
(1863–1922)
Norville Edward
(1885–1960)
m. Maud Sawdon
(1894–1974)
8/4/1926
Myrtle Annie
(1887–1922)
m. Stanley Lee
(1889–1956)
m. 9/8/1909
Ada Elphinstone
(1890–1979)
m. Ross Merrian
(1892–1974)
m. 10/10/1917
Thelma Victoria
(1897–1940)
James Murray
(1899–1993)
m. 1922 Eloise Baird
divorced 1939
d. 3/17/74
Merle Eleanor
m. Wm. Howes
10/24/1953
Wm. Craig
(1955–)
Robert Wynn
(1957–)
Helen Elizabeth
(1959–)
Jean Hilda
(1912–)
Edward Alvie
(1914–1982)
Marian Elizabeth
(1916–1992)
Murray Luck
(1920–1995)
Margaret Myrtle
(1922–1973)
Wm. Horatio
(1918–)
Donald Everett
(1920–1969)
Victoria Bernice
(1926–1982)
m. 12/30/46
Witold Preyss
Gregory Preyss
(9/8/50–)
m. Janet Ingalls
(1919–)
divorced 1945
m. Eroeda
Sinitskaya
(2/5/21–)
m. 11/16/1947
Nadya Elizabeth
(11/26/48–)
Edward Nicholas
Luck
(9/14/83–)
Edward Eugene
(10/3/50–)
m. Lorraine Calta
Natalie Jane Calta
(12/17/84–)

Descendants of Norville Edward Luck




Descendants of
Arthur Stanley Lee
(1889–1956)
Myrtle Annie Luck
(1887–1925)
Jean Hilda
(3/6/12–)
m. William Lewis
Weaver 10/14/39
(2/5/13–1/17/88)
Edward Alvie
(3/3/14–4/15/82)
m. 1938 Doreen
Simmonds
(? –1981)
Marian Elizabeth
(1/13/16–3/?/92)
m. 7/13/40 Fred
Alex Barrett
(8/31/14–8/26/88)
Murray Luck
(4/13/20–9/16/95)
m. 10/31/42 Clara
Crumb
Margaret Myrtle
(2/24/22–3/22/73)
Wm. Stanley
(1943–1943)
Ann Carolyn
(1944–)
Robert Douglas
(1946–)
John Richard
(1950–)
Marlene Ruth
(7/18/39–)
Elizabeth Lee
(6/12/41–)
John Frederick
(8/4/43–)
Susan Lorraine
(5/11/46–6/23/82)
Thomas Edward
(5/28/50–)
William Wayne
(12/29/43–)
Linda
Twila


Descendants of
Ada Elphinstone Luck
(1890–1979)
Rosswell Merriam
(1892–1974)
William Horatio
(11/01/18–)
m. Josephine Picklyk
(3/28/24–)
Brian
divorced
m. Jeanette Stevenson
Reid
(1/08/34–)
Donald Everett
(10/25/20–8/03/69)
m. 5/17/56 to Marie
Saegesser
Eleanor
12/08/56–)
Martin
(9/08/58–)

Descendants of James Murray Luck

James Murray Luck
b. 10/23/1899
Paris, Ontario, Canada

m. 9/1922
Eloise Victoria
Baird
divorced 1939

Victoria Bernice
b. 5/23/1926
in Toronto
d. 2/25/1982
San Francisco

m. Witold Preyss
(Witold Waskiewicz)
m. Liverpool
12/30/1946

Gregory Duncan Preyss
b. 9/8/1950

James Murray Luck
(1899–)
m. Sept. 1939

m. 9/1939
Janet Kay Ingalls
(1919–)
divorced 1945

(no children)

James Murray Luck
m. 10/19/1947 (civil)
11/ 16/1947 (church)

Eroeda Nicholaevna Sinitskaya
b. 2/5/1921
Harbin, Manchuria

Nadya Elizabeth
b. 11/16/1948
Palo Alto, Calif.

Edward Nicholas Luck
(Edward VI)
b. 9/14/1983
Mtn. View, Calif.

Edward Eugene
(Edward V)
B. 11/3/1950
Palo Alto, Calif.
m. Lorraine Calta

Natalie Jane Calta
b. 12/17/1984
Mtn. View, Calif.

Family of Eroeda Nicholaevna Sinitskaya (wife of J. Murray Luck)