SOCIAL INFLUENCES ON TECHNOLOGICAL PROGRESS

29 September 1952

455

CONTENTS

Page

INTRODUCTION--Dr. B. H. Williams, Member of the Faculty, ICAF.....1

SPEAKER--Dr. Hornell N. Hart, Professor of Sociology, Duke University.....1

Publication No. L53-30

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

456

Dr. Hornell N. Hart, Professor of Sociology at Duke University, was born in St. Paul, Minnesota, in 1888. He received his A.B. degree at Oberlin College in 1910, his M.A. from the University of Wisconsin in 1914, and his Ph.D. at the University of Iowa in 1921. He was the executive secretary of the Iowa Child Welfare Commission in 1924. From 1924 to 1933 he was associate professor and professor of social economy at Bryn Mawr College. He was professor of social ethics at the Hartford Theological Seminary from 1933 to 1938. He has held his present position since 1938. Dr. Hart is the author of "The Science of Social Relations," "The Technique of Social Progress," "The Gateways to Creative Living," and other books. In 1948 he received the Edward L. Bernays award for the best study of the social implications in atomic energy.

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DR. WILLIAMS: For the last week or so we have been hearing about scientific research and development; we may have the idea that it is a continual progressive trend upward. But as the song says--you may have heard it--"It ain't necessarily so."

I can remember back a quarter of a century in the days of Dempsey and Tunney, when a citizen could sit in his living room and, by a turning of a knob, could get a blow-by-blow description of a championship prize fight. Last week we found that can't be done today. Some invisoble social influences have intervened to deprive the citizen of this great cultural advantage.

Seriously, we are here to discuss the subject of "Social Influences on Technological Progress." When the Technological Progress Branch came to consider who might best present this subject, the name of Dr. Hart of Duke University was the first to come to mind. It was some years ago that Dr. Hart wrote an article for the "Sociological Review" on "Technological Acceleration and the Atomic Bomb," which attracted considerable attention, here, and is referred to in the technological progress monograph. The Branch, accordingly, invited Dr. Hart to come to the college and he was good enough to accept.

It is with very great pleasure today that I introduce Dr. Hart.

DR. HART: Technological progress has occurred at varying rates of speed according to the various interests of mankind. Of all the different fields of human endeavor, the swiftest acceleration in technological progress has occurred in the field of military technology. That fact is closely associated with the existence of this institution at which I feel highly honored to have the opportunity of meeting with you today.

I for one--and I know a great many citizens of the United States--have been profoundly impressed with the systematic and highly intelligent way in which our military leaders are coming to grips with some of the fundamental scientific problems related to these tremendous questions of social change of social evolution.

I should like to begin by presenting for your consideration a mathematical curve which attemps to sum up one of the indexes of technological progress. This curve represents the killing area (as I have called it).

By that I mean the area within which a given individual or military group can kill an enemy without contact with the earth between their base of action and the enemy. For example, let us take a Neanderthal man, several hundred thousand years ago. The Neanderthal man did not have a bow and arrow; indeed he did not even have a hafted spear. He may conceivably have had a wooden spear, pointed in a fire, but probably the longest distance at which he could kill an enemy would be the distance over which he could hurl a rock with sufficient power to crush the skull of his enemy. We can say with a good deal of confidence that this area would have a radius not longer than the modern shot-put record, but probably considerably shorter than that. Indeed, the maximum killing area of a Neanderthal man could certainly be fitted into the main part of this auditorium here.

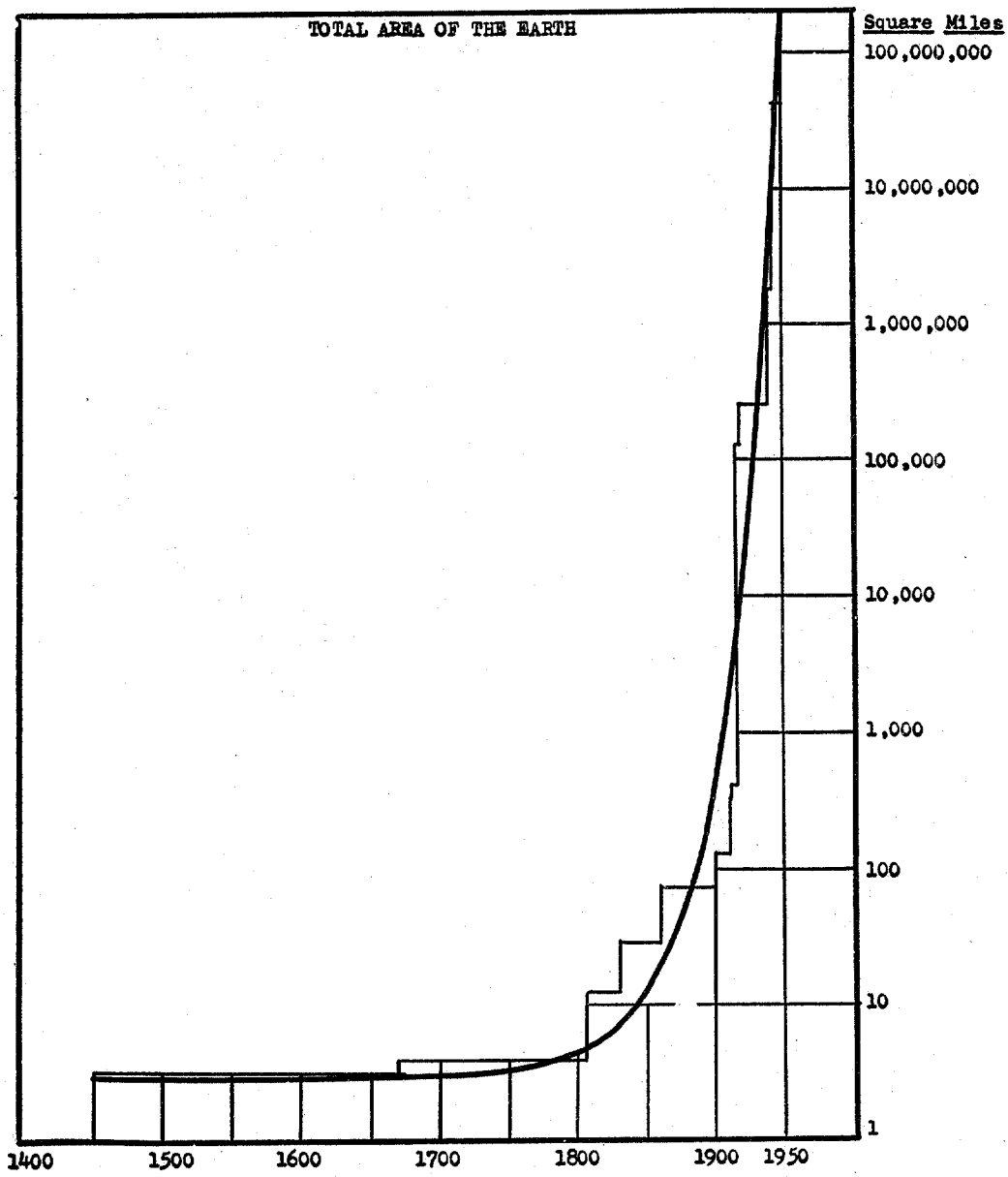
As the tens of thousands of years went by, gradually the prehistoric man acquired the hafted spear, then the spear thrower, and then the bow and arrow. At first it was a very simple bow and arrow; later on man acquired the crossbow. Then the ancients developed those tremendous machines for hurling rocks against the cities to which they were laying siege. By the time of Christ, the killing area had enlarged to approximately a quarter of a square mile. It stayed at that point until along about Columbus' time.

As you know, of course, cannon were first introduced with a range of approximately one mile, and the killing area went up and began to approximate three square miles (or a little more) and stayed about there until we began to gradually increase the range of artillery. Then we developed the bombing plane--and then the plane refueled in flight--until now (we civilians are told) it is possible for you military men to take off from a base here in the United States, to bomb any chosen target in the world, and, under reasonably favorable conditions, to come back safely to the base from which the flight started.

In other words the killing area as now developed is global. I would like to show you this growth of the killing area in Chart 1.

Chart 1, page 3, represents only the latter part of the development. It shows the total maximum killing area from 1750 to 1950, with a fitted loglog trend. When I talk about logistic curves and loglog curves, I am not talking about military logistics but about mathematical curves based on logarithms, in this case on the logarithm of a logarithm. The vertical divisions of Chart 1 are in terms of logarithms. That means that the multiplication for each division is about 10--the scale reads 1, 10, 100, and so on up. The total area of the earth is indicated by the top boundary of the chart. The growth of the killing area, with its various sudden rise

CHART 1



MAXIMUM KILLING AREAS, 1453 TO 1949, WITH LOGLOG TREND FITTED (Source of Data: Table 1.)

and then plateaus, has followed a curve which can be expressed adequately only in logarithms of logarithms.

Let us stop off a minute and ask ourselves, from the sociological standpoint, what that development implies. Obviously, the power to kill, to destroy, is shooting skyward with appalling rapidity. How can the danger implied in that acceleration be met? Well, I suppose that a great many military people would say that any increased offense is met by a corresponding development sooner or later in the defense. What we need is an adequate defense. We civilians are hoping that you military people are developing adequate defenses so that this power to destroy shan't be applied to Washington, D. C., first, and and then to the other great cities of the United States.

But (as a mere civilian--a mere college professor) I submit to you that this is not an adequate answer. In World War II the defense had been developed. There were methods of intercepting bombing planes. There was a tremendous application of intelligence and of military organization to shoot down attacking planes--and yet, at the end of the war, not only Berlin but vast areas of London were devastated.

I might say--just as a suggestive or illustrative curve, which cannot be demonstrated mathematically--that, if you take the number of persons killed per thousand of population in World War I in England and Germany and then figure the number of civilians per thousand of population who were killed in World War II, you find that the civilian death rate from bombing in World War II was 100 times as great as it was in World War I.

Those are just two points on a curve. We have a base line of zero, running back through history. Of course, a base line and two points can be made the basis for setting up a loglog curve, but not the basis for demonstrating it. Yet, if you interest these multiplied civilian death rates in the light of other military indexes, the trend is obviously headed toward the wiping out of civilization. That is not just a scare term, with which some sensational persons have tried to frighten America. That is the mathematical trend.

What is the offset to that? I take it we can find that inductively by observing certain significant facts. None of us is worried about whether New York is going to bomb Chicago. Why? Well, for two reasons: First of all, we Americans don't feel that way toward one another. We may argue politically, call each other names, and have tremendous presidential campaigns but we do not assault each other in a military way; or if anybody starts that, he is recognized as a gangster and is as promptly as possible put away by the FBI and the courts.

Furthermore, we are not afraid that Canada is going to bomb Washington, Detroit, or Chicago. And the British are not afraid that the United States is going to bomb London.

Such securities as these are the product of an offsetting development, which represents first of all the power organized in the Government. It represents, furthermore, the international attitudes which were partially organized in the United Nations, and more fully in the establishment of a World Court. It represents the fact that we are prepared to settle by negotiation and voluntary agreement any differences between us and Canada, between us and Great Britain, or between us and various other countries.

This offsetting development, then, is the rising curve of the democratic spirit, the accelerating upward curve of the willingness and the capacity to solve our differences, and to reach working agreements without destroying and killing. How about the adequacy of that development? Can we rest back and say, "That's nice! We can trust this readiness to cooperate democratically to take care of the accelerating power to destroy"?

Now, first of all, can we measure the trends in the power to cooperate? It is harder to get adequate measurements in that field than it is in military technology, but we do have certain indexes that go back into at least ancient times.

We have maps which show us the areas of the largest empires that man had achieved up to any given date during historic times and, from the study of anthropology, we can estimate the largest areas that were under any single government before the dawn of history. As, for example, the Iriquois League here in North America.

From the size of these areas governed from a single capital, we can get what we might call "the maximum governmental area," which may perhaps be used as a sort of crude basis for comparison. From it we can tell (within broad limits of error) what has been the rate of our development of security in the best sense of the word. By this I mean governmental security, the security of friendly and law-abiding attitudes, the security of democratic willingness to cooperate--as an offset to the capacity to kill each other and ruin each other's structures.

To get an index, we must classify our empires because there have been three fundamental types during the history of the world. First, there is the landborne empire, of which Russia is (or has been until quite recently) the outstanding representative. The Roman Empire

belongs in the same category--an empire which was extended and maintained primarily by means of land armies, with only incidental employment of naval forces.

The second type of empire is the seaborne. The best ancient example of that was the Phoenician state, which had colonies at various points around the Mediterranean Sea, and which maintained contact by means of that wonderful Phoenician fleet. The British Empire in modern times is the outstanding example of a seaborne empire.

But now we are developing a third type not, properly speaking an empire, but we might say an area of power, an area within which aggression might conceivably be restrained. That of course is airborne and, undoubtedly, the United States of America represents the supreme example of that development. You might perhaps ask me: How about the fact that Russia has a great many more airplanes than we do? As a civilian, and subject to your correction, I would suggest that the bulk of those airplanes are relatively short-range fighter planes and short-range bombers and, while the Russians have a few international bombers, some of them copied from our B-29 or other models, nevertheless, at the present stage of the game, and from the standpoint of airborne power, the United States is tremendously out in front.

Let us look for a minute at the development of the landborne empires of the world.

Chart 2, page 7, shows that on the left we have the Western World, centered in the Near East, North Africa, and Europe--around the Mediterrean sea. On the right side we have the Eastern World, centered in China Here are the early record-breaking empires in history, of which we have adequate maps--the Semitic, Median, Persian and Saracen Empires--each of which ruled a larger territory than any of its predecessors. These have been succeeded by the development of the Russian Empire in recent times.

Over here we have Shang, Choy, Tsin, Mao-Tun, Han, and Tang, and then that tremendous expansion of the landborne empire of Genghis and Kublai Kahn. The combination of Russia and China may be taken as the modern successor of both eastern and western record-breaking landborne empires, (though it is not shown on this chart).

These curves are of the type which, in our sociological sense, are called logistic--that is, based upon a function of logarithms.

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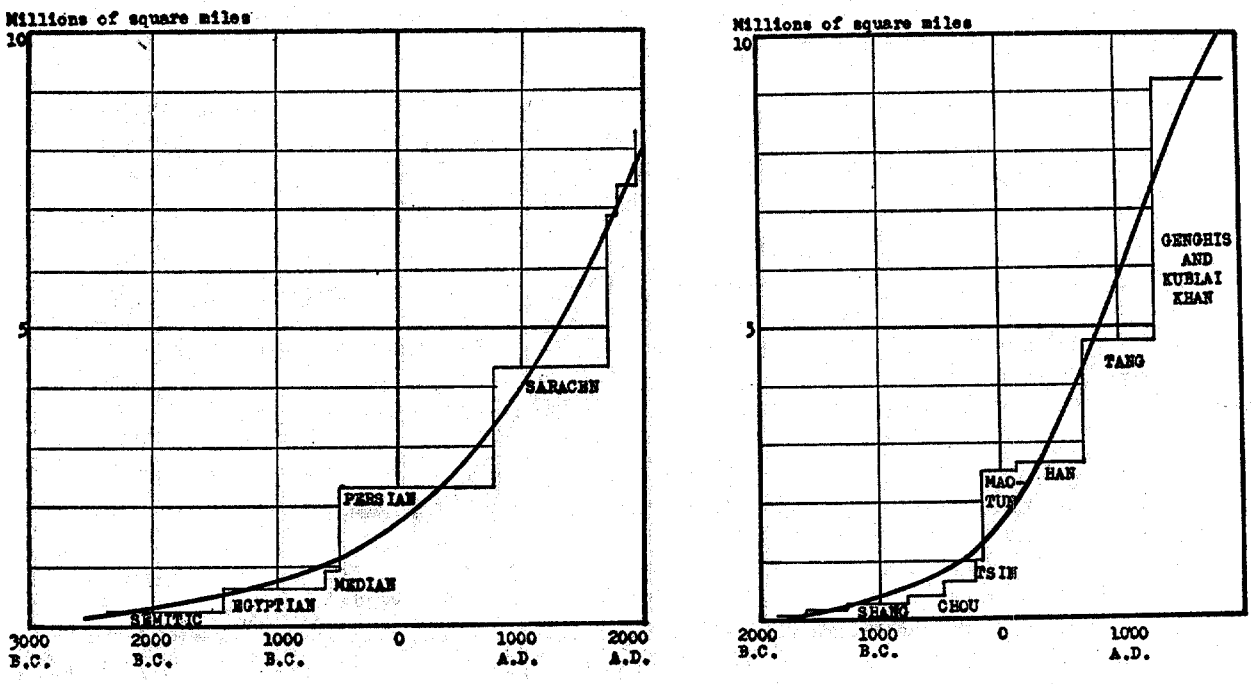
CHART 2



LOGISTIC GROWTH OF RECORD-BREAKING LANDBORNE EMPIRES
(Data from Tables 1 and 2; formulas for Curves, Table 3, Lines 1 and 2)
A (left). Western World (Centered in the Near East, North Africa or Europe. B (right). Eastern World (centered in China).

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They are the kind of curve which accelerates slowly at first, then more and more rapidly. Such curves reach a point of inflection and then proceed to slow down symmetrically but inversely with the early part.

The curves on both sides of chart 2 are logistic. You can see that there has been an acceleration in the development of landborne empires; If we wanted to put in the seaborne and the airborne, we would find the same type of developments.

How about the comparison between this acceleration and the acceleration in the power to kill? Is our power to govern--to maintain law and order in the world--increasing at a rate at all comparable to that of the power to kill? The next chart gives us an answer.

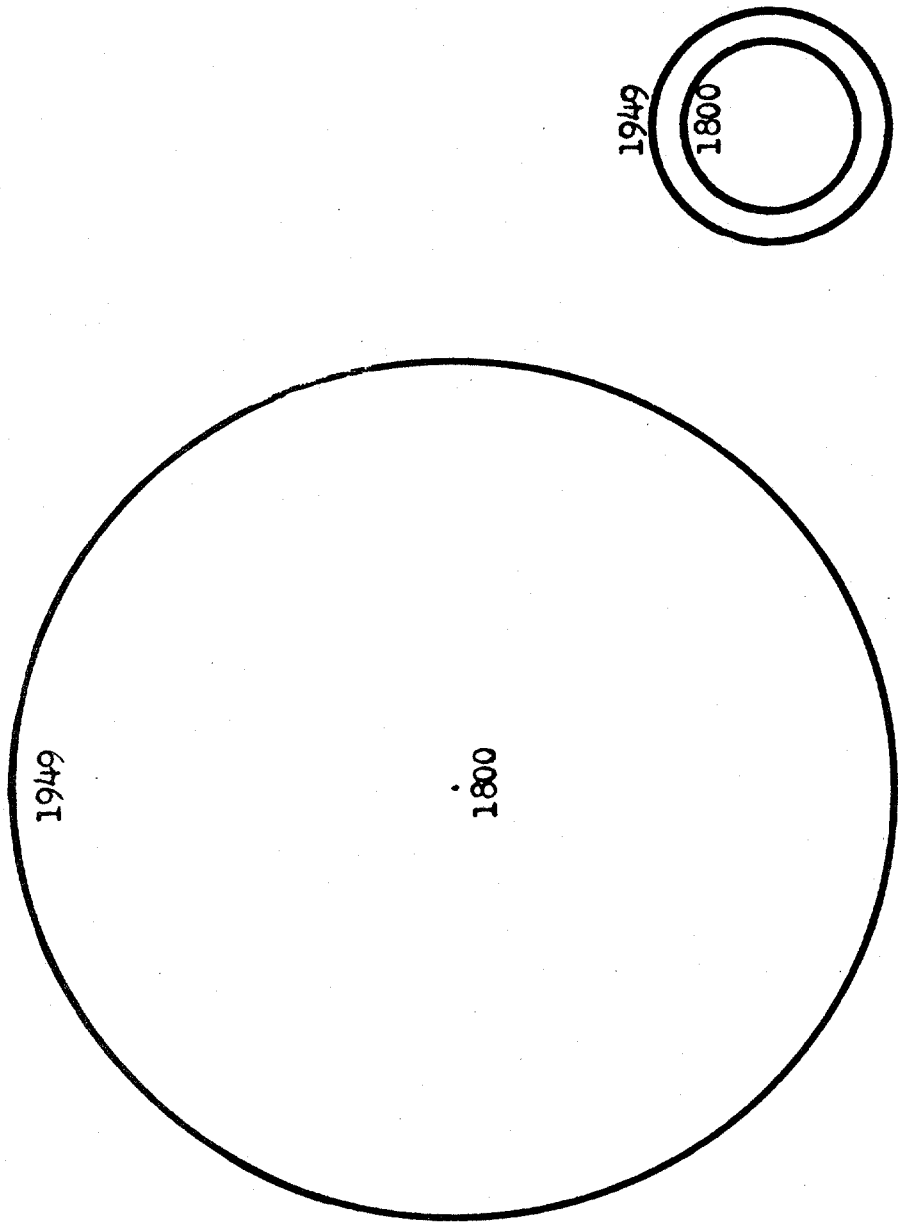
Chart 3, page 9, shows the growth in man's power to kill in comparison with the growth in man's power to govern. On the right-hand side, the 1800 circle represents the largest area up to 1800 which was governed from a single capital. The 1949 circle represents the largest area governed from a single capital up to that date. Of course, the United Nations is not a government, so its area is not included here.

The little dot in the circle on the left represents the maximum killing area in 1800. The large circle at the left represents the maximum killing area in 1949. The rate of increase from 1800 to 1949 is represented by the expansion in the killing-area circles, as compared with the increase in the circles representing the power to govern. That discrepancy is an example of what sociologists call cultural lag. Cultural lag represents the difference in the rate of progress in different indexes of social change, where those two rates are related and where the discrepancy creates a social problem.

The social problem created here is the problem of whether mankind is to survive, or if we do survive, whether we will survive on a basis of robber gangs wandering over desolate and largely radioactive ruins.

Before we try to get some sort of answer to that question, let me take up the point of whether the technological acceleration in military matters is or is not concurrent with a fundamental principle of accelerating change in other aspects of culture. Let us look first at a chart published in a sociology textbook.

CHART 3



Growth in the Largest Area Within Which Men Have Been Governed From One Central Capital, 1800 to 1949

Growth in the Largest Area Within Which Men Could be Killed From a Single Base, 1800 to 1949

GROWTH IN MAN'S POWER TO KILL, COMPARED WITH THE GROWTH IN MAN'S POWER TO GOVERN

Chart 4, page 11, was drawn in 1929. It represents, so far as I know, the first attempt to put into graphic terms an index representing long-range changes in any aspect of human technology. This chart represents accelerating human speeds. Down at the bottom we have foot travel. The speed of foot travel has not changed much since the ancient Greeks used to run their races, and the messenger from the battle of Marathon brought the news of victory--and dropped dead as he told it.

Up higher is speed by horseback. It is more or less a cliche to point out that when Napoleon wanted to get to the battlefield, the fastest way he could travel was by horseback.

Around 1829 the locomotive was invented. It increased its speed along the indicated curve. Then the automobile came in, and the speed increased along the indicated curve. Then airplane speed accelerated along their curve. The X's represent specific data points. When the author of the textbook was drawing the chart, the world record for maximum human speed was about 290 miles an hour. The author drew the chart with a top limit at 300 miles per hour. Before the book could go over the press, some aviator had made a record of 358 miles per hour. Not having time to draw a new chart, the author extended the curve right through the "roof." The chart was published in revised form in one or more subsequent sociology textbooks. Then, on 2 January 1950 "Life" magazine took the chart over, bringing it up to date.

Chart 5, page 12, shows the pony express back in 1800, two early locomotives and two later locomotives.

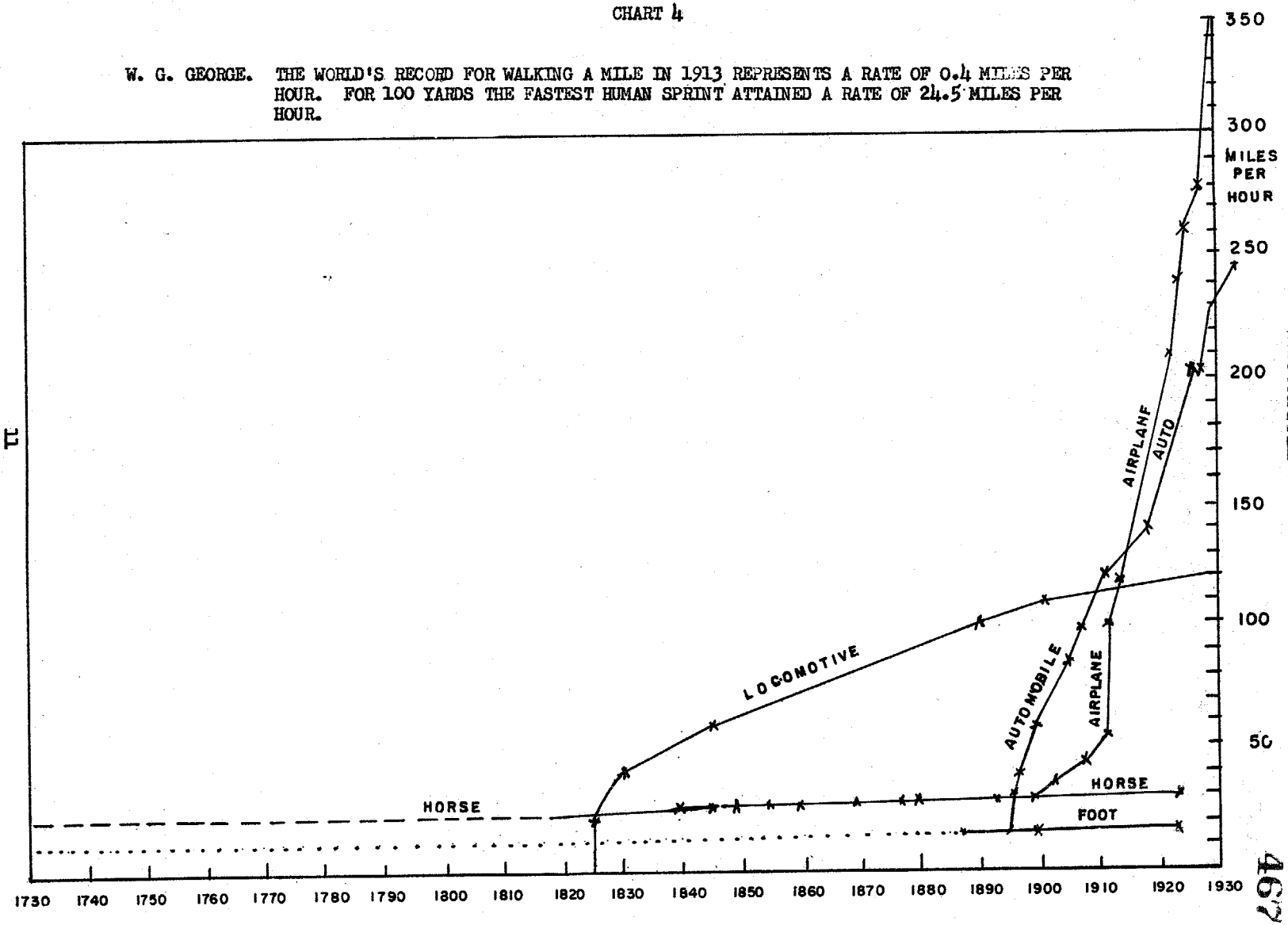
Then comes Oldfield's automobile which did 132 miles per hour. Then comes an early biplane; then the seaplane, which for a time, as you know, held a record higher than land planes; then other airplanes. The high point is 1,000 miles per hour in this chart in 1949. Of course, you know that last summer that record was officially broken by a Navy Skyrocket jet plane which went 1,238 miles per hour. I might suggest that you raise in your own mind the question: Where does this curve go from here?

For a number of year past I have been experimenting with trying to project the curve of human speeds into the future. But each time that I have made a daring projection, the aviators have later proved that I was much too conservative. Each time the actuality turned out to be a sharper acceleration than the one anticipated.

Another question arises: How is this curve of human speeds related to the trends of human culture in other respects?

CHART 4

W. G. GEORGE. THE WORLD'S RECORD FOR WALKING A MILE IN 1913 REPRESENTS A RATE OF 0.4 MILES PER HOUR. FOR 100 YARDS THE FASTEST HUMAN SPRINT ATTAINED A RATE OF 24.5 MILES PER HOUR.



ACCELERATING HUMAN SPEEDS

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CHART 5

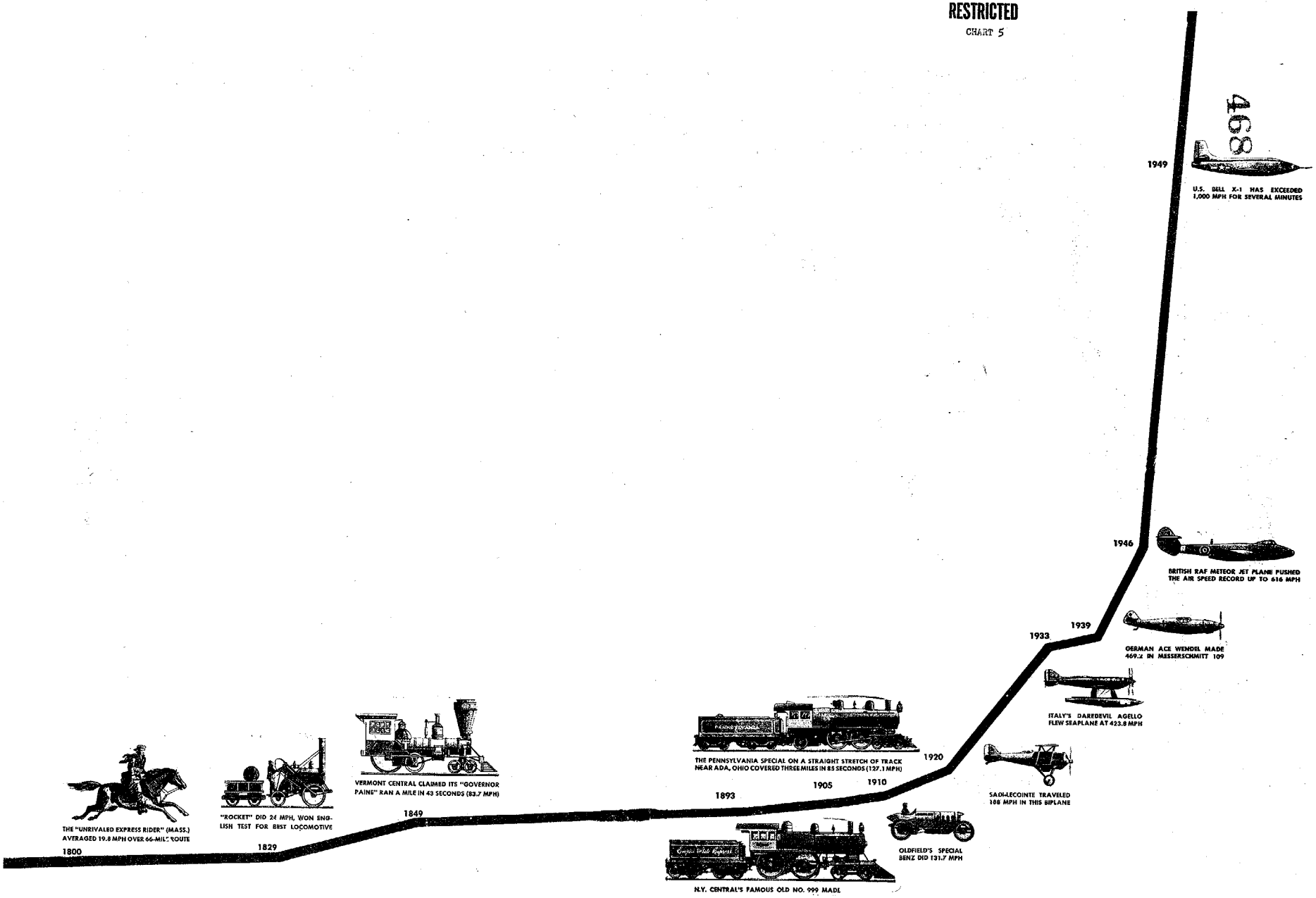


Chart 6, page 14, has four examples of curves that go back (in varying degrees) to ancient and prehistoric times. The one on contributions to science, down in the lower right-hand corner, goes back only to 1600; but, the others go back to varying dates--to 2,000 BC, 15,000 BC, and 100,000 BC. You will note each one of these curves is on a semilogarithmic grid. The vertical dimension is in terms of logarithms and the horizontal is in terms of arithmetical time units.

Let me call attention to what seems to be a blunder in the interpretation of these facts, which was made by Stuart Chase in his book, "The Proper Study of Mankind." I take it that this book is the best popular summary of this general subject which is in print at the present time. But Stuart Chase assesses cultural acceleration in accordance with the compound-interest curve. Now, the compound-interest curve, on an arithlog chart, would have to be a straight line. A straight line might be of varying degrees of steepness, but it would be a straight line.

Notice that not one of the trends in chart 6 is a straight line. The one in the upper left-hand corner represents a careful rating of the efficiency of cutting tools, beginning with eoliths. These were the first types of flints that could be recognized as having been chipped by human beings. You will see that the efficiency of cutting tools has been accelerated along a loglog trend.

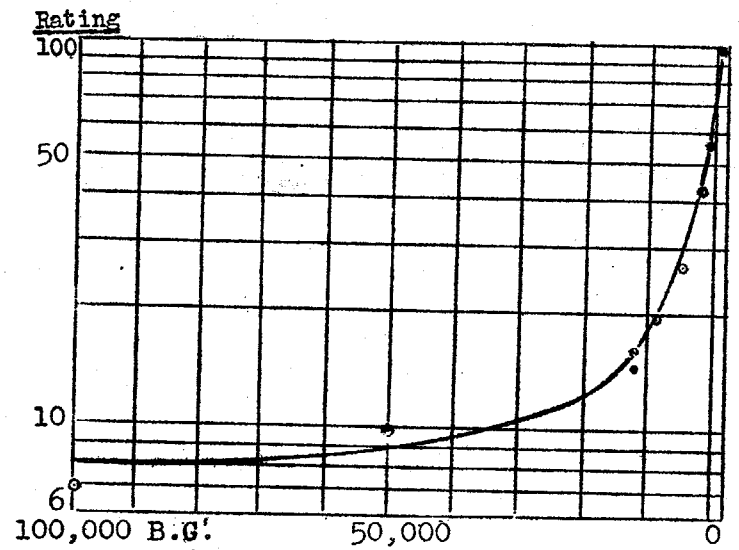
The curve in the upper, right-hand quarter represents the growth of diffusion rates. It is generally agreed that agriculture appeared in Egypt about 16,000 BC. It took 4,000 years for agriculture to spread up into the Scandinavian states. But just a few years ago some scientists in a Canadian hospital discovered insulin. Within one year insulin was in use in all the modern hospitals in the world. Thus inventions have diffused at rates represented by this curve, which has been rising with loglog acceleration.

The lower, left-hand quarter of chart 6 relates to expectation of life. Scientists can tell, by studying the skeletons of ancient and prehistoric men, what was the average length of life thousands of years ago. This curve shows that the expectation of life at birth is increasing faster now than ever before.

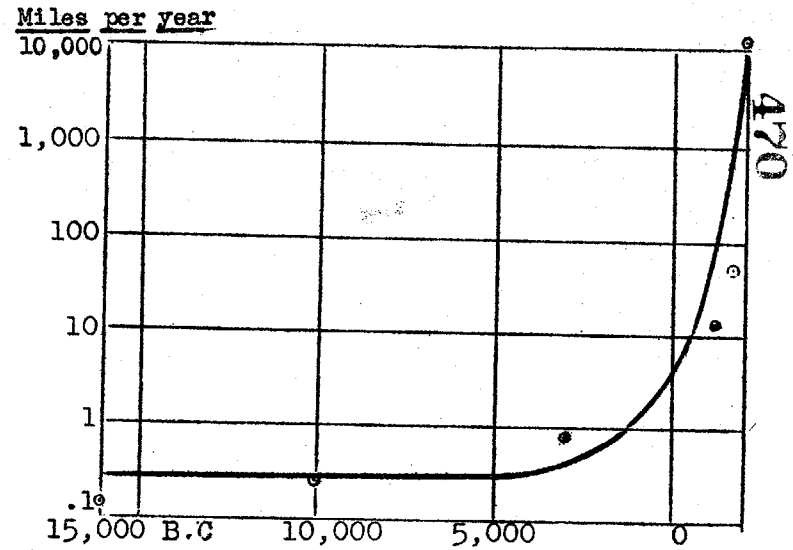
The curve in the lower, right-hand corner is not quite so sensational as the others; and yet, this curve of contributions to science, based on charts worked out by sociologists, shows that scientific discovery also is accelerating faster than a compound-interest curve.

Let us take another example which comes close to something in which you have been directly interested.

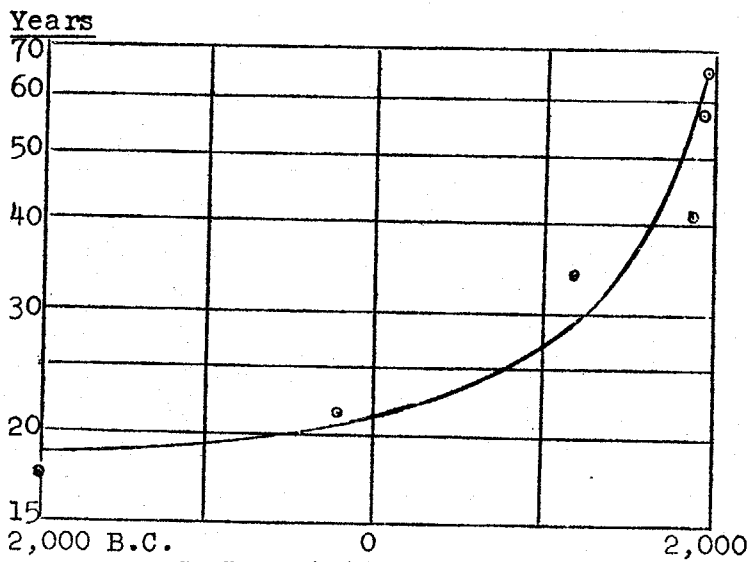
CHART 6



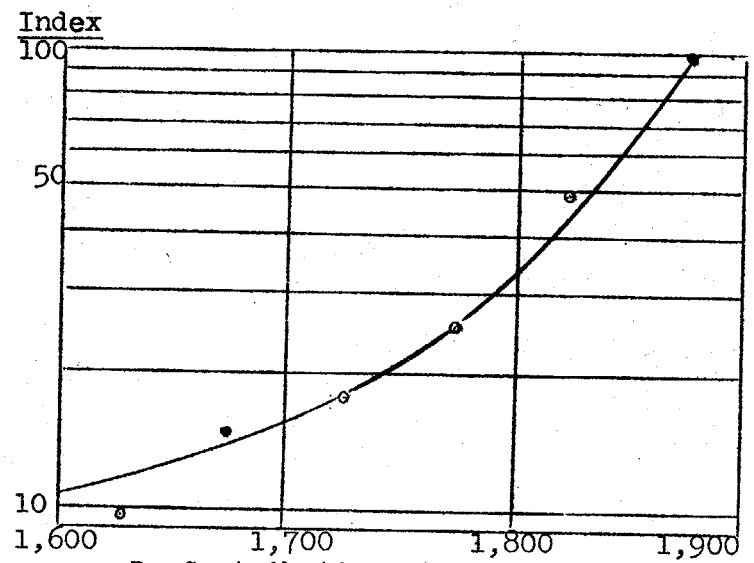
A. Efficiency of Cutting Tools



B. Diffusion Rates



C. Expectation of Life



D. Contributions to Science

FOUR EXAMPLES OF CULTURAL ACCELERATION

Chart 7, page 16, is entitled "Wealth Producing Power Compared Internationally." The international unit is producing power per manhour of work, based on prices in 1934.

At the beginning of this chart, in 1825, the English-speaking nations other than the United States produced more per man-hour than we did. Their curve has been accelerating slightly, up to the latest available date. The United States curve is of an even more clearly and sharply accelerating type. However, various economists have pointed out that the best fit for that curve is of the compound-interest type.

The lowest line in the chart represents wealth-production per man-hour in the USSR. The dotted gap represents years missing during World War II. Quite likely this curve has gone up somewhat during the past few years--but not enough to make very much difference in the comparison between the United States and the USSR. Of course we must remember that in Russia people are able to devote a larger fraction of their wealth-producing power to the manufacture of tanks, airplanes, atomic bombs, and that sort of thing.

From these accelerating curves, representing the production of wealth by various nations, let us now turn to another index of their performance in producing death. One such product I spoke about earlier--namely, the civilian death rate from aerial bombing.

Chart 8, page 17, is a graph representing the military death rate. These figures are based upon data published by Professor Sorokin of Harvard in his book, "Social and Cultural Dynamics." You will notice up to 1700 there was an accelerating trend in military casualties per thousand of population. Then came a drop, that drop represents Pax Britannica. It represents the period during which the British Navy ruled the sea-- most successfully during the Victorian Age.

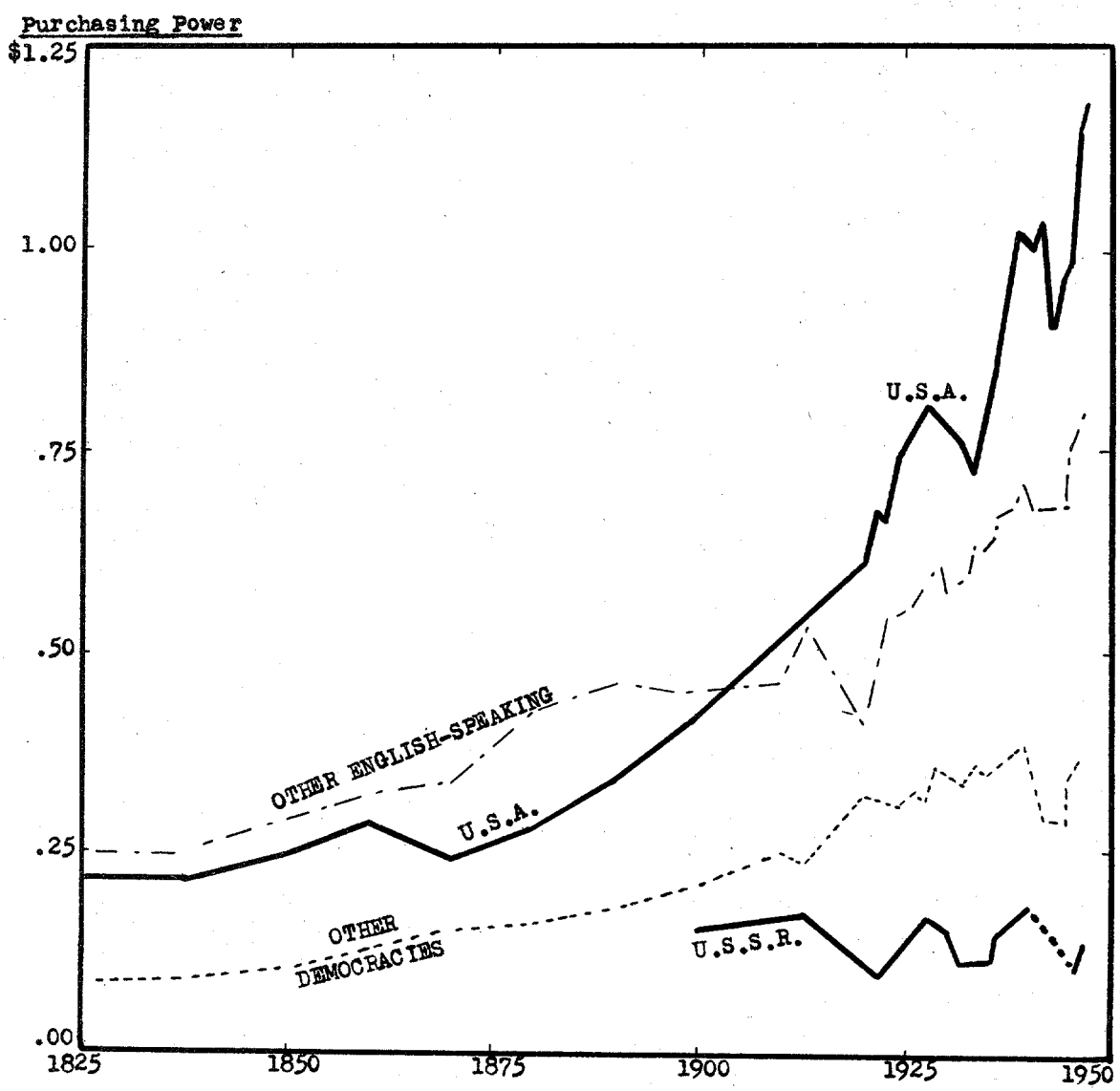
Then Germany broke loose as an aggressive and dictorial power, but at the present time, of course, Soviet Russia presents the menace that may carry that curve up farther. In any case the over-all trend is again this appallingly accelerating upward curve.

Is there anything that can be done about it? I am going to show you six examples of death rates which were produced by technological change, in which mankind by concerted effort has reversed those trends and sent the curve downward toward zero, instead of letting it go upward like the trend toward destruction of civilization. Let us look at these six charts.

472

CHART 7

WEALTH-PRODUCING POWER COMPOUND INTERNATIONALLY

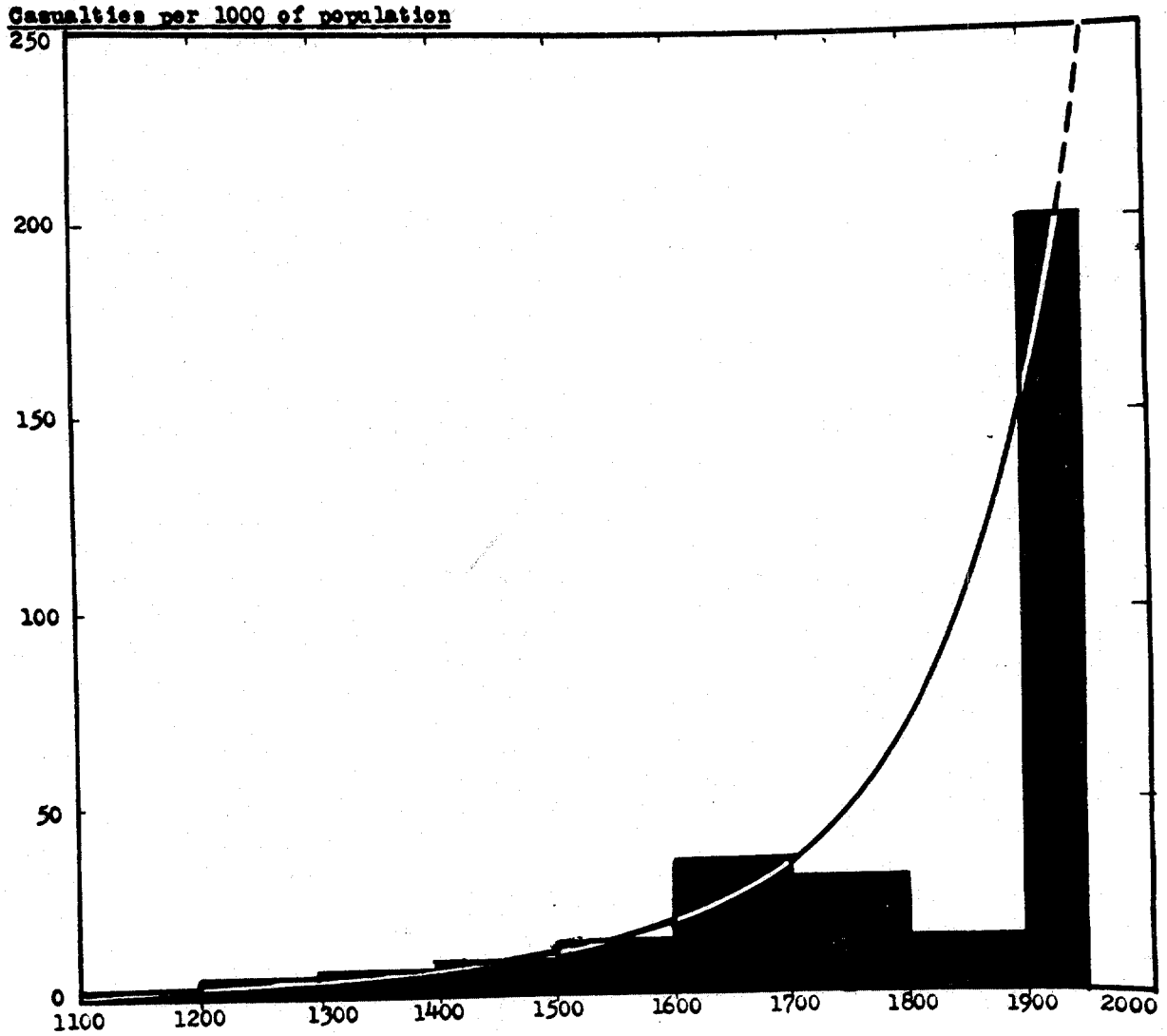


National product per man-hour, in purchasing power at United States 1925-1934 prices, in the United States, the Soviet Union, and two groups of democracies, for available dates from 1825 to 1947.

Source: Clark, Colin, "Levels of Real National Product per Man-hour," Review of Economic Progress, vol. 1, April 1949, p. 1-2.

CHART 8

THE ACCELERATING INCREASE OF WAR CASUALTIES, 1100 TO 1950



474

Chart 9, page 19, is entitled "Six Social Conquests of Death Problems." Let us start with the one in the lower, right-hand corner, the railroad fatalities per billion freight-ton miles. When railways first began, the curve started at a low level. But the mileage of railroad traffic increased; so did the speed of railroad trains, the number of persons employed and the number of persons traveling on railroads. The fatality curve then rose far above the top of F on chart 9.

Then safety methods began to be applied. You can see the descending curve heading toward close to zero. This represents the results of man's deliberate, planned, cooperative conquest of a death rate due to technological cultural lag. Technology had shot out ahead of man's power to manage it; then man gradually caught up with it again.

Up above the railroad death curve is C on chart 9, representing aviation's passenger fatalities per hundred million passenger miles. This curve comes down much more sharply than the railroad death curve. It tends to flatten out on a plateau, indicating that we are not yet headed for a zero rate--as we may on some of the other curves.

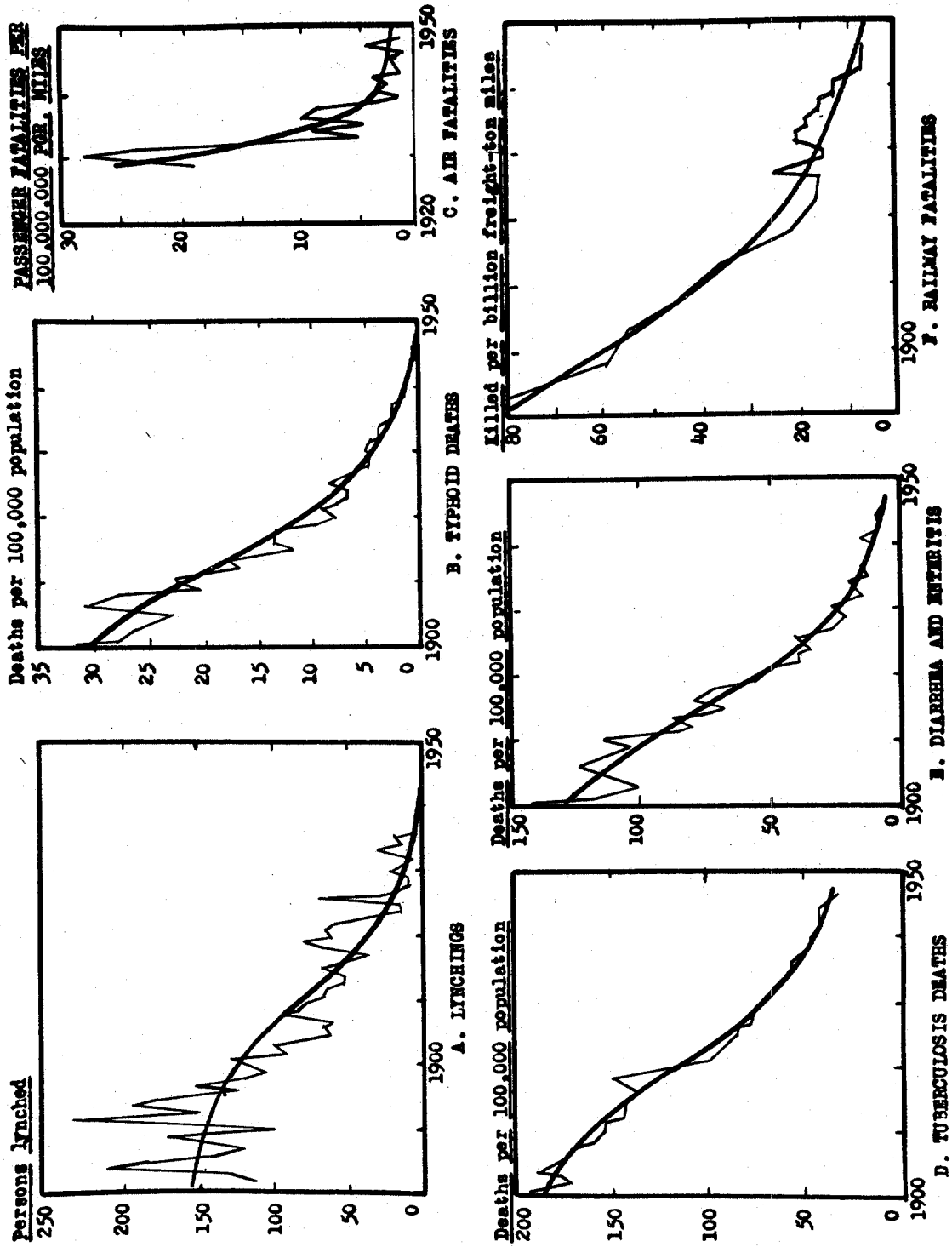
Let us jump to other death problems created by technological progress and curtural lag. B shows on chart 9, the typhoid death rate, which was hoisted aloft by the invention of the industrial city, and then by the subsequent invention of sewerage systems. When I first moved to Milwaukee, the city government was dumping sewage into Lake Micgigan and then pumping drinking water out of Lake Michigan. The result was that, in some epidemics 400 or 500 Milwaukeeans died of typhoid fever in one year. But now typhoid fever is practically down to zero. The same with diarrhea. That also was created by the invention of cities. Then with the great health inventions of recent years that curve also has been going down toward zero. The tuberculosis death rates have been heading downward in the same fashion.

In the upper, left-hand corner is a curve representing lynching. There used to be a great need for an antilynching law. The lynching rate used to average 160 per year. Now it is between four and zero per year. That represents concerted social idealism--the building up of attitudes and social structures which reduce those death rates.

Now I want to say a few words about the reasons for cultural accelerations. As you are all doubtless aware, every invention is a new combination of previously known elements. Take the airplane, for example--the Wright Brothers' airplane at Kitty Hawk was a combination between the box kite, the screw propeller, the gasoline engine, the human body and what the Wright Brothers really contributed--flexible flaps to balance the (called "ailerons") machine.

SIX SOCIAL CONQUESTS OF DEATH PROBLEMS

CHART 9



476

Every invention is thus a conbination of previously existing factors. Starting with that basic principle, we have five fundamental explanations for the speed of social change.

1. The first factor is: How many different elements are available to the inventor to be combined? The cave man had his fingers; he had the dirt he walked on, including the clay in the bog; he had the sticks that grew in the forest and in the shrubs. He had the wild animals about him and the skins he could take off them by knocking two stones together to get a knife to flay them. He had a few simple ideas; that is about all he had. And the number of inventions he could make was sharply limited by the number of items he possessed and could combine.

By way of contrast, consider the number of elements the modern inventor has. He possesses knowledge of the chemical elements and the unlimited possible combinations between those elements--plastic, different types of wood which are available, ceramics. These are just in the line of raw materials. You can go to any other field for examples.

The primitive man had not more than three or four different kinds of cutting instruments. The last time you went to the dentist's office you may have glimpsed a few of the vast number of kinds of torture instruments he had in his cabinet. That is just one type of cutting instrument. Then there are the number of cutting instruments which the steel mill has, the butcher shop, the biology laboratory, and so on. The number of units available for combination in new inventions has increased at an accelerated rate of speed. That is the factor most sociologists and anthropologists emphasize.

2. There is a second factor, the potency of the elements which are to be combined. Take for example the man who, say, invented horseback riding, or donkey riding, or maybe camel riding--whoever invented riding on the back of a partially domesticated animal. Combining himself and this four-footed beast he could achieve a speed of perhaps 10 miles an hour. If we had a race horse, he could make a brief dash, up to 25 or 30 miles an hour.

But now take your modern aviation engineer, with 10,000 horses at his command for power alone. Here is a vast increase in the potency of the available elements.

Again, consider the man inventing the first magnifying glass. He took an odd-shaped bead and when he held it above his hands he saw that it made the hairs seem to look larger. He multiplied seeing power by perhaps two or three diameters.

Compare that with the invention of the electron microscope. The power of the units which that inventor had available to be combined enabled him to multiply seeing power ten-thousandfold.

3. The third great factor is one of the fundamental explanation of why military technology has accelerated so much more rapidly than have other kinds. It is because of the urgency of the need. When you have to invent something, you do invent something--at least if you are going to survive, you do.

4. Crucial from the standpoint of the possibility of controlling cultural lag is the fact that the speed of social change depends, among other factors, upon the techniques of invention and discovery which are employed. Back in ancient and prehistoric times, discovery and invention were practically always matters of accident. For example, the primitive basket maker lined his basket with clay, to hold water, and then set his water-filled, clay-lined basket near a fire. When the basketry caught fire, it burned the lining into a pottery jar; thus a crucial invention was made by accident.

In more recent times, invention and discovery have made use of systematic fumble-and-succeed techniques in trying out as many combinations as possible, hoping to hit upon one which will work. More and more, as science itself has developed, inventors have become aware of underlying principles enabling them to select intelligently the inventive combinations which would be most likely to work.

The scientific type of invention has come to be very widespread, if not almost universal, in technological invention; but, we are still far from reaching it in our attempts to invent the social machinery which might prevent our accelerating technology from destroying urban civilization. Probably the most promising line of action which could be taken by the Industrial College, or by any of us who have become thoroughly awakened to the challenge of the present world crisis, would be to stimulate and facilitate the scientific study of the processes of social invention, particularly as applied to the solution of the problems of cultural lag.

5. The fifth factor determining the speed of social change is the speed with which an invention spreads after it has been made. This is usually referred to as "the speed of diffusion." Three subfactors are of major importance in determining the speed of diffusion. The first of these consists of the efficiency of the means of communication. The development of scientific journals, for example; the holding of discussion meetings of learned societies; the discussion of social problems in newspapers and periodicals, and the like, have all made it progressively

easier and easier for social inventors to become aware of what other social inventors are doing and discovering; they have also made it easier for the general public to learn about such inventions as sociologists and other social scientists may develop.

The second factor is negative, namely, the extent of obstacles to communication. In prehistoric and ancient times, language barriers were of major importance in this respect; suspicion of "foreigners," anachronistic and restrictive rules by governments and other agencies--such things as these--have been potent in holding back progress.

In this connection it is interesting to speculate whether the Soviet Government, by its prohibition of free discussion, by its insistence upon conformity to Communistic dogmas and the party line, and by its use of fear and fraud as methods of social control, may not crucially hinder the progress upon which the very life of the Soviet Union may depend. However, it is certainly not safe to count upon this possibility as a major factor in helping the democracies to survive the menace of Soviet attack.

The third subfactor affecting the speed of diffusion is the attitude which people take toward social change. Most of the fundamental inventions have been bitterly resisted by people who felt that their own vested interests were menaced by the innovation. Railroads, labor-saving machinery, airports near cities, anesthetics used in connection with childbirth--these are mere offhand examples of social developments which have had to struggle against bitter social resistances.

On the other hand the general public is coming more and more to expect increasing and even accelerating progress in such fields as automobile transportation, television, military weapons, scientific knowledge, the conquest of disease, and other fields.

One of the problems which confronts us is that of making clear to the people who are in control of crucial decisions the urgency of the need for solving cultural lag in the field of the control of the weapons of mass destruction, and of engendering the sorts of attitudes which will lead to effective social progress.

The accelerating development of technology, of science, and of social knowledge have opened up the possibility of turning earth into a paradise.

But the unsolved problems of cultural lag still threaten our very existence. Whether our children and our grandchildren are to live a life of unprecedented richness and joy, or whether they are to exist (if they survive at all) in a world of radioactive ruins and of social anarchy, is a question which hinghes, to a great extent, upon the effectiveness with which organized intelligence is applied to the crisis of our age.

(28 Nov 1950--750)S/mmg