33. S. Mednick and F. Schulsinger, in *The Transmission of Schizophrenia*, D. Rosenthal and S. Kety, Eds. (Pergamon, Oxford, 1968).
34. R. Parnell, *Behavior and Physique* (Arnold, London, 1958).
35. E. A. Lane and G. W. Albee, *Amer. J. Orthopsychiat.* **35**, 747 (1965).
36. E. Gellhorn and G. Loofbourrow, *Emotions and Emotional Disorders: A Neurophysiological Study* (Harper & Row, New York, 1963); W. Ross, J. Hay, M. McDowal, *Psychosom. Med.* **12**, 170 (1950); P. Huston and M. Pepernik, in *Schizophrenia, A Review of the Syndrome*, L. Bellak, Ed. (Logos, New York, 1958); C. Rosenbaum, *J. Nerv. Ment. Dis.* **146**, 103 (1968); H. Freeman, in *Schizophrenia, A Review of the Syndrome*, L. Bellak, Ed. (Logos, New York, 1958); L. Rees, in *Schizophrenia: Somatic Aspects*, D. Richter, Ed. (Macmillan, New York, 1957).
37. J. Huxley, E. Mayr, H. Osmond, A. Hoffer, *Nature* **204**, 220 (1964).
38. R. J. Britten and E. H. Davidson, *Science* **165**, 349 (1969).
39. J. Karlsson, in *The Transmission of Schizophrenia*, D. Rosenthal and S. Kety, Eds. (Pergamon, Oxford, 1968).
40. L. Heston and D. Denney, *ibid.*
41. P. Tienari, *ibid.*
42. E. Inouye, in *Proceedings, Third World Congress of Psychiatry* (Univ. of Toronto Press, Montreal, 1961), vol. **1**, p. 524.
43. F. J. Kallmann, *Amer. J. Psychiat.* **103**, 309 (1946).
44. J. Shields, I. Gottesman, E. Slater, *Acta Psychiat. Scand.* **43**, 385 (1967).
45. E. Kahn, *Monogr. Gesamtgeb. Neurol. Psychiat.* **36**, 1 (1923).
46. B. Schulz, *Z. Gesamte Neurol. Psychiat.* **168**, 322 (1940).
47. G. Elsässer, *Die Nachkommen geisteskranker Elternpaare* (Thieme, Stuttgart, 1952).
48. I thank James Shields, John Price, Irving Gottesman, and Russell Noyes, who commented on various phases of this manuscript.

Casualties of Our Time

Social and technological changes produce new sources of death and disability which raise public issues.

Amasa B. Ford

"It is changes that are chiefly responsible for diseases, especially the greatest changes, the violent alterations both in the seasons and in other things."

—HIPPOCRATES

Violent alterations in the human environment have occurred at an increasing rate since the beginning of the Industrial Revolution. From the late 18th century, dislocation from the land, turbulent crowding in growing cities, and the economic deprivations of factory life affected the health of the people. Old diseases like tuberculosis flared up, and new sources of death and disability developed, such as the industrial injuries which were incurred by inexperienced hands attempting to master new machinery. Great changes, visible in a man's lifetime, gave motives for new laws and institutions. Social hygiene, with tardy assistance from therapeutic medicine, brought effective measures to bear on the new health problems, while hospitals, asylums, and other institutions were established to take the place of the now obsolete welfare systems of farm and village. Economic and technological changes thus produced specific new kinds of casualties, along with new resources for coping with them.

In the present century, the rate of change has accelerated. Many old problems have been mastered, but new ones have arisen. "Poor laws" and workhouses have gone the way of phthisis and chlorosis. Now we must ask whether general hospitals can cope with increasing drug addiction among alienated youth or how health departments can protect the public against cigarettes and overeating. But before we can restructure our health services we must assess what we know about the particular health needs of today. Because established social institutions have great inertia, change is slow and tends to lag behind need. New problems, therefore, call for special attention, since they foreshadow future needs.

The purpose of this report is to identify sources of death and major disability which are new or are of new importance in developed countries in the two decades since World War II. Using examples from Great Britain and the United States, we make some estimates of how people are being affected.

Certain casualties result from immediate causes, such as the toxic effects of a new drug or the increased use of motor vehicles. Many, possibly more, take the form of major disability resulting from conditions that have complex origins. Examples are the extended survival of old people with chronic disease and the social alienation of young people. A rough classification by cause will serve as an outline, since an understanding of how disease originates is the most reasonable basis for control and prevention. Effects on health may be produced by changes in population, by technological developments, by new factors in medicine, or by shifting social and cultural patterns. These categories, however, should not obscure the fact that specific casualties may result from multiple causes.

Signs of Change

Prosperity and life expectancy have reached unprecedented levels in developed countries during the past 20 years, but there are indications that we may be approaching the limit of effectiveness of current methods of disease control and prevention.

In the early 1950's infant mortality rates ceased to improve at the rate which had prevailed for many years. In the decade 1946–56, rates had decreased 46 percent in the United States and 45 percent in England and Wales. In the subsequent 10 years, they decreased only 16 and 22 percent, respectively. The estimated average length of life, which in effect is inversely related to infant mortality, has increased to 70.1 years in the United States and 68.4 years in England and Wales, but the rates of increase since 1956 have been less than a fifth of what they were in the previous 10 years. The progressive reduction of deaths in the first year of life, which has been one of the finest fruits of social and medical development

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for over 100 years, has been arrested.

Similar changes are taking place in other mortality rates. Until the mid-1950's the trend of the overall death rate in the United States was downward. Since then it has leveled off, while in England and Wales, as well, the general mortality rate has been almost stationary for all age groups since about 1956. Some continued improvement in death rates from major infectious diseases has been counterbalanced by substantial increases in overall mortality from such conditions as ischemic (arteriosclerotic) heart disease, malignancies, motor vehicle accidents, pneumonia, and cirrhosis of the liver.

In addition to these broad changes in mortality trends, some kinds of morbidity have been moving counter to the economic tide in these two decades of affluence. Although employment and consumers' expenditures have continued to rise, so has "sickness-absence" from work. While a greater proportion of young people attend colleges and universities every year, crime rates, drug addiction, and illegitimate births are increasing more rapidly among teenagers and young adults than in any other age group.

These trends may be temporary eddies in a stream of general progress or the first signs of rocks ahead. In either case, they warn that medicine and public health are facing new tasks for which old methods are not adequate. Let us examine some specific problems.

Population Changes

The numbers of persons aged 65 and over in the United States increased from 10.4 million in 1946 to 18.5 million in 1966. This increase of 78 percent was twice that of the general population during the same period [Table 19 in (*1*)]. The rate of increase for those aged 75 and older was even greater: 111 percent in the same period. These trends have altered the age structure of the population. Since disability increases rapidly with age, an increase in numbers of old persons means a disproportionate increase in those who need care (Table 1).

Thus, in the United States there are 700,000 older persons in institutions, and this number has been increasing by an average of 15,000 a year for the past 20 years. There are, moreover, from two to four times as many disabled older persons living at home, and their numbers have likewise been growing more rapidly than other groups in the population.

Table 1. Measures of disability among older persons in the United States in the 1960's (*49*).

Status of persons	Age			
	65–74		75+	
	Rate (per 1000)	Number (1000's)	Rate (per 1000)	Number (1000's)
Persons in institutions				
In nursing and personal care homes	8	90	57	355
In geriatric and chronic disease hospitals and wards	2	19	6	37
In long-stay mental hospitals	9	99	11	67
Disability among persons not in institutions				
Blind or unable to read newsprint	24	263	96	565
Deaf or unable to hear conversation	162	1808	317	1904
With one or more chronic condition and:				
Unable to work or keep house	135*	2370*		
Confined to house	47*	821*		
Need help in getting around	65*	1139*		

* Those over 75 also included in these totals.

Population migration within a country, especially when it occurs rapidly, is likely to be followed by social maladjustment with adverse effects on health. An example is the massive postwar movement of Negroes from the rural south and whites from the impoverished areas of the western Appalachians into the northern cities of the United States. Over the past 20 years, between 0.5 and 2 million persons have migrated from farms every year, while the farm population has declined from 18.0 to 6.4 percent [Table 24 in (*1*)]. The nonwhite population of 19 of the 21 largest cities in the United States increased by over a third between 1950 and 1960. The resulting strain on health and welfare services is evidenced by the fact that during this decade 13 of these large cities experienced rising infant mortality rates among nonwhite residents (*2*). In five of these cities rates increased among whites as well. By 1966 the situation had improved in some cities, but in four, the infant mortality rates among nonwhites continued to rise, while in one the rate among whites was again higher than in 1960. This drastic population movement has affected more than infant mortality. It has been a groundswell under the urban violence which has periodically swept through American cities in the past 10 years. Migrants into the cities have transferred from their rural environment educational, social, and nutritional deficiencies which have accentuated contrasts in health between the poor in the center cities and well-to-do suburbanites. Recently enacted programs have so far not been able to reduce the casualties of this latest wave of migration into the cities of North America (*3*).

Technological Change

Rapid technological change has become so familiar in developed countries over the past 20 years as to blunt our perception of what is happening. Greater ease of living tempts us to overlook costs in human health. Whereas the effects of some changes, such as environmental contamination, are complex and may take years to assess, the impact of the automobile is unmistakable. We can begin to count these casualties now.

The annual crude death rate from motor vehicle accidents in England and Wales increased from 95 per million in 1946–47 to 110 per million in 1956–57 and, even more rapidly, to 152 per million in 1966–67 [Table 8 in (*4*)]. About 40 percent of these deaths were attributed to skull fracture or head injury. Many of those who died in this way were old people, but there was also a disproportionate mortality among young men (Fig. 1). The death of a young man entails the social loss of his productive years. Still more costly is the increasing number of young people who survive head injuries to live for years with residual disability.

A rough estimate of the morbidity resulting from head injuries can be based on records of hospital discharges in England and Wales. During the 8 years for which data are available, the numbers of discharges with a diagnosis of head injury have

increased at an annual rate of almost 5 percent. Of these injuries, 46 percent resulted from traffic accidents [Table 18 in (*5*)]. The estimates in Table 2 are probably high, since the relationship between "discharges" and numbers of patients is unknown. The actual figures, however, would not be likely to be less than two-thirds of those presented (50 percent readmission rate in a year). Thus, at least 1000 disabled people are being added to the population every year from this source, and the rates continue to increase.

Ecological Casualties

The casualties of motor vehicle accidents can be attributed to an immediate cause. But for several other forms of death and disability which may result indirectly from advancing technology, a cause and effect relationship is more difficult to establish. Public attention has recently been directed to the possible effects of environmental pollution on human health (*6*). Scientific evidence is beginning to clarify the dangers (*7*). Some of the most evident environmental pollutants which have been accumulating at an increased rate during the past 20 years are pesticide residues in soil and food chains, fallout of isotopes with long half-lives, and an increased burden of organic and mineral wastes in surface water.

Air pollution is a form of contamination which has been studied particularly intensively in the past 10 years, and its relationship to emphysema and chronic bronchitis is becoming more evident. These diseases are major causes of sickness-absence, chronic disability, and mortality in industrial countries. In the United States and the Netherlands death rates from these conditions have more than doubled since 1950 (*8*, *9*).

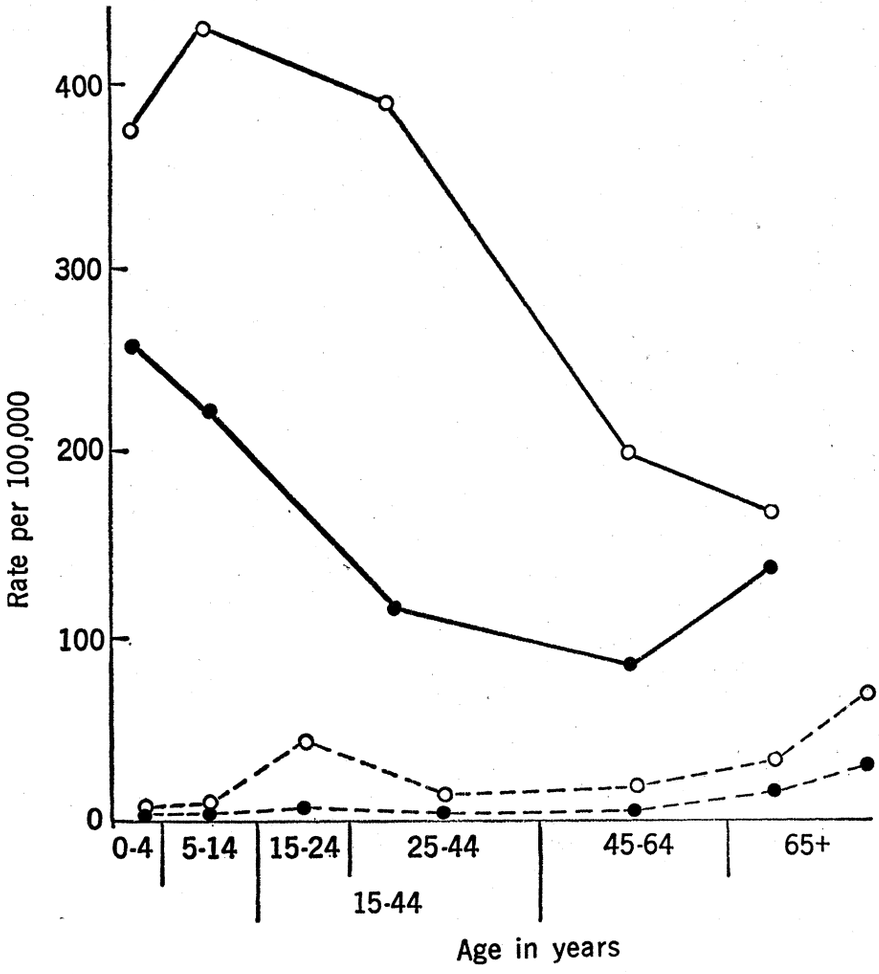

Fig. 1. Hospital "discharges" (solid lines) due to head injury (I.C.D. codes N800, N801, N803, N804, and N850–N856) and deaths (broken lines) due to motor vehicle traffic accidents (I.C.D. codes E810–E825), by age and sex, England and Wales, 1965. (Open circles) Males, (solid circles) females. [Table 18D in (*4*) and Table 19 in (*5*).]

Links between chronic bronchitis and emphysema on the one hand and air pollution on the other are becoming firmer. Sudden increases in respiratory illness and death were dramatically evident in the London smog of 1952, when an excess mortality of 4000 persons was recorded in a 5-week period (*10*). Subsequent work has shown that changes in the atmospheric concentration of oxidants, carbon monoxide, sulfur dioxide, and oxides of nitrogen are significantly related to hospital admission rates and length of stay for respiratory and circulatory conditions (*11*). Symptoms of chronic pulmonary disease have been found more frequently in areas of greater air pollution (*12*). Anatomic emphysema increases in prevalence above the age of 40 and has been shown to be more common in a sample from a heavily industrialized urban community with high air pollution than in one from a prairie-agricultural city with much lower pollution (*13*). As the epidemiologic picture of chronic pulmonary disease develops, the "cause," like that of other chronic conditions, appears to be the interaction of several environmental and host factors, including age, climate, and smoking as well as air pollution (*14*).

Efforts to make even a rough estimate of casualties due to air pollution are beset with difficulties. Etiology is complex, nomenclature has changed, and bronchitis and emphysema are both diagnoses which are frequently linked with other diseases. Still, the fact remains that 18,763 more deaths were attributed to these two causes in the United States in 1966 than 10 years earlier—an increase of almost two and a half times, and one observed at all ages above 35 (*9*). If only one half of these increased deaths were attributable to air pollution, this would still amount to nearly 1000 additional deaths a year. Chronic bronchitis and emphysema are typical chronic diseases, in which years of increasing disability usually precede death. The price of a polluted atmosphere in terms of illness and reduced functional capacity may be greater than its cost in years lost through premature death.

In addition to air pollution, new methods of food preparation and han-

dling, massive distribution of detergents, pesticides, and antibiotics, and increasing military and industrial use of radioactive materials all pose possible threats to human health by environmental contamination. Whether strontium-90 in the bones or chlorinated hydrocarbon residues in other tissues will eventually produce casualties cannot be predicted now, but these processes call for close surveillance. The fact that mortality from heart disease and from major malignancies of the digestive, respiratory, and urinary tracts all show positive correlations with degree of urbanization in the United States suggests that environmental pollution may contribute to other conditions besides chronic pulmonary disease (*15*).

Curiously, the casualties of technological change are exceptionally difficult to enumerate, although they arise from the practical application of science. Possibly 1000 additional deaths from chronic pulmonary disease a year—and what else? The very speed of change makes evaluation difficult. Intensive study of the pathogenesis of those conditions which show increasing prevalence is needed, as well as improved methods of monitoring contamination of the environment.

Casualties of Medical Progress

Doctors have always been viewed by the rest of mankind with respect tinged with suspicion, since they appear to have special access to the secrets of life and death. As medicine has become more scientific it has become more effective, but also, in some ways, more dangerous. New drugs which control or cure previously fatal disease can also injure and kill. New diagnostic methods permit the detection of hidden disease, but accidents can occur in their use. The very fact that once-doomed lives can be saved means more surviving invalids.

Since doctors are trained to be unbiased observers, they should be watching closely and reacting promptly to unintended harm resulting from new methods which they adopt. That a healthy self-correction does in fact operate in medicine has been demonstrated repeatedly in the past 20 years. An example is the story of retrolental fibroplasia. Increased blindness among premature infants, first noted in the 1930's, was found to be associated with prematurity in 1942 (*16*) and with oxygen therapy in 1949 (*17*). Oxygen was soon pinpointed as the injurious agent, and a decade of rigid oxygen restriction (1955–64) followed. As a result, the number of new cases has dropped sharply, although hundreds of persons remain blind, with only a 3.4 percent chance of regaining sight (*18*). More recent studies, however, suggest that the neurological sequels of prematurity increased during that decade and that they may have resulted from insufficient oxygen. The use of oxygen for premature babies will evidently have to be still more precisely regulated before we can gain its benefits without incurring new casualties (*19*).

The pace of introducing and distributing new drugs has become so rapid that control of harmful effects inevitably lags. In the decade 1955–64 production of vitamins more than doubled in the United States, while that of penicillin increased more than five times [Table 105 in (*1*)]. Ten years ago, Welch estimated that there were 17 to 20 million individuals in the United States (about 10 percent of the population) who may react to contact with antibiotics (*20*). Hospital surveys show that 10 to 18 percent of hospitalized patients who receive drugs develop reactions to them (*21*). The mechanisms by which therapeutic drugs may cause death or disability include distrubance of body defense mechanisms, cell injury, imbalance of essential materials, genetic disturbances, chemical carcinogenesis, and change in microbial ecology (*22*).

An informal network of clinical observations, laboratory testing, and legal requirements provides much information about the adverse effects of drugs (*22*, *23*). Epidemiologic information, however, from which the incidence and risk of casualty can be estimated is extremely limited. The effects of two specific drugs, thalidomide and chloramphenicol, have been studied in terms of population and can serve as examples, but these only suggest the magnitude of the problem.

Table 2. Head injury (International Classification of Diseases codes N800, N801, N803, N804, and N850–N856), discharges from hospitals in England and Wales, 1966 [Table 19 in (*5*); (*50*)]. Items other than total are estimates.

Item	Number	Percent of total
Total such discharges	110,000	100
Major injury*	7,700	7.0
Died in hospital of injury	3,630	3.3
Survived with functional recovery	2,530	2.3
Survived with handicap; able to do limited work	880	0.8
Survived with handicap; unable to work	660	0.6

* Posttraumatic amnesia for more than 24 hours.

Absent and distorted limbs and other severe congenital anomalies can be produced by the sedative thalidomide if it is administered in the first trimester of pregnancy. This dramatic example of drug toxicity has received publicity, the drug has been withdrawn, and only a limited cohort of malformed children remain as reminders of the risks inherent in the pace of change in modern drug usage. A systematic search of the records of 23 hospitals in Hamburg revealed 139 cases of thalidomide-type of malformation in the years 1958–63. The drug was introduced in 1957 in Germany and elsewhere (*24*), and the first case of malformation occurred that year. The rate of thalidomide-type malformation rose rapidly from 0.2 per 1000 births in 1958 to 3.1 per 1000 births in the first 6 months of 1962. Thalidomide was withdrawn in November 1961. Eight months later, in the last 6 months of 1962, the birth rate of malformed infants had fallen to 0.5 per 1000, and only one such case was recorded in these hospitals in 1963 (*25*). A survey of Canadian infants in 1963 disclosed 117 cases, and 869 were known to investigators by 1965 (*25*, *26*).

The toxicity of chloramphenicol has been even more thoroughly documented over the past 20 years. In spite of all that is known about it, this drug continues to be widely used, for both sound and trivial purposes. Chloramphenicol was introduced in 1948; the first warnings of its association with aplastic anemia were published in 1952; and the peak number of cases was reported in 1959. The mechanism by which this (and other drugs) produce this irreversible and fatal suppression of the bone marrow is not known, but the epidemiologic association is very strong. For example, of 771 cases of aplastic anemia reported to a registry of drug reactions in the United States (1956–66), 43.8 percent had received chloramphenicol, and 45.5 percent of these

had received no other drug (*27*). A detailed epidemiologic study has been made in the state of California, where all fatal cases of aplastic anemia in an 18-month period (60 cases) were analyzed for exposure to the drug and considered in relation to drug sales and distribution. The risk of fatal aplastic anemia within a year of exposure to chloramphenicol is estimated to lie between 1 : 40,800 and 1 : 24,400, which is 13 times the risk for persons not exposed to this drug (*28*).

Thus, there is a measurable toll of chronic illness and death to be set off against the presumably larger sum of lives saved and suffering relieved by the use of one antibiotic. For other drug-induced diseases we have no comparable estimates, but the very number of such conditions which have been identified calls for greater caution in the use of drugs than many practitioners now exercise. Among the diseases resulting from the use of modern drugs are such well-recognized clinical problems as peptic ulcer and reactivation of tuberculosis after treatment with steroid drugs, persistent Parkinson's disease after treatment with chlorpromazine, and damage to the eighth (auditory) nerve from streptomycin.

Diagnostic Risks

The adverse effects of therapeutic drugs may be a necessary price, but it is never one to be paid complacently. Casualties resulting from diagnostic procedures are still less acceptable. No method of diagnosis, including medical consultation and simple admission to a hospital, is without risk. Techniques which involve the introduction of instruments and other substances into the body are used increasingly. These include needle puncture of arteries, veins, the spinal canal, and most external and internal organs; catheterization of blood vessels, the heart, and the urinary tract; x-ray contrast visualization of organs and vessels by means of injected substances; biopsy of every tissue in the body; and local and general anesthesia given for diagnostic purposes. The major hazards of these procedures are mechanical trauma to tissues or organs, anoxia of brain or heart, embolism, spread of tumor cells, infection, drug reactions, and disabling anxiety.

Table 3. Outcome of cases of spina bifida, England and Wales, 1963–67 (*51*).

Outcome	Number	Percent of total
Born alive 1963–67	6000	*
Surviving in 1968 under 5 years old	2500	*
Surviving in 1968 age 5 to 10 years	1250	*
Surviving in 1968 age 10 to 15 years	200	*
Born alive in 1966	1200	100
Expected to survive to 5 years	480	40
Mentally and physically normal	132	11
Mentally normal, physical handicaps	216	18
Educationally subnormal	96	8
Profoundly retarded	48	4

* Not applied.

Radiographic visualization of the kidneys and urinary tract by intravenously injected substances is a common and well-established diagnostic measure. This procedure has a safety record which does credit to medicine and the pharmaceutical industry. A summary in 1954 of 3.8 million such procedures reported a mortality rate of 0.008 percent (*29*). No permanent disabilities are described in recent series, although transient side reactions, such as nausea and vomiting, are reported in 5 to 25 percent (*30*).

The use of arteriography (injection of contrast material into arteries) has expanded greatly in recent years. With this technique, the dangers of anoxia and embolism are added to those of drug reaction and infection. The incidence of severe permanent disability resulting from these procedures is reported to range from 0 to 12 percent (*31*, *32*). In the centers with the most experience it is probably about 0.5 percent (*33*). The total number of such procedures cannot be estimated, but active hospitals perform 400 to 500 a year. Techniques are constantly changing, and safety improves with experience (*32*).

Prior to cardiac surgery, the heart and related vessels are usually studied by introducing a catheter to measure pressures, to take blood samples, and to inject contrast materials. Experience in 16 major cardiac-catheterization laboratories in the United States over a 2-year period was summarized in 1968 (*34*). The average incidence of major complications was 3.59 percent and the mortality rate 0.44 percent, based on 55 deaths. The incidence of major residual disability (estimated from the text) was 0.16 percent. If we assume conservatively that the average number of procedures for all 513 cardiac laboratories in the United States (during 1961) is half what is reported here, there would be approximately 100,000 such procedures, with 160 new cases of permanent disability and 440 deaths from this source every year. This is a high price to pay for information, but it is important to remember that the greatest risks occur in infants with severe, sometimes life-threatening congenital heart disease. For such patients, accurate diagnosis and skillful surgery may offer the only chance.

Although the advance of science in medicine is sometimes said to have simplified the doctor's task and to have reduced the need for experience and judgment, the facts just presented indicate the opposite. Many drugs and many diagnostic procedures can be used with little fear of adverse reactions, but new dilemmas are constantly being presented to the physician. Is it better medical practice to give cautious advice to the family of a child with a heart murmur or to insist on thorough investigation, perhaps including cardiac catheterization with its attendant risks? What, apart from specific diseases like typhoid fever, are the indications for the use of chloramphenicol? How serious must the threat to life be before a drug which carries a known risk of fatal adverse reaction is used? How much must a physician know about a new drug like thalidomide before he starts to prescribe it for his patients? Surely the situation calls for more, and perhaps different, technical training, continued throughout professional life. Beyond this, the doctor needs as much as ever —perhaps more than ever—broad awareness of human values and sound personal judgment.

Extended Survival

Old ethical issues have been sharpened by more effective scientific methods, but the recently increased power to extend human life raises an essentially new question which has profound social, ethical, and religious implications.

New kinds of therapy which have been developed in the past 20 years permit life to continue in spite of potentially lethal disease. Following the discovery of insulin, for example,

Table 4. "Maternities conceived outside marriage," England and Wales (*4*).

Year	Annual number per 1000 unmarried females of age		
	15 to 19	20 to 24	15 to 44
1938	11.8	32.6	18.6
1952–55	15.7	42.8	25.3
1956	19.0	48.6	28.9
1960	24.0	58.0	35.5
1964	30.3	68.0	42.5
1967	35.9	67.6	46.4

other essential hormones have been identified and made available so that life can be sustained after total removal or destruction of the adrenal glands, the pituitary, or the thyroid. Orthopedics, neurosurgery, and cardiac surgery are now able to accomplish the complete or partial repair of certain congenital abnormalities which, untreated, are incompatible with life. New prostheses, mechanical and transplanted, are coming into use, although still in very small numbers of cases. Above all, a wide range of effective new antibiotics makes possible the control of infection which in the past terminated the lives of the disabled, the elderly, and those with chronic disease.

The question of euthanasia has in the past been largely an academic one, since there was little support among either the general public or the medical profession for assigning to doctors or anyone else the responsibility for actively terminating life. Now, however, the possibility arises with increasing frequency of permitting a patient to die by withholding treatment which could prolong life, sometimes a painful and distorted life.

An example of the dilemmas posed to physicians and society is the treatment of spina bifida cystica. This is a congenital anomaly in which the lower end of the spinal canal fails to close and a meningomyelocele, containing nerves and spinal fluid, is present. Complications include progressive hydrocephalus, sometimes producing mental retardation, and various degrees of neurological deficit in the legs and lower trunk. Largely because of infection, mortality in the first year of life was 88 percent before modern treatment was developed, and the survivors were those who had the least deformity (*35*). From 1955 through 1962, deaths from spina bifida and hydrocephalus in England and Wales occurred at a constant rate of about 1200 a year. After the introduction of early surgery (in the first 24 hours of life), the number of deaths fell rapidly to 815 in 1966. The introduction of this lifesaving procedure is too recent to assess ultimate effects. Table 3, however, suggests that 358 children with mental and physical handicaps are being added to the population every year, most of whom would have died as infants prior to 1963. As these disabled children advance through the school years, more places will be required for them in special schools, and many will need permanent care at public expense.

A second, less apparent by-product of improved treatment is the increased genetic burden produced when infants or children with potentially lethal heritable disorders are enabled to survive and reproduce. The clearest example is that of congenital pyloric stenosis, which can be effectively cured by a simple operation, allowing a normal life for persons who might otherwise have died in infancy. The resulting increase in numbers of such cases does not pose serious burdens of treatment or care (*36*). However, there are other more serious and common diseases, such as diabetes, in which heredity plays a definite part, and in which modern therapy makes possible a higher reproductive rate. More research is needed before we can estimate the numbers of casualties to be expected from this source (*37*).

Social and Cultural Change

The past 20 years have witnessed the maturing of an essentially new social order, aptly termed the affluent society. Economic productivity and automation have brought us to a point from which the total eradication of poverty can be glimpsed as a practical goal (*38*). Even now, large segments of the population of developed countries enjoy a superabundance of food and physical conveniences more lavish than those which were available to the tiny minorities of rulers and nobility in the past. Citizens of the United States have an average of over 3000 calories of food energy available daily, which is twice the minimum required to sustain life (*39*). The average energy expenditure of the American factory worker is probably less than twice the rate of resting metabolism and far below the level of effort required to gain a living by

Table 5. "Estimated illegitimacy," United States (*52*).

Year	Annual number per 1000 unmarried females of age		
	15 to 19	20 to 24	15 to 44
1940	7.4	9.5	7.1
1950	12.6	21.3	14.1
1960	15.7	40.3	21.8
1966	17.5	40.8	23.6

hunting or farming (*40*). Of a sample of British civil servants, 10 percent report that they do not even climb stairs in the course of a normal day (*41*).

Obesity has become a major health problem, highly associated with increased morbidity and mortality (*42*). It seems logically related to increased calorie supply and reduced energy expenditure (*43*), but information is lacking about whether the prevalence of obesity is increasing (*44*). Social and economic change have clearly produced some casualties in this way, but the numbers may be static.

Arteriosclerotic heart disease, on the other hand, has become increasingly prominent as the leading cause of death in advanced countries, with prevalence and incidence still rising. Among the several factors which define the high-risk population for this disease are obesity, high consumption of saturated fats, and physical inactivity (*45*). In the 10 years 1957–1966, the death rate in the United States for arteriosclerotic heart disease increased 10 percent, while the death rate from all causes decreased 0.7 percent. During this period, the numbers of persons whose deaths were attributed to this condition increased by an average of 17,425 each year in the United States and 3,750 in England and Wales. The causes of these casualties are not yet plain, but the epidemic is occurring specifically in the "advanced" countries and must be connected with social and possibly with psychological changes related to industrial and economic growth.

Young Casualties

Young people are at the vortex of modern social change. Whether they initiate change or react to it, they are paying an increasingly heavy toll. Popular opinions about previously unacceptable kinds of sexual behavior are rapidly changing (*46*), and the availability of effective methods of contraception has

contributed to rapid changes in sexual relationships among young people. The ultimate psychological and social benefit of more honest attitudes toward basic human functions could well be great, but there are penalties along the way. Whether the birth of an illegitimate child can be classed as a casualty might be questioned, but the fact is that the rate of such births is rapidly rising (Tables 4 and 5). The data shown are incomplete, but they do demonstrate trends. To be sure, in England and Wales, two-thirds of the births to girls aged 15 to 19 are subsequently legitimated by marriage, but it is also true that two-thirds of the births to girls of this age are conceived out of wedlock. In spite of penicillin and its successors, which offer potentially effective means for eliminating bacterial venereal disease, the battle against syphilis shows doubtful gains, while a new wave of gonorrheal infections is evident in England and Wales (Table 6) and in the United States (*47*). Young people are affected predominantly. In 1967, age-specific rates show that new cases of venereal disease increase rapidly among males from 0.03 per 100,000 below age 16 to 2.85 at ages 16 and 17, to 9.33 at 18 and 19, and to 12.58 at 20 to 24. Above age 25, the rate drops back to 5.31 per 100,000. A treated case of gonorrhea in a young man, of course, does not produce disability. But figures on reported cases of venereal disease are only the tip of the iceberg. One estimate puts the reservoir of persons needing treatment for syphilis in the United States at 1,200,000 (*47*). Gonorrhea is notoriously difficult to detect in women; the causative organism can develop resistance to antibiotics; and the incidence of nonspecific urethritis in males, sometimes complicated by arthritis and eye involvement, is also increasing (*48*). Late complications of syphilis and gonorrhea do not show signs of increasing, but there is a lag of several years in their development.

Table 6. New cases of venereal disease, England and Wales (*48*).

Disease	Average annual number in 1000's for years		
	1953–57	1958–63	1963–67
Syphilis	5.3	4.2	3.8
Gonorrhea	19.9	33.1	37.9

Modern youth is dedicated to change, whether in the form of volunteer work in developing countries, reform of universities, or extreme shifts of fashion in personal appearance; compliance and conformity are intolerable. Not all can stand the pace. Some fall by the way and are injured or disabled. Young victims of the automobile have been referred to above. Addiction to drugs among teen-agers and young adults has been rising at startling rates in England and Wales. Reported rates of crime are also increasing, most rapidly among young people (Fig. 2). Comparable figures for the United States are difficult to produce because of variations in states' laws and because of the concentration of narcotics users in large coastal cities, but there is no doubt that juvenile crime rates and the use of addictive narcotics are increasing rapidly in this country also. From 1950 to 1960 the numbers of persons in correctional institutions in the United States increased 27 percent, compared with a population increase of 19 percent. A quarter of these—99,021 individuals in 1960—were under the age of 25, and the rate of increase in this group was higher than in any other, namely 36 percent [Table 229 in (*1*)]. As with increases in illegitimacy and venereal disease, it is difficult to enumerate exactly how many more young people become physically disabled and socially dependent each year because of early involvement in crime and drug addiction. The term "dropout," however, has melancholy overtones. Present methods of prevention and control are simply not working, penal systems and drug and venereal disease treatment centers are already overloaded and often out of date. Like the casualties of war, these are the most costly kind because of the years left to live and the likelihood of relapse.

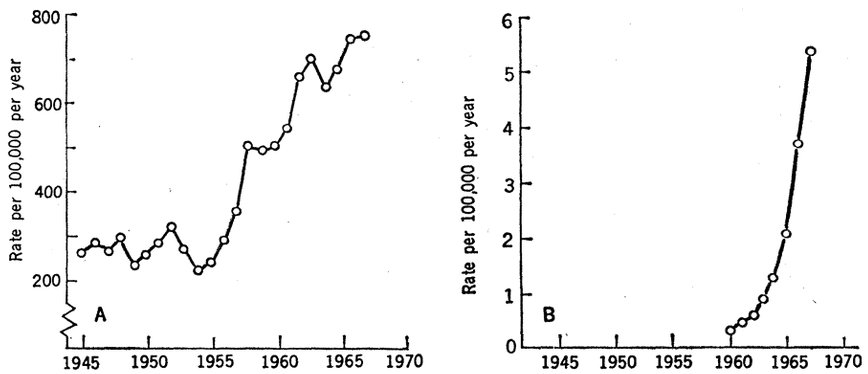

Fig. 2. (A) Arrests for breaking and entering, England and Wales, ages 17 to 20. (B) Numbers of known addicts to "dangerous drugs," England and Wales, below age 35. Before 1960, very few and majority over 30 years of age (*53*).

Conclusions

The roll of casualties of our time is incomplete. Among those numbered in hundreds every year we have counted invalid survivors of spina bifida, patients accidentally injured during cardiac catheterization, and those disabled by reactions to such drugs as chloramphenicol. Rising casualties numbering thousands annually result from the health environment surrounding certain infants born in our cities, from the vulnerability of young people to head injuries, drug addiction, and crime, and from chronic lung disease associated with air pollution. Increasing numbers, in the tens of thousands every year, suffer or die from arteriosclerotic heart disease or are disabled by the frailties of age. Other casualties may be on the way: additional victims of environmental pollution, more infants surviving with genetic defects, more casualties of affluence, made useless by automation or retired from boring work, more artificially supported survivors, and more casualties of new drugs. Though these numbers may in a sense be outweighed by a rising standard of living, better education, less work, and less discomfort, they are surely enough to cause concern.

These casualties raise some fundamental questions. Do we understand the real reasons why death rates now are scarcely falling? How well do we grasp the meaning of increased sickness-absence or the use of drugs?

In practical terms, are we prepared to cope with the immediate future? First, do we have adequate information? Are our systems of surveillance and detection flexible enough to keep up with the rate of change? Who is re-

sponsible for keeping track of what is happening and for finding out causes? Who acts on the knowledge we already have and will acquire? How can we prevent new casualties? Who needs to be educated and who will be the teachers?

Disabled and dying people need help immediately. Are we training the workers, developing the services, and setting aside the funds that are already needed to make a decent life for tens of thousands of disabled old people and thousands of invalid children and young adults? Finally, what value do these needs have in relation to our other social purposes? Some casualties have occurred while we had our eyes fixed on goals other than human welfare. Concentrated attention directed to these unfortunate fellow-beings may help to get some important priorities sorted out.

References and Notes

1. U.S. Bureau of the Census, *Statistical Abstract of the United States: 1967* (U.S. Government Printing Office, Washington, D.C., ed. 88, 1966).
2. S. Shapiro, E. R. Schlesinger, R. E. Nesbitt Jr., *Infant, Perinatal, Maternal, and Childhood Mortality in the United States* (Harvard Univ. Press, Cambridge, Mass., 1968), p. 83.
3. J. R. Hochstim, A. Athanasopoulos, J. H. Larkins, *Amer. J. Public Health* **58**, 1815 (1968); *National Advisory Commission on Civil Disorders, Report* (U.S. Government Printing Office, Washington, D.C., 1968), pp. 136–139.
4. General Register Office, The Registrar General's *Statistical Review of England and Wales, 1966* (H.M. Stationery Office, London, 1967).
5. Ministry of Health and General Register Office, *Report on Hospital In-patient Enquiry, 1965* (H.M. Stationery Office, London, 1968).
6. R. Carson, *Silent Spring* (Hamilton, London, 1963); P. H. Abelson, *Amer. J. Public Health* **58**, 2043 (1968).
7. J. R. Goldsmith, *Arch. Environ. Health* **18**, 710 (1969).
8. K. Biersteker, *ibid.*, p. 531; L. Breslow, *ibid.* **8**, 24 (1963); I. M. Moriyama, *Public Health Rep. 78* (1963), p. 743.
9. A. J. Klebba, *Mortality from Diseases Associated with Smoking*, PHS Publ. No. 1000, Ser. 20, No. 4 (U.S. Government Printing Office, Washington, D.C., 1966).
10. W. P. D. Logan, *Lancet* **1953-I**, 336 (1953).
11. T. D. Sterling, S. V. Pollack, J. Weinkam, *Arch. Environ. Health* **18**, 485 (1969).
12. B. G. Ferris and J. L. Whittenberger, *N. Engl. J. Med.* **275**, 1413 (1966).
13. S. Ishikawa, D. M. Bowen, V. Fisher, J. P. Wyatt, *Arch. Environ. Health* **18**, 660 (1969).
14. E. J. Cassell, M. D. Lebowitz, I. M. Mountain, H. T. Lee, D. J. Thompson, D. W. Wolter, J R. McCarroll, *ibid.*, p. 523.
15. N. E. Manos, *Comparative Mortality Among Metropolitan Areas of the United States, 1949–51*, PHS Publ. No. 562 (U.S. Government Printing Office, Washington, D.C., 1957); E. A. Duffey and R. E. Carroll, *United States Metropolitan Mortality 1959–61*, PHS Publ. No. 999–AP39 (U.S. Government Printing Office, Washington, D.C., 1967).
16. T. L. Terry, *Amer. J. Ophthalmol.* **25**, 203 (1942).
17. V. E. Kinsey and L. Zacharias, *J. Amer. Med. Ass.* **139**, 572 (1949).
18. E. Rogot, I. D. Goldberg, H. Goldstein, *J. Chronic Dis.* **19**, 179 (1966).
19. W. A. Silverman, *Amer. J. Public Health* **58**, 2009 (1968).
20. H. Welch, C. N. Lewis, H. I. Weinstein, B. B. Beckman, *Antibiot. Med. Clin. Ther.* **4**, 800 (1957); H. Welch, *J. Amer. Med. Ass.* **170**, 2093 (1959).
21. Anonymous, *Brit. Med. J.* **1**, 527 (1969).
22. W. Modell, *Annu. Rev. Pharmacol.* **5**, 285 (1965).
23. R. H. Moser, *Diseases of Medical Progress* (Thomas, Springfield, Ill., ed. 2, 1964).
24. F. H. Happold, *Medicine at Risk* (Queen Anne Press, London, 1967), pp. 9–10.
25. W. Lenz, *Ann. N.Y. Acad. Sci.* **123**, 228 (1965).
26. J. F. Webb, *Can. Med. Ass. J.* **89**, 987 (1963).
27. M. M. Wintrobe, *J. Roy. Coll. Physicians London* **3**, 99 (1969).
28. R. O. Wallerstein, P. K. Condit, C. K. Kasper, J. W. Brown, F. R. Morrison, *J. Amer. Med. Ass.* **208**, 2045 (1969); K. M. Smick, P. K. Condit, R. L. Proctor, V. Sutcher, *J. Chronic Dis.* **17**, 899 (1964).
29. E. P. Prendergrass, P. J. Hodes, R. L. Tondreau, C. C. Powell, E. D. Burdick, *Acta Radiol. Suppl.* **116**, 84 (1954).
30. M. P. Small, and J. F. Glenn, *J. Urol.* **99**, 223, 1968; S. H. Macht, R. H. Williams, P. S. Lawrence, *Amer. J. Roentgenol.* **98**, 79 (1966).
31. S. Kuramoto, M. Watanabe, K. Yoshimura, Y. Takamiya, Y. Ohnaka, T. Lee, K. Iwai, *Kurume Med. J.* **14**, 95 (1967); E. K. Lang, *Acta Radiol. Diag.* **5**, 296 (1966); T. Södermark and P. Mindus, *Acta Med. Scand.* **183**, 177 (1968); J. D. Mortensen, *Circulation* **35**, 1118 (1967); G. Haut and K. Amplatz, *Surgery* **63**, 594 (1968).
32. J. McGuire and T. Chou, *Amer. Heart J.* **73**, 293 (1967).
33. L. V. Perrett and W. J. Caldicott, *Austral. Radiol.* **11**, 107 (1967); W. K. Haas, W. S. Fields, R. R. North, I. I. Kricheff, N. E. Chase, R. B. Bauer, *J. Amer. Med. Ass.* **203**, 961 (1968).
34. E. Braunwald and H. J. C. Swan, *Circulation* **37**, suppl. 3 (1968).
35. Anonymous, *Lancet* **1969-II**, 34 (1969).
36. C. O. Carter, *Human Heredity* (Penguin Books, Harmondsworth, Middlesex, England, 1963).
37. K. Mather, *Human Diversity* (Oliver and Boyd, London, 1964).
38. Anonymous, *The Economist*, 10 May 1969, p. 19.
39. A. Keys, K. Brozek, A. Henschel, O. Michelsen, H. L. Taylor, *Biology of Human Starvation* (Univ. of Minnesota Press, Minneapolis, 1950).
40. A. B. Ford and H. K. Hellerstein, *Circulation* **20**, 537 (1959).
41. J. N. Morris, unpublished data.
42. H. H. Marks, *Bull. N.Y. Acad. Med.* **36**, 296 (1960).
43. J. Mayer, *Physiol. Rev.* **33**, 472 (1953).
44. National Center for Chronic Disease Control, *Obesity and Health* (U.S. Department of Health, Education, and Welfare, Washington, D.C., 1966).
45. J. N. Morris, *Uses of Epidemiology* (Livingstone, Edinburgh, 1967) pp. 172–182.
46. Anonymous, *Time*, 6 June 1969, pp. 18–19.
47. W. J. Brown, in *Preventive Medicine*, D. W. Clark and B. MacMahon, Eds. (Churchill, London, 1967), pp. 525–538.
48. Chief Medical Officer, *On the State of the Public Health, 1947–1967* (H.M. Stationery Office, London, 1948–1968).
49. G. S. Wunderlich, *Characteristics of Residents in Institutions for the Aged and Chronically Ill*, PHS Publ. No. 1000, Ser. 12, No. 2 (U.S. Government Printing Office, Washington, D.C., 1965); C. A. Taube, *Characteristics of Patients in Mental Hospitals*, PHS Publ. No. 1000, Ser. 12, No. 3 (U.S. Government Printing Office, Washington, D.C., 1965); A. L. Jackson, *Prevalence of Selected Impairments*, PHS Publ. No. 1000, Ser. 10, No. 48 (U.S. Government Printing Office, Washington, D.C., 1968); C. S. Wilder, *Limitation of Activity and Mobility Due to Chronic Conditions*, PHS Publ. No. 1000, Ser. 10, No. 45 (U.S. Government Printing Office, Washington, D.C., 1968).
50. W. Lewin, *Brit. Med. J.* **1**, 465 (1968); P. S. London, *Ann. Roy. Coll. Surg. Engl.* **41**, 460 (1967).
51. J. Lorber, *Medical Officer* **119**, 213 (1968).
52. U.S. Department of Health, Education and Welfare, Public Health Service, *Vital Statistics of the United States, 1940–1966* (U.S. Government Printing Office, Washington, D.C.).
53. Home Office, *Annual Criminal Statistics* (H.M. Stationery Office, London, 1945–67); reports by H.M. Government of the U.K. to the United Nations.

54. I thank Professor J. N. Morris, Professor of Public Health at the London School of Hygiene and Tropical Medicine, for guidance and assistance. The report was written in his department during my sabbatical leave, with financial support from the United States Public Health Service and the Milbank Memorial Fund.