»OPINION ON PROBLEMS OF TODAY«

MAN AND TECHNOLOGY

MAX HUEBER VERLAG MÜNCHEN

ON PROBLEMS OF TODAY

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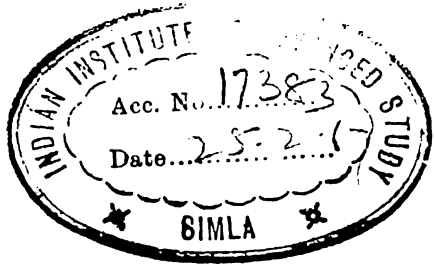

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Introduction

The second number of this Review, now setting out on its intercontinental journey to spread German opinion on topical themes, is devoted to technology.

The lives of all of us are being increasingly invaded by technology. Its advance determines the rate of economic and social development. Technical progress is expressed in new materials, new methods of manufacture and quicker production. At every stage, therefore, it can give a new lease of life to an entire branch of a country's economy. On the other hand, in consequence of its complicated interrelations, it may also be attended by many dangers.

Before setting up a programme of technical development, every nation and its leaders ought first to consider the human values which we are at present concerned to preserve. Technology in the true sense of the word, i. e. as an aid to man, serving his needs, is not necessarily diametrically opposed to his spiritual life. The machine should be complementary to man. Technology should be regarded as an intellectual phenomenon, simply as the outcome of man's struggle for a higher level of civilization. It is only by recognizing this higher function of technology that a nation will be able to enter on the credit side of its balance sheet the supreme value of humanity, the finest fruit of the human spirit, where it will act as a corrective, as a harmonizing feature in its programme. Technology contains in itself many elements of our mass civilization with all their manifold dangers. The peril inherent in technical progress can be effectively counteracted only if technology develops in a state based on social responsibility, on freedom of speech and thought. A round-table discussion of all the problems attendant on technology will then be possible and solutions will be found.

The time is past when history could be looked upon as development, as a drama just as full of pathos and heroism as any classical epic. Today there are no longer any unknown and unexplored areas, as were often to be found in former days: all nations and all men play a part on the stage of world history in our time. It is true, particularly where mass populations are surrounded by the myth of politics, that the role of such masses is often more passive than active. But in political programmes the masses always appear as responsible agents. The tension thus caused between man's struggle for individuality and his absorption in mass civilization has been greatly accentuated by technology.

Like its predecessor, the present number represents German opinion in the essays selected. These writers look at things clearly. They present the situation realistically and with a sense of responsibility. Their articles are not blurred by rhetorical flourishes and are free of publicity gimmicks. Such unambiguous and honest statements are valid for all human beings; they should thus contribute to a discussion of one of humanity's most important problems today.

As before, the articles have been selected from lectures, reviews and newspapers. The authors belong to very different spheres of mental activity. The great interest shown by intellectuals in the problems of technology is in itself a reassuring symptom. The scholar in Greek, for instance, whose writings are a welcome contribution to philology and belles lettres, does not confine his attention to studies in Old Greek. Being also aware of the problems involved in technology, he combines the study of classical languages with a modern man's appeal to humanity, in order to establish harmony between the classical age and the present era of the machine. Scholars in the service of the Church also voice their opinions; their supreme knowledge of the issues at stake enables them to put their finger on the danger spots in the present situation. There is also a slightly ironical article in criticism of our time – a privilege enjoyed by every writer – which is concerned with the astounding success of the exploration of outer space. It is a sharp repudiation of the anti-religious assumptions of the first astronauts, illuminating them by means of gently provocative arguments of a technical nature, based on the pace of a snail, and expressed with a subtle, intellectual humour. The doctor among our contributors knows that our hectic age is more than ever in need of care and treatment by responsible physicians. He knows of the crying need for justice towards those who are growing old in this technical age. Finally, there are articles that attempt to clarify the historical bases of the age of the machine.

The editor hopes that this collection of German essays, here translated into English, will, like its predecessor, be welcomed by all interested in German writing and by students of intellectual movements in Germany. From the Federal Republic of Germany, whose citizens, whatever their intellectual and human interests, are united by concern for the reunification of their country, in a future of peace and freedom, he sends hearty greetings to all his readers throughout the world.

Walter Leifer

Friedrich Klemm

The Spiritual Bases of Technical Development

Western civilization is founded on Classical Antiquity, Christianity and the Latin and Teutonic races. These three springs of energy are equally essential to Western technology. Ancient Greece developed for the first time – and here is its particular merit – a scientific consciousness, in which the science of the Christian West took root. But it is the natural science of the West, which followed the lead of the Ancients and, especially since the Renaissance, developed in its own way, that is the basis of modern technology. Medieval Christianity, with its characteristic attitudes towards work and the physical world, was surely more likely to promote craftsmanship and technical knowledge than to hinder them, as we are often given to believe. In spite of many trends in other directions, and in strong contrast to religious developments in the East, Christianity in the end acknowledged the value of the material world. Finally, it was the open minds of the Latin and Teutonic peoples and their burning desire to transform nature that provided the conditions for technical advance. Political and economic conditions in the West may also be considered to have favoured technical development. Let us now look in detail at the particular spiritual forces and at the economic factors which shaped European technology in the various phases of cultural evolution.

The Greeks created pure science and pursued it without any utilitarian motive. Science was incomparably superior to practical technical work. The free citizen applied himself to matters of State, to scientific thought, to contemplation of the arts. Handicrafts and technical work were left to foreigners and slaves. In general, a fusion of science and technology was therefore impossible. Plutarch tells us that Archimedes did not wish to leave anything in writing about his technical inventions, as he considered everything utilitarian vulgar and unworthy of the exertions of noble men. And in the first century of our era, Seneca says that manual work, with body bent and eyes on the ground, became only those of inferior mind. Thus, technical work in Ancient Greece was in the hands of slaves, who were generally available in adequate numbers. There was no lack of

gifted men, but their talents for technical construction were channelled into the production of curios and play-things, as there was no demand for big machinery. The activity of Alexandrian mechanics in the third century B. C., whom Ktesibios mentions, testifies to this. They constructed a multitude of small contrivances and mechanisms which were worked either by compressed or heated air, or by steam, and were equipped with well-designed taps, valves, cogs or rollers.

Although under the Romans the purely theoretical approach peculiar to Greek thought was superseded by their endeavours to solve practical problems, there was still no significant change in technical activity. The vast technical problems with which the Roman Empire was faced in its programmes to construct roads, bridges, aqueducts and war engines, in general building and in mining, were solved with simple technical resources and well-organized armies of workmen.

According to Vitruvius, the real engineer of the Roman Empire was the "architectus", who was responsible not only for underground and surface engineering but also for the construction of lifting gear, war engines and water gauges. While stone served as material for buildings, wood was the usual material for machines. Vitruvius actually says that a machine is a combination of wooden parts. The water-wheel was known to the Ancients and Heron even mentions the wind-driven wheel, but neither of these generators of energy attained any great importance at that time. Due to the ancient form of harness, which impeded the draught animal, horsepower could be exploited only to a limited degree. So the slave remained the essential source of energy. Slaves worked the hand-mills, moved the treadwheels of lifting gear and water supply systems, and carried the heaviest loads.

With the decline of the Roman Empire the centre of civilization shifted gradually northwards. Christianity began its triumphal march. The Christian Middle Ages dawned. "Enlightened" historiographers generally saw the Middle Ages, those thousand years between 500 and 1500 A. D., as a period of unrelieved spiritual darkness. Even today one occasionally meets with this view. Yet the Romantics of the early 19th. century opened our eyes to the greatness of medieval art and thought. The golden age of medieval philosophy has won recognition. It is now appreciated that the schoolmen of the 14th. century had already arrived at an empirical criticism of the Aristotelian view of nature, as propounded by their predecessors, and had progressed towards opinions which contained the germs of the new natural science that was to emerge under Galileo, Kepler

and Descartes. In the last few decades we have also changed our opinion of medieval technology. We now know that the Middle Ages between the 11th. century and the 14th. saw a technical advance which essentially altered the material environment of the times. The Christian Middle Ages placed a far higher value on craftmanship and technical skill than Antiquity had done. Christianity ennobled work since it regarded it, in the sense of the Old Testament, as a basic duty with which God had charged Mankind. Christianity, which proclaimed the equality of men before Christ and the dignity of man, played an important part in the gradual decline of slavery. The growing diversity of secular and ecclesiastic institutions in the West led to a rivalry which greatly stimulated cultural development and promoted craftsmanship and technical skill. It is most significant that even early Christianity did not deny nature, nor reject the imitation of nature by technical inventions but, as Gregory of Nyssa wrote in the 4th. century, appointed man king over a nature which was to help him on his way to God. And a special place was given to daily manual labour in monastic rules drawn up from the time of St. Benedict in the 6th. century down to the early Franciscans. Theophilus, probably a German Benedictine monk of the 11th. century, who wrote an important work on the arts and crafts in which, among other things, the casting of bells is fully and clearly treated, repeatedly stresses that man ought to create with his hands so that he may procure the means with which to help those in need. In the 12th. and 13th. centuries the Cistercians attached great importance to the self-supporting activities of their communities. They also played a prominent part in spreading advanced technical processes in the provinces of Eastern Germany. Another proof of the higher repute of crafts and technical work was the inclusion of industrial arts such as weaving, metal-work and architecture, as well as navigation, agriculture, hunting, medicine and stage-craft in the curricula of medieval schools. All this did not fail to influence the artisan culture of late medieval towns.

In the 13th. century, chiefly through Arab mediation, the whole of Aristotle's work, with its variety of subjects, became known to the West. The knowledge possessed by the Ancients threatened to burst traditional medieval science asunder. It was then that Albertus Magnus, deeply convinced of the ultimate harmony of faith and knowledge, undertook to incorporate Aristotelianism into the Christian cosmos and to create a Christian-Aristotelian ideology which embraced scientific knowledge. It thus became possible for Aristotelianism to be discussed within the

Church. The late scholasticism of the 14th. century had already arrived at conclusions which differed from those reached by Aristotle and which, as already mentioned, contained the seeds of a new physical science that blossomed around 1600, and later formed the basis of modern technology. With all its other-worldliness, Christianity retained a strong sense of reality which made possible its study of nature and interest in technical work. External conditions, too, were favourable to technical development: the rapid rise in population between the years 1000 and 1300, the growth of free trade and the rise of the cities. The advance of technology during the High Middle Ages was marked by a number of important inventions. A material civilisation developed, which increasingly learnt to make use of the energy of animals, running water and the wind. From the 12th. century onwards, the water-wheel became more and more widely used and, in the 13th. century, was adapted to variable motion by the introduction of the cam. Not only were grinding and spinning mills now driven by water power, but also fulling-mills, bellows, saw-mills, hammers and cutting tools for iron. In the 12th. century the windmill was introduced into Europe, probably by way of Persia, and in the same century the stern-post rudder was invented, which made ships more manageable. The broad-beamed ocean-going sailing ship without oars appeared. In the 10th. century collar-harness first came into use and increased the pulling power of the horse three or fourfold, compared with ancient times. This improvement greatly stimulated agriculture and land transport. Larger production units, using water-power, became possible. Capital began to be pooled. Roads and bridges were built. The elementary processes in handling textiles were further mechanized: the spinning-wheel was invented in the 13th. century, and also the pedal-loom. Large enterprises in the field of cloth manufacture, like those of Flanders and Florence, came into being with an extensive division of labour. Early forms of capitalism appeared. In the 12th. century the strong acids were discovered; in the 13th. the lathe was greatly improved and the weight-driven clock was invented. This is a truly remarkable record for the period between the 10th. and 13th. centuries. While we are reviewing the technology of the High Middle Ages we must not overlook the achievements of the Gothic master-masons. The Gothic system of buttressing is particularly striking. In the Gothic cathedral all parts of the building have a static and a structural function, viz. to balance stresses. At the same time they express the aesthetic feeling of the time. The result is a wonderful union of technical quality and artistic expression.

The building becomes the symbol for that harmony of faith and knowledge of which we spoke earlier on.

The technical achievements of the Late Middle Ages are generally better known than those of the High Middle Ages which we have just mentioned. At the beginning of the 14th. century we have gunpowder as a weapon, cast-iron and the blast furnace, the two latter made possible by water-driven bellows. The art of printing, an invention born of the needs of a rising bourgeoisie, takes us to the end of the Middle Ages. Fire-arms and printing were to have a lasting effect on the course of civilisation as a whole. Technical advance was one of the prerequisites for our emergence from the Middle Ages. Great credit is due, however, to the Middle Ages, especially in the classic period, for building up a material culture by means of important inventions and, not least, through the Christian doctrine that all men are born free and equal before God. This new culture was no longer, as in Antiquity, based on the institution of slavery but on the increasing use of mechanical devices for heavy work.

The Renaissance was an epoch of further profound spiritual change. The middle classes, which had become self-confident and powerful through their economic activities, attempted to shake off the restrictions which the Middle Ages had imposed.

Technical work, at that time, was usually confined to the artisan class. Only in the textile, mining and smelting industries do we find large-scale enterprises. Here, economic activity burst the fetters of medieval restrictions, and a capitalist economy emerged. The enterprises of the Medici and the Fuggers are examples. The mines and smelting works of that time which, ever since the late Middle Ages, had been flourishing as a result of the increased use of water power, are well described in the book "De re metallica" by the German physician, Georg Agricola. In keeping with the ideas characteristic of the Renaissance, Agricola related his exposition of practical mining and smelting methods to erudite humanistic conceptions. It is significant that Agricola begins his book with a defence of mining work which, he says, is in no way contemptible or unseemly. Undoubtedly there were still many, especially among the humanists, who scorned mining and technical activity in general. On the other hand, Paracelsus, a contemporary of Agricola, was deeply convinced of the dignity and worth of technical activity, which he considered to be a continuation and elaboration of divine creation.

During the Renaissance, the scientific writings of the Ancients, such as Archimedes, Heron and Pappus, received fresh attention. Generally

starting from Archimedes, a number of scholars in the second half of the 16th. century added greatly to the science of statics. Their work, which proved useful in technology as well, was continued at the end of the century by Galileo, who after much toil, succeeded in working out a scientific system of dynamics.

But this brings us into another period, the Baroque. It was an exceedingly active time in the mathematical and natural sciences; in technology, it was more of a preparatory period for the major developments which began in the second half of the 18th. century. While the Renaissance had in many respects shown very realistic trends, the Baroque, in spite of its own realism and rationalism, once more inclined towards the incalculable, the enigmatic, the fantastic and the metaphysical. In contrast to the compact, balanced and restrained forms of the Renaissance, as exemplified in architecture and sculpture, dynamic movement was now introduced. We can see this development everywhere. In physical science, dynamics were added to statics. Medieval astronomy, which saw the heavens as a closed, rather static system, was recast and a dynamic theory took its place. Analytical geometry became the complement to classical geometry. The differential and integral calculus were born. Means thus existed for a mathematical comprehension of natural events in relation to time. The idea of spontaneity in nature was replaced by the laws of mechanics and so the concept of natural laws was arrived at. In biology, to mention another important field, interest shifted from the description of organs to the study of their functions. The circulation of the blood was discovered and a "physiologia animata" came into being. On the technical side, the Baroque mind delighted in fantastic designs; and "perpetuum mobile" came up again. In spite of the rapid development of experimental physics and the beginnings of a scientific approach to technical problems, craftsmen were, on the whole, still using simple, traditional tools. Wherever major technical problems had to be solved, as sometimes happened at the courts of absolute monarchs, the engineers tried to manage with a multiplication of simple devices. Examples of this method are the pulling down and re-erection in 1586 of the Vatican obelisk, which was carried out with 40 winches, 140 horses and 800 men; or, a hundred years later, the building of the waterworks at Marly in 1685, where 14 waterwheels worked 221 pumps, which raised 37 litres of water per second to a height of 162 metres.

In philosophy, the Baroque was the epoch of the great rational systems which did not, however, fulfil their promise in the end. In the period

after the first thirty years of the 18th. century, the rational view was directed more towards individual objects. The attachment to "systems" and the taste for metaphysics disappeared and an empirical rationalism remained.

In the 17th. century mathematics was more or less supreme. It was believed that physics could be identified with mathematics. We need only think of the "mathesis universalis" of Descartes and Leibniz. But now mechanics became a separate branch of science, which made increasing use of mathematics, as we see in the work of Euler, Dan. Bernoulli, d'Alembert, Lagrange and Laplace. The 18th. century now strove to apply mathematics, which had made great progress since the Baroque period, to technical processes. It was no longer, as during the Renaissance, the craftsmen who wanted a scientific explanation of their techniques, but mostly the scientists who endeavoured to give a reasoned exposition of technical work. During the last thirty years of the 18th. century an applied science, which was soon to prove most successful, established itself, particularly in France. In England, by contrast, technology was at first confined to practical experiments. Due to favourable political and economic conditions, however, technical development in England began much earlier; free and bold enterprises sprang up there sooner than elsewhere. English technology gained the lead. Watt produced his ingenious invention of the steam-engine, which enabled the output of iron and coal to be greatly increased. The use of coke for blast furnaces (1735), the invention of cast steel (1747) and the introduction of the puddling process (1784) were "breakthroughs" for iron, which was the most important raw material. Between 1788 and 1806, the production of pig-iron in England increased fourfold. With the steam-engine, other machines appeared. Textile processes were further mechanised, and the old manufactories became factories. As early as 1787 steam and cotton came together: the steam engine moved into the mechanical cotton mill. The sudden mechanisation and industrialisation produced profound psychological, economic and social repercussions at the end of the 18th. and the beginning of the 19th. century. As we have seen, rapid technical development, especially in the 19th. century, was closely linked with the tremendous increase in the production of coal and iron, with the extensive use of the steam-engine and, later, of the internal combustion engine; with the introduction of ever more efficient machines, and with the growing influence of science on technology. The middle classes, who were inspired by the idea of liberalism, were the chief agents of the Industrial

Revolution. They strove, against guild restrictions and monopolies, for the freedom of industrial activity and of the economy as a whole. They set out, some sooner, some later, to gain a voice in affairs of State. The citizen who, by his own initiative and with his own capital, was to play a part in the industrial development of his country, had to be given a bigger share than heretofore in the running of the State. Industrialisation and constitutional reform went hand in hand. It was not by accident that the Elbe steamer of the 'forties', built by the firm of Henschel in Kassel, bore the name of 'Constitution'. The middle classes, who were the prime movers of technical development in the 19th. century, had unbounded faith in never-ending progress. This faith spurred them on to extraordinary technical feats. Liberalistic tendencies led to capitalist enterprises, capable of great achievements. At the same time, democratic aspirations born, like liberalism, of the French Revolution, crystallized into a socialist movement, under the pressure of the social ills of the Industrial Revolution. The battle between capitalism and the workers was on.

Industrialisation became a problem of training, above all in Germany. Following the English example, a class of efficient industrialists and engineers had to be built up. In this task the State had to help with technical schools of various types. Furthermore, the education of the workers had to be improved. Material standards of living also had to be raised. It was a matter of educating people for industry, that is, for production, on the one hand, and of promoting the consumption of industrial products, on the other. The polytechnical schools which had been built in Germany since the second quarter of the 19th. century soon became training establishments for the scientific study of technical problems. In this respect France had shown the way with the opening in 1794–95 of the Paris Ecole Polytéchnique, an institution which had sprung from the needs of the Revolution.

Steel, to which the principles of statics and resistance could be applied more easily than to stone, was more and more used as a structural material in the second half of the 19th. century, particularly after the steady improvement in rolling processes since the middle of the century. The requirements of railroad construction gave a further stimulus to the use of steel. Another branch of technology, which was of purely scientific origin and developed only in the late 19th. century, was electrical engineering. It originated in the laboratories of the physicists, who also built the first motors and generators. Within a few decades it grew, as an

engineer expressed it in 1893, into a young giant who was determined to do away with the drudgery of steam.

During and after the last thirty years of the 19th. century technology spread throughout the world; European engineering was adopted by other peoples, a process greatly speeded up since the first World War. The great idea of Western technology is hence being carried on, and perhaps brought to its final conclusion, in areas outside Europe. A characteristic of the development of technology in the 20th. century is its increasing specialisation. In structural engineering bolder constructions are made possible by an advanced scientific approach to the problems involved, and by the improvement in the strength of materials. Parallel with its economic activities, the Deutsche Stahlbau-Verband (Association of German Steel Construction Engineers) has also made it its business, in conjunction with the technical colleges, to conduct experimental research in the field of steel construction. In present-day mechanical engineering we are witnessing increasing automation. Besides mechanical structural engineering and synthetic processes, we have today the world of instruments with its great variety of electronic devices, among which the calculation and control systems are destined to revolutionise many branches of industry through further automation. In the past, the machine was meant to relieve man of physical labour; now systems are being developed which are to take over mental routine work. The process started with the simple machines for addition and multiplication invented in the Baroque age. And now, in our time, the technical exploitation of atomic nuclear energy is commencing. We have seen how, far into the Middle Ages, technical work was performed by human energy. Then came the great change when, in the 11th. century, men learned to harness the forces of nature, of animals, of running water and the wind. Another radical change occurred at the end of the 18th. century when the thermodynamic properties of coal and, later, of oil, were realised. The source of all these kinds of energy is, ultimately, the energy of the sun, which is generated by nuclear processes. And now the nuclear energy of terrestrial elements is being released and, with it, the atomic age. When, in 1673, Christian Huygens succeeded in building an internal combustion engine powered by gunpowder, a tiny experimental machine, men rejoiced at the prospect that the force of gunpowder, which had hitherto been used only for purposes of destruction, could now be put to peaceful and constructive use "ad maiorem Dei gloriam et ad hominis bonum". In the 17th. century religious sentiments were still active, even in the technical

sphere. Let us hope that, in our own day, the religious concept of moral responsibility will guide us more than it has done hitherto, so that atomic energy, at first used only for destruction, and the whole of our advanced technical civilisation may ultimately work for the greater glory of God and the good of all mankind.

(From a paper read at the Congress of Steel Construction Engineers at Baden-Baden on September 17th., 1954)

Fritz Tischler

Technology – The Herald of Progress

Anyone who looks at the world with open eyes will discover that the present time is like nothing that has preceded it. We find in the same room a Gothic Madonna cheek by jowl with a house bar and Mexican ceramics on the mantelpiece; pictures consisting of pieces cut out of 16th century atlases must help to cure the psychic neuroses caused by looking at contemporary works of art, which are entirely devoid of any human element. For modern works of art portray ideas, not human beings.

Does this explain why we are so fond of celebrating the birthdays of men, of figures of flesh and blood, or are such celebrations the effect of the general half-educated state evidenced in quiz broadcasts, which owes much to the reading of cheap newspapers with a wide circulation? The result, sociologists assure us, is a demand for celebrities of all kinds as material for the press and crossword puzzles.

Or should we venture to assume that we occasionally feel the need to pause for a few moments on our journey through time and look back in order to gather strength for new adventures of the spirit?

In the past, as in the present, we find a spirit bent on research and classification. As long as we are concerned with *homo sapiens,* this spirit is one with our own. The artists of Altamira and Lascaux, the poets of the epic of Gilgamesh and of the texts on the Pyramids, Buddha, St. Augustine, all are equally comprehensible to us, since the human mind has remained substantially the same, its physical environment alone having constantly changed. As a somewhat drastic illustration of this, I should like to ask if a motorist who drives his car from Duisburg to Antwerp is a more higly developed human being than the charioteer of Achilles.

Regarded from this angle, it does not matter whether actors play the parts of Hamlet or Agamemnon in baroque coustume or in contemporary dress against a background of colourful gobelins. The important thing is to realize what is common to the spiritual features of various epochs. To recall men and women of the past keeps us from forgetting: how many of the places where human beings once lived and thought have been swept away by the wind or obliterated by the sea? About the year 500 B. C. men

in Greece had already discovered that the earth is a globe, and in the third century before our era Eratosthenes had calaculated the earth's circumference almost exactly, arriving at 23° 51′ 19″ as the deviation of the ecliptic instead of 23° 45′ 19″, the correct measurement. In addition, he developed a projection map of the world as then known. A century later Hipparchus plotted the earth's orbit round the sun. In the second century of the Christian era Ptolemy took over these findings and produced his map with a network of parallels and meridians, an Equator and two Tropics. And all this was forgotten! Forgotten, like the language of the Etruscans, the history of the Hittites or the poems of Tut-Ank-Ammon.

Man's image of the world was a disc with Jerusalem at the centre. The continents of Europe, Asia and Africa formed, as it were, an earthly trinity. Projections and knowledge were lost in the mists of dreams and experience. We are strangely moved when we look at the maps of the 13th and 14th centuries. They are documents of faith, but just because of their religious background, they were ultimately swept away by scientific research. The challenge to Christians to subdue the world led the crusaders to the East and pilgrims to Rome and other holy places. Such pilgrims by land and by sea had to have maps and, since political interest and trade followed the same routes, such maps were supplemented for practical use.

The term "supplemented", however, represented the transition from the theocentric thought of the Middle Ages to the Renaissance. Perhaps only our own generation can fully grasp what it must have meant for all the important modes of thought to have been ousted by new ones in the space of one hundred years (15th–16th century).

It was then that the curtain rang up on the great European drama: men set out to discover the world (and to fix it in maps). Nor is our interest less because we know that other men had already been in most places in the world in some previous century. All these early hunters and collectors remained anonymous; the discovery of their bones and tools is the only proof that they were once in this or that area. Perhaps we should mention that, in addition to the Atlantic shipping routes discovered by Vikings, Hanseatic navigators, Spaniards, Portuguese and Englishmen, the Pacific was crossed by many early seafarers in voyages just as amazing as those across the Atlantic.

We have thrilling accounts of expeditions to all parts of the earth which opened up hitherto uncharted seas, rivers and continents. Every

voyage demanded the last ounce of strength from discoverers. It is characteristic of all such pioneers that they are inspired by the restless power of the spirit, a Promethean boldness to blaze new trails in defiance of God and man. The earth was born anew, as it were, and charted afresh. The famous terrestrial and celestial globes, therefore, are not only artistic and technical achievements which we study and admire. They represent a new image of the world, whose centre could no longer be Jerusalem, particularly after Copernicus and Keppler had put the finishing touches to their concept of the world.

At that time the Atlantic took the place of the Mediterranean as the central scene of human activity, in the same way as we in the 20th century have been driven into the Pacific. Just as Alexandria and Constantinople were once the great centres of communication – and it is no accident that they were also the homes of famous geographers – they were succeeded by Antwerp and Amsterdam after the short supremacy of Italian towns.

The growing demand for globes and, later, particularly for maps went hand in hand with the new techniques of printing. Pictures, maps and books in a profusion hitherto undreamt of, disseminated ideas. We have an analogy in the broadcasting and television of the 20th century, means of communicating news and knowledge such as only a Jules Verne might have imagined. Today we practically take it for granted that 400 million people can all take part in the launching of a space ship at Cape Canaveral and experience it with their own eyes and ears. Our sense of wonder has almost atrophied. The supermen in the world of technology – successors to Prometheus – have spoiled us. They have of course been living in various guises among us for a long time; indeed, to indicate that the prerequisites for our present age did not exist until man had reached the third stage in his evolution, we might add that they are as old as *homo sapiens*. Neither Neanderthal man nor the earlier anthropoids can be counted among our spiritual ancestors. Perhaps this will comfort those of us who are oppressed by proclamations of the end of the world. For why should God's power of creation have exhausted itself already?

I must qualify my assertion that our sense of wonder has almost atrophied. It is not always true, as I should like to demonstrate by a trivial example. In 1924, when I had to give my very first lecture, I had to speak about one of Sven Hedin's expeditions. Greatly excited, I traced the adventurous route followed by the explorer, looked at his pictures and maps, which impressed me far more than the close-ups in the costly

collections of photographs we now have. When I had finished speaking, my teacher asked if I was aware that Sven Hedin himself would be lecturing here in about three weeks. I must have looked amazed, for I had no idea that Sven Hedin was still alive. It had never occurred to me to ask; I did not consider it possible that I should be the contemporary of anyone resembling the discoverers of the 15th and 16th centuries, men who set out on their expeditions without adequate technical equipment, men who trusted in their physical strength, men possessed by ideas and ready to suffer hunger and thirst in the cause of human knowledge. Columbus and Magellan, Vasco da Gama and Raleigh had set out on their voyages in exactly the same way. Thinking they knew the limits of the seas, they actually discovered new shores and brought home a new picture of the world.

With the same youthful enthusiasm I then read the reports of Stanley, a contemporary of my father's. In 1874–1878 he crossed Africa in 999 days and, acting for the King of the Belgians, he made the treaties with the chiefs on which the State of the Congo was founded. May I remind you that all this started 80 years ago? The image of the world can change considerably in 80 years.

Every one of us who has any feeling for the wonders of the world will not forget Glenn's calm voice when he announced his positions on his space flight. Africa was crossed in as many minutes as it once took years. What a tremendous leap beyond our earth into the mysterious, dangerous cosmos, where rays, meteorites, inconceivable cold and loneliness threaten man! I repeat: the period from Stanley to Gagarin lasted 80 years, the same span that separated the discovery of America from the projection map of the world of 1569 with its parallels and meridians.

Only by such examples can we realize what the 16th century meant for contemporaries. So it is perhaps not an accident that certain words which were new, or at least took on a new meaning in the 16th century, are now again changing their meaning. I am thinking of the word "atlas", for instance. Developing from its origin in mythology, the word came to designate a collection of maps. In the last 30 years a "generous interpretation of the word Atlas" became necessary when photos of works of art, of technical plant and special maps and aerial photographs were collected in one volume, which was still called an atlas. Our young children, however, who have not yet seen an atlas at school, already know that Atlas is the name of a super-rocket at Cape Canaveral, which

is more complicated in structure than Cologne Cathedral. By means of such rockets and sputniks it was possible to take photos of the back of the moon, a truly astonishing proceeding!

Worlds hitherto unknown are revealed in all their immensity and with all details. Just as in the 15th and 16th centuries the existence was discovered of new continents like America and Australia, which then found their place on globes and maps. The fanatic determination to explore the cosmos or, more precisely, the first cosmic ring round the earth, produces newer and newer instruments, for new ideas shape their technical aids, not the other way round . . .

Just think what it means to have regular air services over the North Pole only 53 years (almost to a day) since the American explorer, Robert Peary, first reached the Pole on April 6, 1909. On that occasion Peary wrote: "East, West and North had disappeared. Only one direction was left, and that was South. Every wind that blew in our faces had to be a south wind, no matter from which point on the horizon it came. Where we stood, a day and a night made a year, a hundred such days and nights, a century." And now, 53 years later, Polaris submarines under the Pole, jet planes over the Pole – all according to a timetable! In a state of weightlessness Glenn saw the sun rise and set three times in one day. Do we always really grasp the enormous jump in human thinking from the 19th to the 20th century? Did contemporaries notice the jump from 1492 (the discovery of America) to 1569 (the projection map of the world)?

The answer is that perhaps some thinkers did notice what I have tritely called a "jump". Many reacted to it unconsciously. The relation of man the explorer to the traditional concept of God was no longer what it had been. G. B. Shaw, with his usual acumen, once said that there was something wrong with the world. Whereas obsolete dynamos and engines were scrapped, people refused to throw away their obsolete prejudices, their antiquated systems of morals and their obsolete religions. What, he asked, was the consequence. That people were doing good business in machinery but in morals and religion they were working at a loss that was bringing them nearer bankruptcy every day.

The East-West conflict about ideologies or church reform is not particularly typical of the 20th century. But our common experience of the struggle and the suffering it entails makes it easier for us to understand the 16th century, which is drawing to a close for good in our time.

(From a lecture given at Antwerp on April 14th, 1962)

Werner Conze

Historical Landmarks in a Technical Age

Conclusions important for historical research and teaching emerge when we give due weight to the interrelated view of history that is now gaining ground. In outlining these, we shall direct attention to the practical consequences attendant upon certain general theories.

We must first discuss the problem of periodicity, which is closely connected with forecasting the future course of history. We shall approach this matter with all possible reserve, but certainly not because we wish to deny the convincing realities of metaphysics and metahistory. Nor do we only wish to avoid the danger of naively accepting the immanent facts of received history, but rather to shun hasty, portentous observations on the content and purpose of history, a subject on the periphery of our discipline. Following Toynbee, therefore, we may speak of three great phases in the history of mankind, essentially as he described them, but without feeling obliged to support his mythical, ultra-historical prognoses.

In accordance with these introductory considerations, we have a historical triad of primary eras. The first phase was literally the pre-historical period, the millenia of early man, with a primitive form of civilisation and social organisation. Such primitive cultures, based on limited technical knowledge, in which man is still largely in the state of nature, but is already showing the technical ability latent in humans who dominate and change nature, existed up to our day in some parts of the world. Rudiments survive still – the "pre-history" of modern times.

The second stage began with the cultures that flowered some 6000 years ago, and came to an end with the revolution of modern method. These were the millenia of diverse cultural groups or "civilisations" (Toynbee), i. e. relatively closed societies expanding into various political associations, or even into large empires, but limited by geographical environment, initiative, population, the strength or weakness of natural obstacles, or of enemies inhabiting unsettled areas outside but, above all, by the level of technical knowledge. Inner cohesion and the expansion outwards of influence and contacts were dependent upon the latter. In spite of a

measure of intense activity, in peace or war, within certain periods on the one hand, and between periods, on the other, these cultural groups generally remained so distinct from each other that separate treatment by historians and philologists was not only possible, but essential. History was therefore specialised to a study of certain cultural units. Where history was conceived to be general or universal in character, it never – whether originating in a universally accepted religion or in a secular power – in fact dealt with all the independent cultures, but was viewed from within the culture it served. A history, therefore, written from the European standpoint, and dealing with the Orient and Greece and Rome was also considered to be universal. Such a history would hardly mention the Far East, for instance, which was an entirely different and remote world, enjoying only tenuous links with Europe.

The third phase was not reached until our time, the era of industry and technology. It first stirred Europe in the 18th. century and, properly understood, can be regarded as the ultimate goal of European history, in Hans Freyer's sense of the term. The history of our times may, in the future, be called a "new period" in a quite different and structurally wider sense from the "new era" it was to scholars of the 16th. and 17th. centuries, as compared with the receding "Middle Ages". The sharp distinction still made in our teaching and research between the Middle Ages and the Modern Period has, moreover, become increasingly blurred recently, since the Modern Period has been extended back to include the 13th. century while, structurally, the Middle Ages are now understood to end in the 18th. century. The early period of the modern technological revolution, by contrast – even though its conclusions are by no means generally recognised – has shown itself since the 18th. century to be more than a significant turning-point that can only be compared historically with the burgeoning of culture in the 5th. and 4th. millenia before Christ. For, in a political and social, as well as in a technical and organisational sense, the modern changes – they have revolutionised Europe – produced cumulative effects that created the intellectual and technical conditions for a radical re-shaping of society, first in Western, then in Central, Europe and potentially throughout the world. In the process, man's control over nature progressed by leaps and bounds. That impetus is not yet exhausted, and steady advances, not of course unlimited in scope, are being made.

If we accept this division into three main historical periods as basic, we shall have to revise, sooner or later, not only our already outmoded,

complacent, ideas about historical evolution but, in particular, the way we teach history in our schools and universities.

For the interval between the founding of the early civilisations and the coming of revolutionary changes in Europe, more attention will be given than before to parallels and differences in the various cultural groups. It is true that Europeans always tend to esteem more highly the general approach of European Classical Antiquity, as described by Ranke. This is because our understanding of our own history is involved, especially since the modernising of the world began here, on foundations laid long before the 17th. and 18th. centuries, in the course of more than a thousand years of European history. But, aside from the dead hand of impersonal lists of dynasties, rulers and warriors, history would have had to tell us about the basic framework, relatively static over long periods, of Arab, Hindu, Chinese and Japanese history. Such knowledge is a necessary preliminary to a proper understanding of the industrial and technological age. For, as modern changes spread across the earth, they impinge everywhere upon widely-differing societies with deep roots and, even in dissolution, exert considerable influence in a world that is moving towards standard patterns of living.

The history of our own culture, moreover, that of Europe from the Franks to the Industrial Revolution, should be regarded as a coherent phenomenon and taught as a uniform survey. Subdivision into Middle Ages and Modern Period are then unnecessary, being conceptually and chronologically vague; but chiefly because the era of industrial and technological change can no longer figure as a primary period in modern European history. It is no accident that such considerations take us near Guardini's "The End of the Modern Age", although both the premises and conclusions are different.

It is not possible, of course, to date the development of pluralism precisely into different periods and to distinguish it from the age of industrial technology. The co-ordinating influence exerted by European industrialisation on diverse cultural groups and residues of primitive social orders is a long-term process that generally eludes exact chronological definition in terms of revolutionary change. In western and central Europe the problem is most acute for the second half of the 18th. century. In those years the changes ahead were heralded in numerous emancipatory tendencies until the great French Revolution started in 1789 and, jointly with English mechanical inventions, clearly marked the beginning of an epoch of change. That such a landmark is justifiable in

a relative sense is apparent if we consider Hazard's "Crisis of the European Spirit", for the attrition of Christian influence by religious wars and the Cartesian philosophy involved revolutionary change in the 17th. century, and this paved the way for the autocratic, yet hopeful, spirit that wished to disrupt, change and reconstruct the pattern of human existence. But, on the other hand, the emergence in Bismarck's time, of national forms of government in Europe was essentially a phenomenon peculiar to European history. For, although political change was threatening in various guises, as the Industrial Revolution forged boisterously ahead, political activity continued to follow traditional lines and was the preserve of a class whose social antecedents predestined it for this rôle. Accordingly, the period is usually described by historians around the actions of its statesmen, a reflection of the mannered charm it exuded on the political stage before a pre-revolutionary audience. But neither the 19th. century revival in Europe, nor the intellectual prelude in the 17th., alter the fact that the age of industrial change commenced towards the end of the 18th. century, in the middle of a period of transition, during which Freyer's "Reason in the Right Environment" inspired change of all kinds, and has lasted until our day.

In the second quarter of the 19th. century the United States had, more decisively than Europe, accepted without reserve the spirit of change that led to more democratic methods and the opening up of vast areas of virgin land, using new techniques and untrammelled by tradition. In a colony far from Europe, the way was cleared by severing ties with England in the American Revolution. Developments since the time of General Jackson freed America from the traditions of Europe, and laid the foundations of modern industry, with greater finality and vigour than was shown during the struggle for independence. This is the period Huizinga associated with the first stirrings of America's frightening metamorphosis. He took it as the extreme example of an industrial society living in conditions of modern mass democracy.

We may regard the year 1917 as the point of departure in the case of Russia. It is true that preparatory structural changes in Russian society had been in progress for many decades. The intelligentsia was permeated with the revolutionary ideas of European socialism and, ever since the peasants were emancipated in 1861, the rural communities has been steadily freed from serfdom and its obligations. Traffic routes had been opened up and industrialisation had spread widely since the 'nineties. But none of these changes – not even Stolypin's liberal agrarian reforms

after 1906 – moderated the pace of change, nor succeeded in warding off the violent sequel. While revolutionary changes in the United States had been introduced from the outset by way of encouragement, or as a matter of principle and – kept in check by an instinctive aversion to anarchy – were given a free run, it being unnecessary to first attack and destroy the citadels of pre-revolutionary institutions; under the Czars, centuries of the customary gulf between ruler and serf could not be neutralised in the short span of half a century of spasmodic reforms. To the end, neither the Czarist régime, nor Russian society, was capable of creating a democratic pioneering spirit analogous to the American. If it was to have any success, Lenin's Revolution had to be imposed "from above", through a planned industry and political coercion, because local circumstances and an unstable political situation were inimical to individual efforts at large-scale industrialising in the short term. It is hence more accurate in Russia's case than elsewhere to fix on a definite date to mark the commencement of the age of technological industry, since there, as nowhere else, a great political revolution stands out from a gradual revolutionary process. With Lenin, the political and the social revolution were, for the first time, consciously linked to the revolution in industry. This not only suited conditions in Russia, but was generally characteristic of the industrial era. Chaotic, disordered growth and freedom of operation in all spheres were here, however, transmuted into the rigid discipline of a technically perfect bureaucracy, eschewing the ideals of liberty enshrined in the French and American Revolutions, which it had once re-echoed, and whence its initial vitality derived.

The different historical phases could be similarly described, as they affect Asiatic and African peoples. In general, we may say that, by the 19th. century, i. e. since the white man directed a more intensive engineering and commercial effort towards colonial and semi-colonial territories, the patterns of traditional organisation had begun to break up, and not entirely because of contacts with the outside world. An educated and a working class developed, parallel to the earlier emancipating process in Europe. Lacking confidence, and even ashamed of their native backgrounds, these classes readily accepted a "European" revolution in their own way of life. This marked, and is still marking, the end of isolation for such countries, and the freedom movements have heralded the beginnings of their age of industry and technology – even where they were at first exploited and had no say in their own modernisation. At times, this change comes about imperceptibly, as it were, but usually in irregular

surges, political upsets and violence, whereby the rights established under European rule dispute the terrain with rights demanded by national and social aspirations. The two World Wars reinforced this process, but were not primarily responsible for it.

From the periodic methods already discussed, it follows that, for purposes of teaching history at the Universities, the history of the age of industrial techniques should be treated separately from the so-called "modern period". European history from the 6th. or 8th. to the 18th. centuries, and the story of extra-European cultural groups up to the 19th. century, are succeeded by the new, broad-based history of the world of popular emancipation and revolution, and this admits of no final study as yet. But, even today, we are able to trace relatively continuous lines of progress in the formative history of movements, particularly in regions where such movements and changes began long ago and, using comparative methods, we may advance to determine typical historical patterns.

The treatment of our modern age differs, therefore, from European history up to the 18th. century, not simply because it can only be taught and visualised as general history, but also by reason of its being quite a different sort of history, and this is really its main theme. The "res gestae", in the old sense of the phrase, can only be made the subject of research with a clear conscience, if they have features that are keenly sensitive to the new patterns of history. Fernand Braudel's warning that the "histoire des événements" cannot lead to satisfactory conclusions in the absence of research into "géohistoire" and the "histoire des structures" is even more indispensable in dealing with the Industrial Age than it is for the 16th. century, which was the touchstone of Braudel's method.

The priority given to the application of scientific method to the analysis of historical phenomena, engages the sympathy of people like ourselves, "moderns", influenced by contemporary experience since the crisis in emancipation at the turn of the 19th. century, but this priority does not compel us to the frequently assumed or postulated acceptance of a determinate inevitability about the historical process. Feeling helplessly enmeshed in a network of technical activity – Freyer's "secondary systems" – we are in danger of only perceiving man on a small scale, as an instrument of control, and capitulating in the face of anonymous, hidden forms of remote control that are liable to take the bit between their teeth. These are sinister images, but they are signs of our times that

deserve serious consideration. Kafka's "The Process" mirrored the merciless loss of personal identity when taken to extremes.

Yet such a view is only concerned with one uncanny, though basic, trend of the modern age, the jeopardy in which man himself stands. The full significance of an industrial and technological age, the main features of which are still growing, is not described. Even, perhaps especially, a society that obliges man to become a functionalised operative of incalculable circuits and pieces of apparatus, needs in greater degree a character capable of and ready to take creative, more or less free, and responsible, decisions. Compulsive organisations not only determine the human rôle, they also challenge those who wish to modify or shape them. Should the challenge go unanswered, the political system drifts into dissolution, and is replaced by a stronger one that is not merely more efficient in the technical aspects of asserting its will, but is also prepared to take decisive action on the moral plane. This is the crux of the current conflicts between power-blocs, economic systems and ideologies.

(Lecture given on September 19th. 1956 before the Research Study Group of North-Rhine-Westphalia.)

Anton Hilckman

Technology – Curse, Blessing or Our Responsibility?

If we inquire in what particular our modern times differ from earlier eras, we constantly come up against the awe-inspiring facts of modern technology. In the whole of history there is nothing to compare with our "machine age". And no attempt to look into the human future and to evaluate its possibilities, hopes and fears can avoid technological phenomena.

Yet it is extraordinarily difficult to arrive at an evaluation of such phenomena in all their aspects, or even to take one, long view of technology. It has been called the "liberator" and also the "enslaver" of men. We speak of the blessing, the curse and the evil of technology. Is one, single view of it possible? Should we not try to understand it from various points of view? Probably, but does this not result in the various observers and critics of technology never coming to a uniform, unanimous view of it?

Technology not only concerns the external world, i. e. our surroundings; it is not merely an external thing, unconnected with ourselves. It is man's creation. But his creation has, to an extent, reacted upon its creator and changed man's nature, so that modern man is no longer, can be no longer, like his forbears of past ages.

The rationale, or aim and object, of technology is to ease man's passage through life by relieving him of heavy or onerous burdens. It is also the function of technology to do work and so to accomplish tasks that man alone, unaided by technology, could not perform. We do with ease, aided by machines made with the aid of technical skills, things that the ancients would have found impossible without using thousands and thousands of slave-workers. For their larger constructional projects like the Pyramids, military roads or irrigation works, such peoples had only slaves. Tens of thousands were enslaved, taken into bondage, limited and restricted in their personal liberty, even robbed of it, and of human dignity, in order that the name and fame of a few might be perpetuated.

Even when we consider those of past ages who were not the slaves of tyrants, but were free of alien pressure, how many such were, in their

time, really free to enjoy a more elevated kind of life? The farther we go back into history, the more we discover human life to be bound up with serfdom as a means of obtaining the bare essentials to support life. How much "free" time was left to a poor peasant farmer continually and wearily working his frugal acre with all his family simply to harvest enough for them all to live on? Many ask where the artisan's or labourer's "freedom" was, when he had to perform by hand the hardest, most laborious, monotonous and tiring tasks. Did machines, by relieving man of such work, really set him free for leisure, or did they provide him with the opportunity of having any?

Calculations have been made of the many millions of slaves that would be required today to do, without technical assistance, the work that is done easily by machinery. Machines have made possible, in ways undreamt of, the easy, rapid production of goods required by man, in much greater quantities. Are we not then free today, inasmuch as we need not do that work ourselves and can leave it to machines? Has not technology actually liberated mankind? Have we not gained time, time that need no longer be used to obtain the materials necessary for living, because produced technically? Does that not free us for other purposes? Cannot the time saved by machines be used in the pursuit of other, higher aims in our lives? It certainly can be, but whether it is or not is another matter – at least the opportunity is there!

Consider what the modern techniques of inter-communication have brought to pass. Distance is, today, no object, or very little. Modern means of travel have speeded up mobility – and made it much cheaper too. Many who, in former times, just could not travel, now find it possible, thanks to technology, and use their opportunities with gusto. In a few hours we can be in another country, after a journey that would have, at one time, probably taken as many weeks. How rarely could a migrant who had gone to live in another country or even in another region, expect to see his old folk again! Should he not usually, in most cases, make up his mind when he left them that he would probably not see his parents again in this life?

And have not rapid communications also brought nations closer together? Certain it is that, in a technical age, goods can be exchanged between countries more easily than ever before. Yet true as such things are, we hear voices raised telling us, in recurring protest, that these are not the really important issues and that they are overshadowed by other considerations, also connected with technology. In our day, cultural

exchanges, too, are easier than before. The ground on which they flourish is more fertile than formerly, at all events. But has technology really brought peoples closer in the spiritual sense? Modern critics point to wars of annihilation that, today, in a technological age, are on a scale impossible in earlier generations. They ask whether technology has not turned out to be little more than an instrument perfected for the mutual destruction of humankind.

In externals, by contrast, the critics go on, the nations have become more like each other. They maintain that technology has not enriched and diversified life but, quite on the contrary, has made it more monotonous, gray and standardised. Machines are ironing out national characteristics: racial individuality is ground down to one level in the technical era. The suburbs of our large towns are similar in appearance, not only in Europe, but throughout the world, similarly hopeless, depressing and similarly ugly. And this ugliness has spread from town to country: there too, from about 1870, nothing has been done that is beautiful, genuine or good. Country architecture is no whit less ugly than its counterpart in town. And technology is responsible for all this, for technology expresses itself in ugliness. Of necessity, it goes on creating ugliness everywhere. So say our critics, or something like it, expressing views with which we, however, in no wise agree. It is true that ugliness seems to go hand in hand with the progress of technology but this is far from proving that they belong together, or are even two sides of one and the same phenomenon. It may very well be that ugliness and technology need not necessarily go together. Might we not as well say that, of itself, the coming of technology has brought no kind of ugliness into being? That ugliness was, rather, the outcome of human helplessness in the face of a new phenomenon that was dominating man completely, so that such ugliness *could be* overcome, since the conditions necessary to vanquish it were present in large measure? For we already speak quite freely of the "beauties of technological solutions".

But the critics do not give up so easily. When we talk of the wider, more expansive, ways of living that offer themselves in an age of technological advance, and point out to them the broader horizons it opens up, horizons unthought of before the era of applied science, our critics counter by asserting that many of the necessities created by the new techniques are artificial in themselves, i. e. are not really necessities, and are even unhealthy, pathological desires. Science, they tell us, tends to disturb the peace and tranquillity of our lives – as it has already upset

the balance between man and his environments – and has undermined the niche humanity should occupy in the vast order of nature. And now, they continue, man has set himself against nature, is no longer at one with his habitat, is homeless, uprooted, as was only to be expected. For modern man, technologically conditioned, is indeed a new sort of being, not only as compared with his ancestors of the period directly preceding our occidental Middle Ages, or of the first centuries of the "Modern Period" (for technology did not exist from the beginning of modern times, being relatively quite recent), but he is alien also to all that went before, irrespective of time or place, and he is, as it were, suspended in limitless space, in a vacuum. The age of technology, they say, has finally struck the note that shatters the cohesive forces of nature. We turn our thoughts with longing to those "Middle Ages" when, we assume, harmony existed in all things, in human life and in nature, when man knew and felt himself to be part of a greater order of things, encompassing him and touching him at all points. Such an age drew its stability from religious roots, and was pervaded with piety. But technological science, say the critics, has disrupted such harmonies, and even performed the self-appointed task of clearing away the ultimate débris from earlier patterns of life.

Is all this really true? We always need to put our question to everything the critics bring forward. Is this or that aspect of the matter an effect or a function of technology? It is certainly true that, physically, technology has so changed the face of the earth that people who lived in former times would never recognise it. It has also effected a revolution in all the external circumstances of our lives. But what has, after all, brought that about? Was it technology? Was technology on the scene first? Did technology itself create a new kind of man, its own, technically-minded offspring? Or was the new man there first, inventing technical processes merely as a way of expressing his wish to live a new, changed kind of life? For the moment, let us put the double question in this form: Did technology create technological man or had man himself changed so that, as a changed man, he had to invent technological science? Perhaps it is incorrect to divide the question into two alternatives. Both might be right. It is very probable – and, in one way or another, it has often been said – that technology, itself man's creation, subsequently outgrew him, almost, in fact, at the very moment of creation, and enslaved its master. Technology then stood outside man, like a fact of life, an external force, independent of his wishes, with which he must reckon, and in the capacity

of a subordinate, inextricable and inescapably subject to the laws of a technological environment, so that the creature of his own intelligence, made with his own hands, now takes away his liberty and destroys him.

This would mean that man is no longer the master of technology, his brain-child, but that science has taken command of him. And what are called the "soul-destroying" effects of technology on work are pointed out to us. Modern, technical methods of production are contrasted with those of the old craftsmen. An old-time craftsman himself brought the work of his hands to completion. He made things from start to finish, shaping the product from amorphous raw materials, so that it grew and attained perfection in his hands.

All a man's energies were directed to the task in hand. The craftsman did things "whole" and our critics too, point out the relevance between "whole" and "holy". This craft work, the work of a "whole" man, was "holy" work, for the simple reason that it engaged all a man's powers. Craft work enjoys the same status and pedigree as other "holy" work, like agriculture, for instance, that Virgil praised for its dignity, purpose and beauty, or intellectual activity. This work done in the old trades and crafts – where the boundaries with the arts are so fluid that we are reminded of the Greek word "techne" which means craft and also art – is compared with our industrial mass-production techniques that are based on the mechanising of handwork. No longer does the "whole" man do the whole of the work. Instead, the various stages of the work are split up into their constituent parts, into an infinite number of work processes. The work itself is simply atomised. And this mechanical, atomised kind of work has, we are told, a deadening, degrading effect. The process of making goods for sale is no longer a matter of personal effort. The spirit has gone out of producing consumer goods, it is impersonal. Formerly, a craftsman was frequently an artist (a "technites"), as we see from the wonderful work done in traditional art, as carried out by the smiths, carpenters, potters and weavers of past centuries. All that has gone today. Many of the old crafts have disappeared altogether. We are told this, with the additional observation that whole sections of the populations have been morally ruined by soulless occupations.

The machine and its work must therefore answer a double accusation. In the first place, it is alleged that machines have enslaved man, who has become the servant of his own creation, being no longer a "whole" man but a mere appendage of an iniquitous, unholy mechanism. Secondly, the machine and the kind of attention it demands have sapped man's moral

fibre, dehumanised him, and introduced restlessness and frenzied haste into the life of the individual, and also into that of nations. Technology was to have made life easier for the individual man and for all men. In reality, however, it has proved to be only the instrument of serfdom. It should have made life easier by easing the burden of work and so creating new opportunities for enjoyment and pleasure. But the long-term results have been quite the reverse. Modern social problems, owing their origin to the degradation of those who do standardised work, have only arisen, the critics tell us, because of technology.

They say that the standardisation of work processes is part of the general trend towards rootlessness that shows itself in large things as well as small. Our attention is drawn, for example, to the public apathy in matters of taste that characterised the second half of last century and up to the first World War. It was as if a spirit had fled or vanished from the scene around the middle of the 19th. century, as though the life-giving breath had suddenly died away. It was especially noticeable in the crafts, such as those in the building trade, where methods were largely unchanged. The sure perception of what was artistically sound, a quality always present in earlier periods, had gone. We need only compare the architectural monstrosities that sprouted with increasing luxuriance from 1870 and, from the turn of the century, made all Germany a uniform model of progressive ugliness, with older, plainer but harmonious and elegant structures put up by humble craftsmen in earlier times.

But once more we ask: "Has man become like this because of technology?" Is it the real cause, or perhaps a major cause, of man's spiritual concavity? Or, is it the other way round? Since technology developed as it did, were its effects not due to the appearance of fundamental disturbances in man himself? Such might very well be the case. It might be thought that a mankind still confident of its own place in the scheme of things, might not have been thrown off balance by technology but would rather have been capable of relegating the new techniques to their due and rightful applications. The pre-condition mentioned was evidently lacking. Perhaps this was it: Man created modern technology out of his own, Faust-like unrest. And, even if applied science has become a phenomenon of planetary scope in our day, it is a growth typical of, and deeply rooted in, the Occident. Such phenomena are only possible in the Western hemisphere because here alone are the quite special intellectual, spiritual and social conditions found that could give rise to them.

So that, by and large, technology has, it would seem, spread a vast amount of evil and laid a blight upon the earth. Or, put the other way, Occidentals – whose special brain-child it is – have carried its pestilential imprint throughout the world. We are familiar with all the reproaches and accusations that have been levelled at technology. How it upsets man's concord with nature and disrupts nature to the point where the whole of a countryside loses its original character, and even extensive regions or countries. Later on, too late in many places, people's eyes have been opened to the fearful results of destroying natural resources in the service of technology. As examples, one might cite the deforestation of wide areas, leading to the formation of barren steppe-land and, lowering the water-table as a result of straightening and canalising rivers. Then there is the break-up in traditional harmonies: man's delivery to machinal reaction, devoid of feeling; and we have already spoken about soul-destroying occupations. Man is a complete personality, and his life should be full enough for every aspect of his humanity to be brought into play. Too much specialisation distorts the natural balance and mechanisation has, so the argument runs, mutilated humanness. But human lives should not be misdirected by drafting people, each possessing a complete, unique personality, to further the achievement of partial objectives. And, if such misdirection does occur, a compensatory measure should be devised. But it was just this compensation, that should have rectified the personal distortions inevitable in the specialised modern forms of craftsmanship, and rounded out the lives of industrial workpeople, that was lacking. Man remained mutilated, and we now hear protests about social disorders, and these protests continue to gain in strength. We have already said a little on that subject, but not by any means all.

The "levelling" process is recognised as one of the hall-marks of our time, and the individual's propensity to merge with the mass of his fellows is related to the "soul-destroying" depersonalising effects of industrial techniques developed in a machine age. The principles of mass psychology apply equally to social and to political behaviour. At one time we were told that great men, outstanding individuals, were the pillars supporting historical activity. Today, the rôle is reversed to the impersonal crowd, headed by anonymous, almost interchangeable, leaders whose leadership consists only in the fact that they suffer, to a quite exceptional degree, from the personal shortcomings of each of their constituents, every one of whom recognises in the leader an enlargement of himself on the grand

scale and worships that image, the leader synthesising in himself, as it were, the defects of the crowd.

Such a vitiated proletarian is exposed to a variety of perils unknown in earlier, more settled, times. He tends, in the first place, to be irrational; one might even say downright ultra-rational and anti-rational. It is a paradoxical effect of technological science that, itself the outcome of the most refined rationalisation, it creates, by the very fact of rationalising so many areas of human life, a vacuum that provokes precisely the opposite reaction. Reason is the brightest light that illumines the world of men. But it does not shine on the repetition worker: his inner consciouness is sealed off and he lacks the spiritual strength to break through. Instead, he is attracted to the occult, to the mysteries that thrive in the shadows and seem to him to possess magical qualities, and to other unhealthy sources of knowledge.

In such manifestations we can see nothing more than the individual abandoning himself to a group mentality while under metaphysical influences. Does this not provide us with a clue to the close relationship between technology and destruction? The fact is – and the very recollection still fills us all with horror – that technology has served the ends of destruction. Is this in the nature of technology itself? We have to put the question, but there can be only one answer. Technology is material power; and power involves temptations to its abuse. There is really no more to be said. Technology alone confers on man the awful ability to destroy, in a few moments, his fellow-humans and the results of their labours; to obliterate works of art and cultural monuments that are, or at least should be, revered by all men everywhere: to bring about devastation that can only be made good after years of the most devoted toil, if at all, aided by the constructive resources of technology. In war, modern technological invention has magnified a thousandfold our capacity to annihilate human beings and destroy cultural works. The second World War amply demonstrated such techniques in all their frightfulness, and atomic science can be applied to total destruction.

It would appear, therefore, with very little shadow of doubt, that technology actually does possess an evil attribute of some kind. What matters to us, however, is whether evil is an indispensable characteristic of technology. We neither sing its praises nor condemn it outright. The correct attitude towards the applications of science must surely be to see and acknowledge the benefits they have brought and the opportunities they open up, without blinding ourselves to their terrible dangers.

Seeing a danger is not the same as overcoming it, however, but perils can only be avoided after they have been seen. When we have once recognised the risks associated with technological science, and have our eyes open to the many ways in which its more sinister ramifications menace mankind, we need faith to believe in the possibility of counteracting them. Those who lack such faith, must indeed despair of the human race. The scale of the threat presented to all men everywhere by modern technology when it is used for purposes of war and destruction gives rise, by reason of its very frightfulness, to new hope. Scientific inventions have caused the individual to rely upon his fellowmen and have brought about an interdependence between countries and nations that had not existed hitherto. For this reason alone the least threat to the well-being of one nation is, at the same time, a threat to many more, to all in fact, and invites, nay, insistently demands, joint action by all. The community of interests that is a corollary of our modern concept of humanity has, as its logical conclusion, the abolition of war. That, at all events, is the lesson technology has for mankind in face of the menace of total war in the Atomic Age.

That technology, the creature of man's imagination, invented to serve him, should end by destroying him, really is the ultimate in "reductio ad absurdum" propositions! Yet we must enquire whether that realisation is enough. Let us hope so.

There can only be one remedy, to return technology to its proper place in relation to man. Its proper place is functioning as man's servant, not as his master.

No doubt technology has contributed largely towards the creation of proletarian sections of the community and this malaise of the machine-age cannot be cured by technical means. Technology itself can offer no panacea: man must heal himself. The problem is a moral, I would almost say a religious, one. Its solution lies only in restoring to man that essential part of his nature which would make him human in the full sense of the word. Then, and only then, can phenomena extraneous to his humanity no longer do him harm. For, measured against human nature and the progress of the human personality towards its own perfection and, most of all, against man's eternal destiny, even technology is incidental.

I may be challenged for suggesting that applied science is unimportant. In the context of considerations such as those already outlined, such a view is not only admissible, it is unavoidable. We are certainly not advocating a return to the simple satisfactions of past ages, or of primitive

cultures, merely because the increased needs of modern man can be supplied effortlessly, by means of technology, in ways unknown to earlier times. But man, we repeat, must work out his own salvation. He can only recover the humanity he is in danger of losing if he establishes an order of things in which the machine is subordinated to the human will.

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August Brunner

The Danger of Technical Thinking

Human thought is as limited as man himself, and is hence often one-sided, whether the thinking is done by an individual or a group. There is, in every period of history, a certain level of culture to which thought is principally adjusted and through the various categories of which it attempts to influence the other cultural levels. This cannot happen, however, without distortion and error. The more exclusive ideas become, the deeper the gloom encompassing other fields of thought. There can be no doubt that our times have been profoundly influenced, and indeed shaped, by the natural sciences; and the effects may be observed in those who have never pursued such studies. For technology has become a ubiquitous factor in our lives. It is the outcome of a scientific preoccupation with physical things. And the natural sciences seldom fail to impress modern man as being the sole reliable key to all reality. Technology enjoys an absolute, almost religious, devotion, even at points where its protagonists cross its boundaries and air opinions on matters in which they are no more competent than the rest of mankind. Let us look into some aspects of this kind of thinking and examine the broad reactions it produces on the lives and outlook of the people of our age.

The natural sciences, and physical and technical science in particular, are concerned with our knowledge of things. Their methods have been developed to handle material things, concrete objects and, of course, to control and use natural forces. Such an orientation is an essential part of the methods used and is quite independent of the personal views of individual scientists.

The proper scientific attitude towards material things is that of objective proof or confirmation. Any other attitude or feelings would be out of place. What is required is a reliable and accurate knowledge of the matter in hand, the facts. This is all we have to rely on. The facts are only recognised in the human brain. An object does not assist in the process and is in no way helpful. It simply exists, indifferent to recognition, or its absence, about which it has no knowledge whatever. Man can do what he likes with it, provided he reckons with the properties

of the material composing it: if he steps outside those limits, failure is inevitable. It would be foolish to expect the material to make any special effort to further, or even to evince any sort of predisposition in favour of, a human enterprise. Man is therefore thrown back upon his own resources. His attitude becomes one of seeking to obtain control over the inert, indifferent material for his own purposes, to possess and make all possible use of it. This again necessitates precise observation of the facts. Information can only be used for technical ends when it is logically and transparently certain. Suppositions, expectations and wishes have no place whatever in such work.

In the last resort, the need for certainty arises from the fact that matter behaves in accordance with essential laws and, in consequence, it is possible to calculate its actions in advance, and accurately enough for human requirements. Under similar conditions, the material or substance can be relied upon to behave in a similar way. If it reacted first in one way, then in another, as humans do, and as matter was thought to do in the Middle Ages, natural science and technology could not exist. Neither mood, nor vigour, nor inclination, nor weariness, with all their unpredictability, play any part in what happens. This abstract objectivity is also present in the law that governs the interaction of substances in the purely chemical sense. Its course is determined precisely by the energy latent in the substances concerned. Nothing is lost, and nothing is gained. Nature bestows no free gifts. A process of exchange is going on continuously and it is conditioned by the magnitude of the forces taking part in the reaction. Much as words like "attraction" and "repulsion" betray their origin in a human vocabulary, we know that there is no question of mutual preference or repugnance on the part of the individual forces involved. The action accords entirely with the ingredients participating in it. Nothing is checked, in any real sense, nor does anything enjoy a preference. Such an absence of freedom, mood or emotion, of willingness, or its opposite, calls for a modest, objective approach on the part of the investigator. No human qualities except that of comprehension are needed. Matter's real, and complete, indifference towards man is reflected in the human attitude. This process of man's adjustment to the requirements of inanimate things has been going on in the Occident for centuries. And, if no other forces intervene, there is a danger that man's human characteristics will atrophy.

Matter's entire indifference towards everything that happens entails the further consequence that it does not favour human enterprise. It

proceeds in accordance with its own laws and, if these laws cut across human intentions and destroy man's handiwork, the material world does not hesitate. Man, in consequence, must always be careful to control and harmonise his materials so that his plans are realised, and his works preserved. At no time should he rely on disturbances being compensated for, merely because the materials have some interest in human purposes. Constant vigilance and readiness to intervene are essential to the relationship: a man driving a motor-car dare not sleep, nor allow his attention to wander, for a moment. Man must regard materials with distrust, as it were, always keep them under surveillance and remedy harmful effects without delay.

Technical activity is mainly concerned with modifying nature. And it must certainly take account of natural laws. But man's knowledge of nature must be used in such a way that nature renders services and performs tasks that it would never do if left to itself. From the standpoint of technological objections, nature is not as it should be. Technology perforce changes nature, using nothing but human knowledge and the power it confers. Every change or modification is an intervention that diverts the normal course of events into new channels. Such events do not originate in the nature of matter itself: they therefore disappear again once man's attentive hand is withdrawn for a space. The nature of a material is not affected or changed by man. It remains what it was before. Man can only create new external forms, independent of the innate properties of matter, and provide new starting-points from which the laws regulating its functions can operate. There is a re-arrangement, but no new growth.

Matter is always available and ready to be worked on, even in the most superficial of ways. Today iron is no more and no less iron than it will be tomorrow and, given the means, may be lightly or heavily worked. Its nature knows no ideal stages, no periods of maturity, which fit it for man's use more than at other times or stages. So that physical time, such as is marked by clocks, is a regular flow in which no one point is more distinguished than another, a flow with neither height nor depth. It is not because of any internal compulsion, but simply the human impulse for mastery that shapes the material and disposes it in ways best suited to the purpose in view. But things that are only near to each other in the sense of physical proximity may just as easily move away again, without in any way affecting the essential nature of either, as a result. Clay made into a plate is no better in a material sense, is no more

complete than when it lay, without shape or form, in the earth. All technical activity takes place at the surface of reality and, since it has very little effect on real nature, neither touches nor influences reality itself. All that must come from man, and for all that he relies upon his own resources.

One stage in the technological process, however, is decisive for all, and occupies a paramount position. Yet the distinction does not arise from the materials used, but rather in man, the user. It is reached at the moment when the device or appliance in hand is ready for use. From the standpoint of matter this stage, of usefulness, is merely one among various possibilities, all or any of which possess equivalent value: the material itself tends neither in one direction nor another. The stage is only important to man, so important in fact, that everything done up to that stage has been subordinated to it, and has no point or significance outside the contribution made towards it. The productive process is no more than a necessary evil. It is without intrinsic value and is not desired for its own sake. If it were possible to omit it, that would be done without hesitation. And every effort is made to simplify and shorten it as far as possible. Everything is urged on to the final stage which alone has value. Moreover, simplification is inherent in the methods of the natural sciences themselves which are conditioned by scientific application. Since, in the external world, man can only re-arrange matter in a direct sense and only modify its qualities in such a manner, our knowledge of natural science must be restricted to establishing quantitative ratios, that is, to measurement and the measurable. And all this amounts to building a simplified body of knowledge. The worker of today, in particular, no longer inhabits the diverse world of nature, but a world created by technology, which is a simplified world. And our appreciation of reality is debased thereby to the intellectual naivety that typifies the great mass of people and is rapidly becoming ever more remote from the abundance and variety of nature and, above all, from a genuine intellectuality. Rationalism and a weakness for ideologies are nothing but the intellectual symptoms of this striving for simplicity.

A comparison with the plant world will make this peculiarity of technology clearer. Whereas a machine only becomes a machine when the details of its production are complete, a plant is a plant as soon as, and as long as, it exists. At every stage, and at every moment, it is complete and, at the same time, incomplete. It is what it is in a transitional sense of constant growth and development, of an inner unfolding that results

from a complete harmony of the many processes involved in growing and dying. One situation is not conditioned by another – that is too human a way of looking at it – but every moment of change stands alone, has its own intrinsic value, and is also the vehicle leading to further change. The abundant diversity of such a process, and of the forms it takes, cannot be in the least comprehended by a mere weighing of the objective pros and cons. A plant lives only in the constant succession of every single stage of development. For this reason, it does not strain towards the final stage: that would amount to dying before its time. Quietly, in accordance with an inward rhythm, it goes its way and fills every moment with the events appropriate to its nature, each stage being a preparation for the next. But matter is always prepared, because readiness or maturity is an abstraction that does not apply to material things. With materials it is simply a question of reaching the final result as quickly as possible and leaving the stage of production behind.

The absence of biological growth and internal changes when matter is worked on by technology also fits in with its lack of a historical sense. Technology is not satisfied with the gains of the moment: it must hurry forward to newer and better things. And the success attained today is only a starting-point for tomorrow's progress. It will not, of necessity, figure in tomorrow's success and is not, therefore, preserved in another form. On the contrary, it simply loses its value. All the early models of motor-cars and flying machines have been superseded, and are now only valuable as curios. But compare that with music. There, a masterpiece, say Beethoven's Ninth Symphony, is not eclipsed by what follows, and rendered worthless. In this sense too, technical progress is not growth but a series of leaps, even though the leaps are, in certain cases, very small, but they give us the impression of steady, continuous progress. And, just as the movement on a cinema screen is an illusion of continuity, so too is technology, by its very nature, discontinuous. It is more like a succession of dots, a series, like the minute markings on a clock. Technology is not a coherent whole capable of creating something on its own: it is a sum, the parts of which are outwardly independent of, and indifferent to, each other.

The technical outlook has had the most rapid and lasting effects on economic thought and behaviour. But then, technology serves economic ends above all else. Anxiety about our physical well-being and comfort has, moreover, been passed on to technology in the first instance. Much as science is a human concern, and can never be a purely material activity,

yet its applications concern man directly, not as a personality, but as a living creature. By its nature, technology is hence more dependent upon the material world than any other branch of human activity. So it is not, therefore, surprising if technological ways of thinking are more easily induced in the province of physical comfort. And, to a large extent, that is justifiable.

Without much difficulty we can detect, in the world of modern economics, a striving after pure objectivity. The goal to be attained is an exchange of real values. The human connection is eliminated as far as possible. Human feelings and preferences play no part. This is because they are unreliable and unpredictable, and only obstruct the smooth working of business affairs. The aim is to approximate trade and industry more and more closely to the physical world of action and reaction. Marxist thought even seeks to convert human labour into a factor of mathematical magnitude. It is thus not difficult to imagine that a modern world economy can only continue to exist in these conditions. In the event, the impersonal functionalisation of the business world is already far advanced. Producers and consumers, workpeople and employers, operate less and less on a basis of personal connection.

In this regard, however, there is a reverse side to the coin of a far-reaching elimination of the human factor. Business activity is becoming despotic. It seeks to develop in accordance with its own laws and drives ahead unremittingly, caring less and less for others in the field. All that runs contrary to its interests must stand aside. Business is becoming every bit as absolute in its way as physical science has become in the sphere of understanding. Man yields to its demands with continually diminishing powers of resistance. Where could he find the strength to oppose what has become, for him, the supreme arbiter? But this banishes man to a dehumanised world where peace and quiet, patience and tradition are unknown. His life becomes more comfortable and easier to live but, at the same time, less satisfying. Whole areas of human personality no longer receive any consideration. Even the satisfaction and happiness conferred by material well-being itself, are not realised in practice. There is no time to adapt one's self mentally, and as a person, to earthly possessions. An object is no sooner acquired than it is displaced and already out of fashion. Only the hunger for more, and the latest, remains. And because we do not give things time to impress themselves on our consciousness, to become part of ourselves, and afford us spiritual pleasure, developing

thereby our acquisitive instinct, possessions lie heavily, like so much ballast, upon the limited carrying capacity of our souls.

Has modern man overlooked some crucial element when he regards the things he uses as a mere function of their economic worth? Are they not something more? Are they not cloaked invisibly under the magic spell of human association and value, if we but allow them to share in the reality of our lives? Where there is nothing but an exchange of commercial goods, equal in value, there are indeed no personal feelings involved that might elevate the objects from mere existence to the human plane. How different is the gift given in an access of goodwill, with love and kindness, and without thought of requital! Only so does man learn what love and kindness are, and how they can enfold him so that the whole world seems a good and a safe place to live in. We are constantly enchanted at the very sight of things that appear to us transformed by their human associations. The fact of their existence is heightened and spreads an atmosphere of trust and faith that surrounds us with a grateful awareness of being well looked after.

But where generosity withers under the tyranny of a commercial outlook; where the noble impulse to be kind yields before a mentality that measures and calculates – seems stupid, in fact – where even the gift itself is under the aegis of advertising and is charged to someone at some stage or other: in all such conditions there are not even opportunities to perceive that kindness and goodwill are superior and more effective influences. Enjoying, as he does, a veritable cornucopia of commodities undreamt of in earlier times, modern man is yet "treated" much less often. He lacks something that makes such matters easy and helpful. The world has become prosaic and boring. Materialism is a doctrine that is essentially cheerless and unhappy. It creates an atmosphere of distrust and ruthless "objectivity", where nobody feels at home. How is a man to know what real love and kindness are, if he has never been given anything? He will distrust them both and look on them as calculation in disguise, which puts him in danger of losing the advantage and making himself look ridiculous.

And this brings us to the point at which a one-sided, scientific-cum-economic objectivity constitutes a deadly peril, i. e. in the region of human values. Too exclusive a specialisation in exploiting material resources has stunted the centres in man that alone control the areas of human sensibility. Those who approach their fellow-beings in a mood of domination, and with a desire to exploit them, treat them as lifeless pawns, and esteem

them according to their value or uselessness in the economic sense, cannot have an inkling of the nature of human personality. That can only be appreciated by those who are prepared to acknowledge, through their own attitude and behaviour, the independence of the individual. If we permit the business interest to conduct our affairs, in the place we expected to find a soul, we find instead a vacuum, a void. Experience seems to be on the side of those who regard appeals to intellectual values as so much deceptive talk, just as the materialist philosophy and its bed-fellow, Communism, do, although their theories could never have been propounded without intellect of some kind.

Trust and confidence reside in direct contact with things of the spirit, on which we can rely in our dealings with others. But where the instinct for such spiritual values withers with disuse, trust and confidence too, tend to disappear. The capacity to place reliance on other people, or to approach them with open-minded confidence, is replaced by the urge for certainty by way of material proofs and controlled experiments, by systems backed by power. In physics such methods are justified, because they are suited to the material in hand. Here, by contrast, they distort the very object in view. For, certainty obtained in such ways casts one's opposite number in a passive rôle, changes him into material that can be tested at will and ignores him as a subject, i. e. as a person and as a human-being.

In a world where such attitudes predominate, real certainty is vanishing, despite the increase in technical certainties. For, in the world of men, real certainty can only come from the assurance that springs from the supremacy of spiritual values, and our conviction that they can be depended on. Outward self-possession is only a reassuring quality so long as intellectual poise is maintained inviolate. Because this alone restrains human restlessness. Our entire human life is built up on a natural trust as between man and man: it is not usually disclosed, but it gives our every thought and action an enduring quality. Civilisations are not held together by technology but by human association, which is cemented in belief and mutual trust. These alone introduce our children to the cultural background of our daily lives which then becomes their own property. And, in the wider sense, without, perhaps, realising it in as many words, we assume our fellows are worthy of trust to an extent that is only apparent to us when we see it may have been misplaced. For then technology also loses its raison d'être. And, since technical security is derived from the reality of a human faith, science then takes on a sinister

character and is transmuted, in its onward march, into a menace that throws a growing shadow across our lives, and all this is due to an underlying instability. Our present situation demonstrates this fact with horrifying clarity. How much security comes from the knowledge that enables us to predict with certainty that a cobalt bomb could simply extinguish all life over large areas of our earth, if we cannot be sure that no hand would detonate it, still less that no conscience would be repelled at the thought of committing such a crime!

When a man loses his ability to grow and mature he acquires a new conception of time. For him, time does not really exist, nor does it awaken in him any inward response. It is then no more than a series of breaks, like time in the physical sense, that always mark the sudden disillusion which follows a pleasant experience. This is time as understood in connection with the most transitory and material of human sensations, that of superficial pleasure, the effects of which do not, like true enjoyment, last far beyond its physical period of accomplishment, to enrich and illumine our lives. The conserving and calming influence of things that have endured through long ages, that have remained to inform the lives of subsequent generations, has lost its power to impress. Only novelty counts now, the things of the moment, that can be made quickly. A real sense of permanence first comes to man through the personal aspects of his nature. He learns that he and his fellow humans have, over the course of the years, developed certain resemblances and that, despite all outward or psychological differences, these do not change but last through the generations. The permanent features of civilisation rest upon the enduring similarities between peoples, traditions and, particularly, history. Without such a body of common experience civilisation cannot exist.

Should this essential permanence retreat into the shadows, our feeling of security would go with it and that is an emotion the great and age-old human institutions inspire in man, of feeling at home because one is at home. They preserve and pass on, the modes of behaviour that have permitted man to cope with the great crises of his existence and to deal prudently with the manifold intangible influences that surround him. But the material world has no community life. The sense of community is based upon common interests that take account of the reliability and creative force of ideas. Matter is subject to the relentless interplay of natural forces, and in the world of business things are not very different. Everyone is on his own, with a scope that is limited by

his own powers. Faith and trust have no meaning. But a communal life that is not founded on the implicit certainty that all are united for good and ill is no more stable than a wind-swept sand dune.

It is in the areas where man has lost the faculty of surrendering himself to the common good that his humanity is stunted. Even the family, the first institution that greets us when we enter the world, that should teach us how to choose our path through life sensibly, is in danger and, in a great many cases, no longer fulfills its rightful function. How can it, when the bases of communal life itself, the awareness and influence of human experience in the past, are on the way out? Unreasoning panic at the unexpected seizes those who do not know communal associations. They have not been prepared for such eventualities, and nothing supports and sustains them in times of stress. The great majority of people no longer understand the purpose of a church, for, more than any other institution, it draws its strength from imponderables, and is founded on faith. And those whose only experience is of pressure-groups look on a church as an exercise in either provocative deception or contemptible delusion. And the modern state has converted itself in to a mere welfare institution for the benefit of its citizens.

As the sloughing off of mutual trust and confidence and institutional bonds proceeds beyond the isolated instance, to become a widespread phenomenon, the capacity of the human mind to perceive the ultimate and divine riddles hidden in human intellect and personality also withers and dies. All else too, loses its attachment to the fundamental sheet-anchor of man's power to believe, in the absence of concrete proof. The world is then bereft of purpose. And a world without purpose only fills us with dread. The mistrust that, in physics and technology, is a mere methodological device then invades all our dealings and hardens into an attitude towards everything. The world then appears empty of all constructive and good-natured influences. Man, having accustomed himself to trust in nothing but his own powers, imagines he is thrown upon his own resources and feels hopelessly lost in the infinite void of a silent and faceless world. He, no less than the world, is hollow inside, and all paths lead nowhere. This is the reason why many in our times have lost the ability to believe, and appear to lack all religious feeling. Attitudes that, from one generation to another, have become more and more specialised and misguided and have narrowed the tracks leading to reality and dimmed the headlights of the mind, have condemmed to death something that, in the long run, is more important to man than tech-

nology, more important, even, than his daily bread. For, after all, the old saying is still true: "Man does not live by bread alone".

But since man cannot live without security of some kind, he rushes to the only thing he still has left – the apparent security that can be created at will and bought with money – and this the only kind of security technology has to offer. No human expenditure in real terms is necessary. By means of prudent statistical calculation he attempts to avoid disagreeable surprises. In so doing, it passes unnoticed that his anxious efforts are, at the same time, paving the way for the eventual atrophy of something vital to man. What is capable of calculation is anticipated in advance and is hence not really new. So that when it materialises no creative exertion is needed to deal with it. That sort of exertion is called for less and less, so too are the powers that go with it. They therefore gradually diminish and, correspondingly, the confidence of being always equal to the unexpected. In turn, the reduction in creative capacity makes a greater and more comprehensive outward security essential. Man is thus trapped in a vicious circle in which the desire for technical and social security and the disquieting awareness of being inwardly defenceless are constantly chasing each other. Unable to tolerate the situation any longer, he wishes for nothing more than to surrender his freedom, which is the condition that encourages his feelings of emotional insecurity. He is then liable to grasp at anything that promises security. He eagerly embraces each and every sect and ideology. He does this unthinkingly, of course, for no better reason than spiritual panic. And so he clings to these creeds fanatically for, in his inmost being, he knows well enough that he is merely drugging his anxiety and that the slight shock of having to answer a pertinent criticism would be enough to re-awaken it. For a man who is crippled in his soul is quite incapable of holding a conversation since, for all the differences of opinion that may arise in the course of it, mutual confidence and respect are essential to it.

All one-sidedness exacts a penalty, because the realities it suppresses are not made any less real thereby, nor are they robbed of their potency. And, when the essence of a situation, that which confers sense and significance on it, is crowded out and ignored, reality turns into a threat. Technical advance that is left to its own devices and lacks the master-touch of a spiritually-inspired intelligence, ends by undermining its own foundations. Its mindlessness is a threat to mankind. But it would be wrong to assert that the remedy consists in harking back to a pre-technical age. That is not only impractical but, if it were possible, a cure

would not necessarily be the result. Man himself must turn over a new leaf. He must offset the one-sided specialisation of a scientific outlook by resuscitating the appropriate powers and attitudes of mind – and cultivate them with due care and respect. A place of honour must be found for each and every ingredient of human personality: the criterion for each is its human value. Human security should no longer be equated with mere possession and control. Of what use is such an idea, in any case, when the hand that holds the riches is becoming more and more shaky and uncertain? The acquisitive instinct has its own rôle, but it cannot command security. Man must make up his mind to seek security in things he may not even touch but that are all the more reliable for having eluded human weakness and the short-sighted, and often evil, treatment meted out by man to his fellows. This may well seem paradoxical, even nonsensical, when set against the unilateral scientific and economic thought of our day. But has not the course of history already sounded the knell for this way of thinking and its lack of understanding for the essentials of human life? Mercy is a quality unknown to technology – but it does give security.

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Wolfgang Schadewaldt

Technology and Man

Technology and humanity, the subjects that form the theme of this lecture, cover a field in which exact formulation is difficult.

Humanity or "human-ness", describes man: and it is not easy to decide what or who man is. Nietzsche said that man is "a being that has not yet been classified" and man's identity is not just another of those matter-of-fact questions to which there is one simple answer. The action of enquiring into the nature of human beings involves questions of objective standards, and presupposes subjective decisions, and any change in that situation – despite all the attempts that have been made to "regularise" human behaviour – appears unlikely in the forseeable future. And, since man shows himself in such diverse settings – as an animal in its natural habitat, as a social being, as a personality and as a spiritual force, for example – research into the nature of man crosses terrain divided by the boundaries of the most varied fields of study, from biology, anthropology, sociology, psychology to matters of history, art, ethics and religion.

Technology too, holds the key to extensive fields of knowledge. It is based on, and governed by the nature of, the art of planned and controlled production, characterised by an abundance of the most diverse processes and methods; its dependent relationship with the physical world, in analogy with which it functions now, and will continue to do so in future; then, its rapid growth in recent times; its involvement in economics, industry, politics and the modern habit of living "in the mass"; and its present expansion on a world-wide scale, together with the problems that have arisen in regard to technology's social and psychological effects on the so-called "developing nations". We may also stress the inevitability with which the mental aspects of technology – for we are concerned with mental phenomena, as well as with abstract sociological developments – affect us all, whether we like it or not, and perforce condition our environment. Even if it is man-made, technology now seems to be demanding from man a new sort of adaptation, or even a change in his reactions, such as became necessary in former times as a result of natural phenomena like the Ice-Age, or because of radical

changes in patterns of life such, for example, as the settling of nomadic tribes that once lived by hunting and gathering.

These are only a small selection of topics implicit in the concepts of humanity and technology. They could not be dealt with in a single lecture, but might well be investigated methodically over a longish period of time. I have mentioned them merely because they are relevant in the wide-ranging context of this lecture, and because, when ranging widely, it is always a good thing to keep the boundaries of one's discourse in view. For my part, instead of becoming entangled in generalities, I propose singling out only one of the relationships that exist between my two subjects, the relationship between human beings and technology. I shall enquire about the particular nature of the relationship and, with the aid of my special knowledge of Greek and Roman culture and its influence in Europe, shall attempt to make some contribution towards clarifying a topic too often discussed now-a-days merely in emotional terms. This may also assist in some measure to allay fears, and even clear the air of some of the toxic fumes that have recently poisoned the relationship and, in that respect, I shall be continuing earlier researches made along certain lines.

If I am not mistaken, the relation between man and technology has, in the troubled period in Germany since the last War, been principally looked on as one involving diametrically opposed factors and, basically, this view remains unchanged today. Technology is generally seen, then, as a direct danger to mankind. Apart from the threat to our physical existence contained in radio-activity and nuclear power, it seems to restrict man's social propensities within the techniques, necessary to deal with large-scale problems, that have evolved from the applications of science. Technology not only "standardises" us outwardly, it does the same to our emotional life, by way of standardised leisure, standardised pleasures, standard ways of enjoying nature, even standard love. It may be that these "inner" consequences of technological invention will so attack and modify our deepest mental and spiritual processes that we run the risk of one day living out very comfortable lives without perceiving that we have quietly ceased to be human. The concept of "humanity", on the other hand, may now be defined – there are, in fact, several possible definitions – somewhat as follows. It is the conviction that man should not only behave as a man, as animals behave like their kind but, first and foremost, that he should have faith in himself as a man. He should, moreover, be prepared to defend his manliness, which

means his personal dignity, his freedom, his basic human rights, his whole nature and "eudemony". The latter term signifies more than "happiness" or feeling happy: it means maximum personal fulfilment, the highest development of which the individual is capable. And all these things must be striven for and acquired afresh in each succeeding age. It is this preoccupation of humanistic thought with the best interests of mankind that clashes most directly with many manifestations of modern technology, particularly on account of the pressures it releases in the direction of an unlimited increase in the standard of living, without a corresponding rise in cultural values.

But my studies of classical antiquity, in the first instance, then of its survivals in modern Europe, have led me to believe that between the two "magnitudes", of humanity and technology, there exists a ratio other than that of mere apposition. It would appear that in this, as in many another, case the opposites can be reconciled. If I judge the matter correctly, humanity and the world of applied science are correlated, each being the complement of the other, and hence interacting one upon the other. If, in some measure, technology requires the guiding influence of man, the humanistic approach, on the other hand, both as a conscious idea and as a historical postulate, seems to have assumed a kind of scientific other-world and to have taken its origin and nature therefrom.

Nowadays we have acquired the habit of underlining what is new and unique in a technical world that now encompasses almost all aspects of life, and this is something that has certainly happened since the Industrial Revolution of the late eighteenth century. But, against this, "doublets" are a feature of history. History is always weaving new patterns, never repeats itself, but is fond of turning back on itself. It is always the changing, diverse novelties in life that are new: it is the basic situations, the fundamental groupings that return. The all-embracing phenomenon of industrial technology that surrounds us today never existed before on such a comprehensive scale. Yet, in the course of European history, there have often been, in the broadest sense of the term, concentrations of a technical kind, technological periods – epochs, in other words, characterised by exaggerated, over-civilised mannerisms, and a way of life, on the social, economic, political and intellectual planes, that had become top-heavy and too complex. But it seems we may go further and assert that here we have hit upon a natural law. Life, considered purely as living existence, appears to rely, over the wide field of biology, on generating frameworks, structures, and closely

integrated physical and nervous systems, out of animal tissue. Life can thus be maintained, protected, and continued: and the struggle for existence may be sustained more or less successfully. But now, almost as if to rule, an over-development of certain forms and system appears. The mesh, so to speak, becomes too small, the pattern too intricate and the tissue thickens, hardens and cocoon-like growths begin to form in the structure. In these, life is in danger of being choked in the very structures it created itself. In such a case, the specialised, or even over-refined, creature is in a bad way. He is held fast in an environment to which he was too well adapted and, being incapable of breaking the chains of his own refinement, perishes hopelessly, more particularly if changes occur in his habitat. An unspecialised, receptive man, by contrast, is able to check the formation of "super-structures" and, in changed conditions, may start a new life. At a certain stage of cultural development, it is precisely in eras of exaggerated refinement, or inflexibility, that we observe appeals to "human" vitality. This is when, coining slogans like "Back to Nature", man breaks through the cocoon and, as if drawing new life into his lungs, creates new and freer ways of living in which the processes of growth already described, and the construction of defence mechanisms, begin again.

As I see it, the humanistic concept, in the various forms and guises it has assumed in a modern period we now regard as historical, may be compared with a time of over-civilised mannerism. Left to himself, it should be noted, man has no cause to think of himself as man while he is going about his affairs. When he is living in the simple, patriarchal state of nature, what he must do is decided for him by what usage and custom, ritual and religion tell him should be done. He follows the example of his ancestors, the rules governing rank and position, as well as tribal law and God's will. Here he can find an entirely adequate guide to practical matters which reflects the image of man at, so to speak, ground-level. Man's efforts to see himself in humanistic theory as the human phenomenon, and to consider his position, and make himself the centre of activity, are only observed at times when the forces of custom and religion have diminished. This is the stage at which man, seeking for a new pattern of living, creates a human objective from his own nature and finds, in the idea of humanity, a new type of universal religion. As far as I can judge, such periods occur predominantly when extravagant forms of civilisation threaten the simple, traditional, uninhibited pattern of life, and when the human being in man takes fright at the inordinate

complexity of the artificial and material organisation typical of a civilisation that is too highly differentiated. In this context, the human idea, and technology in the wider sense, stand in a certain relation to each other and are subject to mutual interaction. The relation between them is – to call a spade a spade – a logical one and the historical succession of over-refined ways and periods of plain, human living takes on the character of a dialectical movement.

In that respect technology is itself part of the human story, for it is as old as mankind and began when man began. Man is not, like the animals, irrevocably adapted to a particular habitat but, in order to preserve his peculiar human qualities, is obliged to wrest from a primitive natural environment conditions suited to the specific requirements of man. The instrument by which he masters and transforms his surroundings is technology – initially in the shape of the old trades and crafts. Technology's chief function in regard to man, and indeed it is still a basic function in the modern applications of science, is to equip man to live as humans should live. Not, that is, merely to assist man to live but to help him consciously maintain a certain way of life – not to live somehow, but rather to live in comfort and with elegance. The root idea of the Latin word "cultura" is "care". In this original significance, then, technology liberates man from abandoning himself apathetically to untamed nature, and elevates him above mere vegetating to a dignified existence worthy of his humanity. Whereas, according to Goethe, an animal is merely "informed by his senses", man can inform the senses nature gave him and, through technology, extend, enrich, enhance and complete them. A thinker in ancient times expressed it as follows: "Technology enables us to acquire what nature failed to bestow on us". And Aristotle, seeing it from nature's standpoint, said that nature is only perfected and made whole by technology. Proceeding from its original function as an instrument invented by man to fit him for a human existence, technology has, from the earliest times, freed man to concentrate his efforts on inventing machines. The thought of technology's dominant powers, of the ways in which it has aided man in his struggle for existence and uplifted him to live in a manner befitting his dignity, inspired the men who, nearly two hundred years ago, in the Age of Enlightenment, set in motion the forward march of technology and industry in Europe. Today too, the fundamental idea of technology's human function still operates powerfully, as can be seen in the current tasks it has assumed in areas of the earth that are still a prey to the stagnant

apathy that comes from hunger, disease and the like. And this takes no account of the manifold achievements that stand to the credit of technology in the fields of greater safety and easier living conditions. There is also the spirit of technology, a spirit of calm and logical enquiry, of broad views, tidiness, accuracy and attention to detail. No less an authority than the poet Hölderlin once spoke of the "innocence" of machines, a term that contains a world of meaning.

At this point the dialectical movement starts and – even in our day – takes us to the opposite pole. Technology, intended in its early forms to provide the décor for the human scene, now threatens, inextricably involved as it is with "the masses" in society, with economics, industry and politics, to grow, unnoticed, into a hybrid, over-organised system, functioning purely in its own interests as a system, without regard for, and independent of, the best interests of mankind. Symptomatic of this, is the way in which, instead of satisfying existing needs that arise in the normal course of living, technology – in order to prolong its own existence – has been driven to evolve a special technique for suggesting to man what he imagines he needs. We might eventually arrive at a stage where man, who should be the beneficiary of modern production, becomes a slave to the productive process. On the one hand, he may buy a car, a television set or a washing machine but he becomes, on the other hand, in the office, at his machine in the factory, at his drawing-board, in sales-promotion, or even in the manager's office, merely a tiny cog in a gigantic organisation. He performs his function, plays his part. The little humanity and individuality he has must be bought at the price of living to further the aims of others. Instead of being able to participate in the lively cut-and-thrust of dealing with his fellow-beings, instead of handling matters that concern real people, a modern businessman, surrounded as he is with objectives and anonymities, leads a remarkably abstract sort of life. The result is that feeling of "not-belonging" so often deplored these days in public discussions. It is an inner emotion of modern man who experiences sensations of rootlessness, of belonging nowhere, who feels a stranger in his own backyard. Man's liberation from the vagaries of nature, the basic task we attributed to technology, has now become, by a strange freak of logic, man's alienation from nature. And what in its beginnings seemed destined to exert a humanising influence on man, now turns out to be brutalising him.

But it is at this very point that man, on the evidence so far available, does not abandon himself to apathy but rather heeds the warning notes

sounded by his human instincts. Our thesis, then, taken to its ultimate logical conclusions has, in the dialectic, evoked its antithesis, so that our hybrid, over-refined state of affairs makes new demands on man or, more exactly, offers him a new "challenge". I am here expressly using that admirable English word.

This challenge to the human elements in man, goes all the way. It is a question of man's re-establishing himself as the human being that he is, and will continue to be, in the new circumstances obtaining in the modern workaday world of a technical age. In consequence of his own, peculiar kind of freedom, man is well aware that it is not given to him to just exist and persist. He is more like Virgil's "Rower against the Current" who could only make headway by unremitting efforts and powerful pulls. As soon as he rested his arms the boat moved back. Less figuratively, man's cultural existence as man resides in human action and decision.

A situation very frequent in human affairs is the "crisis". Derived from the Greek word "krisis", it signifies "parting" or "decisive situation" and if everything depends on that decision, then the risk also holds out new hope. In this sense the crisis appears to be a biological law in the cultural development of all mankind but it is, without doubt, crucial in the continent on which we live, for Europe and for the whole of Western civilisation. It seems that, in the dialectical sense already indicated, Europe has, on various occasions, been very close to smothering and becoming decadent, due to the rigidities of excessive ramification and over-refinement, only to become revitalised at a given moment, against normal expectations, as a result of the challenge to human adaptability being taken up. Each such rejuvenation of life on our continent was, in effect, a re-adaption of its people, necessitated by the new conditions and, at the same time, a re-assessment of man by men, as has been demonstrated in the fields of religion, literature and philosophy.

The unavoidable mechanisation of our lives exposes us to dangers of various kinds. These are also probably at their most potent where they influence our outlook, for they result in a disturbance of our proper relationship with what is around, in and above us, degrading our perception of reality and reducing our view of the world to an over-rationalised microcosm. The life that surrounds and supports us, and was conceived by the Greeks as a vast, active world peopled by gods, has contracted in our day to become the material that furthers our lust for power. The Greeks had no expression for a "thing". In "being", as they called it, they saw the silent working of a nature that continually took

on new and different outward forms. To us, almost everything has become concrete and while our empiricism, on the one hand, soars to new heights and extends into ever wider spheres, our appreciation of reality has narrowed to whatever can be measured, calculated, constructed, or touched. This possibly accords with an implicit conviction we derive from so much practical activity, to the effect that calculable or tangible phenomena constitute the only true reality. We thus have no doubts that cybernetics and calculating machines will, in future, be capable of assisting us in unsuspected ways with our enquiries into the nature of existence and reality. But what if it should work out that, in future, our knowledge is not only used to help the machines answer the questions, but also serves to supply the machines with questions and (of this there are already many instances) allows the machine to prescribe the questions from the outset, according to whether it is capable of answering them or not? Something akin to hardening of the arteries would then overtake the whole realm of academic enquiry, since questions constitute the principal life-giving impulse that animates all knowledge and research. All our accumulated wisdom and scientific method would then be deprived of that sense of mental adventure which springs from asking questions and sustains us as we move onwards across uncharted intellectual territory to take up new positions. Research standardised by machines, however, would leave the open country and enter a defile, in which progress could continue unchecked for a while but, despite a measure of partial success, eventually cease altogether.

Some suggestions may be offered as to how the situation can be improved, though only by way of a guide. We have already mentioned that man must seek to re-establish his position in a world dominated by technological influences. An enclave, so to speak, is required around man, isolating him from too direct an identity with technical matters and, at the same time, technology itself must be "humanised", and emphasis laid on the many ways in which it can serve man – this was, after all, its primary purpose. In our modern technology such opportunities abound. Present-day scientific techniques also incline towards the arts and might be imagined as an enormous pyramid of scientific knowledge culminating in, and crowned by, the arts. We should think, too, of the age-old connection between technology and nature, which science imitates by analogy, and we may perhaps enunciate the rule that technology only develops along healthy lines when it balances each unavoidable subtraction from nature, on one hand, by a corresponding addition to

nature, on the other. The most important change of all may well be for technology to operate, and be operated, on the basis of a realisation of its place in the cultural life of mankind. In this, a "History of Technological Ideology" and philosophy, might prove helpful. And not just a technological philosophy, in which technology would appear as one more problem among many, but a philosophy that proceeds from the realities of the natural sciences and their technical applications. Such a viewpoint takes account, in the modern period, of an area that has, from the earliest times, remained beyond dispute and above controversy, and formed a corner-stone of philosophic thought. Whether in the realms of magic or religion – where the magical or the religious realities were beyond question; whether in the Greek "polis" or the Roman "res publica"; whether in the creed of medieval Christianity or in the creative, scientific age of idealism: in all these periods thought was conditioned by certainties that admitted of no argument, from which background philosophy questioned, at intervals, the apparent laws governing existence that had not hitherto been in dispute, attempting to examine and weigh them with the tools of philosophic criticism. This appears to correspond nowadays – whatever is said to the contrary, the facts are manifest from our behaviour – to reality as it is understood by the technology of applied natural science. It is just as indisputably a kind of reality, and one to which our philosophy might well oppose a "critique of technological reason" that would assist in laying the foundations of a new order of things in the modern world.

But I must stop at this point. Philosophies cannot be conjured out of thin air. We may, nevertheless, try to reflect a little on historical and philosophical matters. This lecture has been an effort of that kind and if it has harmonised in any way with the efforts put forth so zealously and on such a broad front by the various working parties in an association as redoubtable as the "Verein Deutscher Ingenieure" (The Society of German Engineers), we have cause to be grateful, and are doubtless justified in entertaining high hopes for the future.

(A lecture given on May 25th, 1962 at the Conference of German Engineers in Karlsruhe)

Joachim Bodamer

Old People and Technology

The generation of men in all industrialized countries who have now reached their maximum physical and mental efficiency and are therefore responsible for further developments is probably the first to entirely grow up in, and be shaped by, a world controlled by technology. The world their fathers lived in was not yet fully mechanized. Although they saw the strange predecessors of our cars on roads hitherto reserved for horsedrawn vehicles, they had vocations, not merely functions. For them, socialism was a movement directed solely towards bettering the lot of the "poor". We now take the mechanization of our age for granted.

In reality, technology is far more recent in origin than we generally realize, thanks to its complete disruption of a continuing tradition. Regarded from the historical point of view, the average man of today is the first to have completely identified himself with the machine, the first who sees in the aims and achievements of technology the consummation of all his hopes. He must therefore welcome every further phase in attaining the technical perfection of existence, even if the problems involved thereby threaten to become too much for him. This justifies our attempt to study the relationship between technology and those now about to quit active life. Two questions arise in this connection: firstly, how do old people fare in a completely mechanized world and secondly, what remains to a man past the prime of a life spent in the service of machines and mechanical devices?

According to Goethe, growing old is retiring from the physical scene, withdrawing from the bustle of life; it is a transition from active doing to passive waiting. A man getting on in years retreats slowly from the centre of his existence to the periphery, with or without reluctance as the case may be. What was dynamic now becomes static. Time assumes a different aspect when it becomes the vehicle of experience and no longer something to be measured out; it flows more slowly, indeed its current seems to flow past the old. When a man quits the arena of active life for good, he becomes a spectator both of himself and of world affairs. The future shrinks and hope with it. All that was shirked in life now appears

as lost opportunity, as an irretrievable loss, as a fault that can no longer be corrected.

In old age a man's life, like a work of art designed and executed, hardens in the mould in which it is to remain for all time. Growing old, like every biological process, is inescapable. No one experiences it without resignation or protest, even if repressed. It may be tinged with melancholy, the sadness born of loneliness and a feeling of uselessness, which leads more often than formerly to suicide amongst old people. Old age may be pervaded by the despair expressed by Solomon when he said that for everything under the sun there is a season which, when past, can never return. Those, therefore, who do not accept the fact of old age, who enter the quiet antechamber of death ungrateful for what has been, will scarcely be able to master this, the most difficult period in life. The graciousness and the meaning of old age will elude them. Growing old, for men as for women, is, if properly understood, a greater art and achievement than anything that has gone before; for old age is actually the distilled essence of human existence, the proof of the pudding, as it were, the proof of whether this individual and irrevocable life has stood the test. Old age need not be a burden to be borne with sighs of despair. It must be apprehended as a necessary stage in life – though the last – blessed with its own peculiar quality, which is the freedom from compulsion and the opportunity to return to one's true self.

Existence in the technical age has been burdened by problems too intricate for technology to solve. As a result, old age has lost its simplicity. It has become a confused, complex state, only a few features of which can be dealt with here.

The face of mass civilization in our present stage of industrialization bears more and more the stamp of old age. The "natural" pyramid has been inverted by the ever-growing number of employees now being eliminated from active production. They are a dead weight on society. The great majority of these old age pensioners require social, medical and spiritual care. Their welfare is a dilemma which we are only beginning to tackle. As always in our highly organized society, the economic problem is the easiest to deal with. It is possible to build homes for the aged and even to equip them with comfortable amenities. And in medicine an entirely new branch – geriatrics – has been developed to treat old age and its diseases. But all this scarcely touches the fringe of the psychic situation of old people in the technical age. A world controlled by technology is biased in favour of youth, which it would prolong

indefinitely. Such a world is equally hostile, or worse, indifferent to old age. For, apart from a few exceptional cases, the aged are useless to society, alarmingly useless for any further development.

An old man – the dignified patriarch of Goethe's day – was venerable in the pre-technical world just because he was a comparatively rare figure. Moreover, since the conditions of life changed very slowly, he possessed a store of experience on which a young man at the outset of his career could profitably draw. Today, the experience gained in a job becomes as rapidly out of date as the workman himself. Even before he retires, he ceases to add to his vocational experience. The lightning speed of development and the growing complexity in all fields of production make such a workman a hindrance rather than a help. His uselessness becomes more and more evident as time goes on. And it is technology, more than anything else, that forces him to realize how superfluous he is.

As for what we call experience of life, things are no different. In old age this should mellow into the wisdom of life. But a man whose existence has been dedicated to machines has no experience of life, this being ruled out by technology as quite unnecessary. What is demanded of people today, and particularly from men? A man must react speedily to new situations, where previous experience cannot help him. He must have an instinct for safeguarding himself against any possible catastrophes, and he must be able to camouflage his true nature in the all-powerful egalitarianism of a socialized community. To react quicker than others, to put safety first and to be inconspicuous are the tactics usually employed in the process of a man's adaptation to modern existence, the instinct for adaptation representing at best a kind of experience of life. Such experience, however, can only be gained and transmitted to a coming generation in a stable world. An old man, for instance, takes note more or less as a matter of course that man has succeeded in penetrating outer space, whereas young people integrate this "experience" into their consciousness of the world around them.

This much, then, must be borne in mind: old age is an absolutely novel problem in a world controlled by technology; here, a man is simply "old", i. e. he can no longer function or, to put it more brutally, he is no longer any use. He does not enjoy the dignity and the prerogatives of old age. He falls out of the assembly line and must be cared for by the community. It is this shift, this decline from being an object of veneration and respect, a rich source of experience, to becoming a useless member of

society that explains the blatantly universal desire to be young at all costs. No one wants to be really old now that the adjective has a derogatory sense in the mind of technical man.

The situation described above, the negation of old age by technology, will be sharply realized by the modern man when his own time comes. Giving up driving his car is a sign that physically, at least, he has reached the limit, and the demands made by modern traffic on a driver's physical and mental powers will push this limit ever nearer the prime of life. One of the manifold features of old age – it may be interpreted as a functional protection – is a gradual loss of elasticity, an increasing difficulty, biologically conditioned, of adaptation and reaction, processes which must be at their best on the road, particularly in traffic. An elderly man's sense of responsibility, or legal regulations, will make him give up driving in the interests of the safety of younger road-users.

A car, however, is much more to a modern man than merely a useful means of getting about quickly. Surrounding it by a magic halo as he does, its driver identifies himself completely with his car. For him, it is the proof of his efficiency, the symbol of his freedom (dubious though that may be), above all, an instrument at his command which gives him power over time, space and other people. A car's mastery of space compensates its owner for the narrowness of everyday life. Though most people feel cramped by the common round, it is a delusion: a man's growth depends solely on his inner life. An elderly man's sense of loss at being deprived of a motorist's opportunities will be in direct proportion to the extent to which he had identified himself with his car. Nowhere is technology symbolized better than in driving a car, with its concomitant road-mindedness and the new way of life it initiates.

Another way in which old age has been degraded by technology can be seen in the "unemployment" of the old. Records in sport and in supersonic aviation can be established only by the young. The same is true of physics, a science conditioned by technology, where more and more Nobel prizes are awarded to young researchers. The priority accorded to youth is obvious all along the line, though it is not always so brutally apparent. At the centres of power in the world of business and industry, human capacity is exhausted rapidly, and at an early stage. Fear of failing efficiency, worry about not being able to stay the course, the anxiety of being outstripped by younger men, force the ageing executive, to whom his profession and position are everything, to overtax his strength by re-doubling his efforts.

Old people, then, present the community with bills for the diseases of civilization, to which the customary ailments of old age are added. The inner life of a man who has grown old and been "scrapped" will inevitably be empty if he has been entirely absorbed previously by a technical vocation, by the ambition for success and efficiency. Such absorption may be dictated by a mechanized world, though a man need not submit to it. But it takes genuine wisdom to attain such freedom, and this is something more than the understanding of machines.

A further disappointment awaits the man getting on in years today: he realizes how easily he can be replaced. It is characteristic of our record-geared age that everyone, even if he is outstanding at his job, disappears from the memory of his fellow-workers suprisingly quickly, once he can no longer take an active part in production. After a short time he might as well have never existed, for all the influence his personality leaves. In the dizzy whirl of development, the achievements he was so proud of count for nothing; at best, they are but a tiny fraction of the total, not perhaps superfluous, but certainly not important. In a highly mechanized world almost every job consists of one single function, which must be discharged smoothly and which scarcely allows the specifically human element to come into play. In such circumstances it is easy, indeed desirable, for a worker to be replaced. Cogs, or even wheels, can always be replaced by others. As a rule, the replacements will be an improvement. Since it is always only the present moment that counts, an elderly man, though he possesses a past that has conditioned him and his view of life, has no history of interest to others. Technology has no concern with the past. It therefore pays no attention whatever to the old, especially to those of them who have nothing but their burden of years to commend them.

Admittedly, the radio set of today owes its existence to the wireless set of 1925. But, for us, the old set is not only antiquated, ridiculous, and quite useless: it is superfluous, and not worth keeping. This attitude towards our technical gadgets, once they are obsolete, permeates our human relationships and naturally reacts with particular emphasis on the older members of society. Where everything is assessed by its fitness for use the same standard is tacitly applied to men.

Paradoxical as it may seem, modern man's supreme need is to prepare himself realistically for old age in a mechanized world. He must not allow old age to take him by surprise. Otherwise he will find himself vegetating morosely in a state of frustration and protest at his loss of

activity and pleasure. The fulfilment of age, its peculiar glory, depends of course on the maturity we have attained during the years before, quite apart from our performance in our job. To reach a full maturity and spiritual objectivity is the hardest, most exacting problem that technology sets us.

(From "Die politische Meinung", October 1962)

Andreas Schoenknecht

Space Travel and Belief in God

Despite all the bravery of astronauts and the genius of scientists and technicians, the word "astronaut" is still too high-sounding in relation to what has been achieved. Gagarin and Titov among the Russians, with the Americans Shepard, Grissom, Glenn and, since the 25th May 1962, Carpenter, have penetrated outer space. Not one of them attained a maximum altitude of even 300 kilometres.

Although they reached a state of weightlessness during their flights and orbits, they did not leave the earth's gravitational field behind. At all points in their journeys through space they were satellites of the Earth. The moon, our main satellite, is another 1000 times as far from earth as the spacemen have yet been. Weightlessness results from distance and speed. By firing retro-rockets against the direction of flight, the capsule's speed was reduced when it was to return to earth. As it slowed down, the forces of gravity overcame those of speed, and the space capsule described an elliptical curve towards the earth's surface, until the pull of gravitation became so strong that it drew the capsule vertically downwards. The "famous" penetrations into space are still very modest compared with the extent of the universe, for no astronaut has yet travelled right out of the earth's gravitational field, always remaining within its rotational orbit.

Certainly their extraordinary feats should be recognised, but that does not entitle Gagarin and Titov to bring forward their knowledge of space and of all creation as complete and final. They are far from having journeyed through the whole universe. Moreover, their American colleagues, who showed the same degree of courage, and achieved as much, are far humbler. They have not made such blasphemous claims and, in general, they were more reserved, although also fully aware of the importance of their enterprise.

If there is a God, and Messrs. Gagarin and Titov imagine he can be seen by human eyes, they should first search the whole universe for him. Even then, they would be as unlikely to catch sight of him as a surgeon is of seeing a human soul when he opens up a mortal body.

God is a spirit that can only be perceived in the mind. All our natural, and cultivated, human senses and instruments, however perfected, are quite inadequate to this task. Senses and instruments only register what can be observed or felt.

It actually excites our compassion when we hear such fine, courageous men as Gagarin and Titov showing as little perception and personality as well-trained parrots repeating unthinkingly what has been taught them. I am not doubting their human understanding; but the statements they are making to audiences in countries they are visiting, about the non-existence of a God, show how shallow their political and social veneer really is.

In what follows I shall simply try to bring out the magnitude of the gross errors into which the two astronauts have fallen. Mathematical comparisons will be used.

Let us assume we have a snail that has intelligence and the faculty of communication. It is on the bank of the River Sanga, which is in the Congo, and lies on the Equator. The snail crawls one centimetre to the East. It then stops and makes an impressive speech: "I have travelled the globe and seen everything that is on it." Such talk would indeed seem ridiculous and brazenly presumptuous. But our snail persists in its stupidity, and continues: "I have always heard tell of an island in the Atlantic Ocean, off the coast of Africa, called São Tomé. No such thing! I have searched the globe and seen neither an island named São Tomé, nor an African coast. Therefore they do not exist."

Now let us measure the enormity of the snail's aberration by comparing its journey of one centimetre, along the Equator, with the length of the latter. In so doing, we shall of course not take into account the number of square centimetres the snail could visit, i. e. the surface area of the whole globe.

Taking the centimetre as our unit of comparison, we see that the Equator is 40,000 kilometres in length, viz. $4 \times 10^9 = 4$ milliard centimetres.

For our snail, the proportion between the known and the unknown distance round the Equator is $1:4 \times 10^9$. If the snail knows a unit of one centimetre along the Equator, it does not know 4 milliard of such units. The snail, therefore, was boasting recklessly.

Now let us take a look at the boasts of materialistic atheists à la Gagarin and Titov, neither of whom orbited at a greater altitude than 300 kilometres.

Our solar system is not, as was long supposed, at the centre of the universe. The universe is made up of systems comprising astronomical bodies and occupying space. Our solar system is one of many milliards.

Astronomists have calculated that we are some 30,000 light-years distant from the centre of the universe. A light-second equals 300,000 kilometres and, in a year, light travels 9·5 milliard kilometres, i. e. $9{\cdot}5 \times 10^{12} = 9{,}500{,}000{,}000{,}000$. The estimated diameter of our universe is some 6 milliard light-years.

Now since we "orbit" some 30,000 light-years from the centre of the universe, for us, the nearest point on the periphery of the universe would be 3 milliard light-years, less 30,000 light-years, away. The distance in kilometres from the earth to this periphery would be: Distance of one light-year in kilometres times 3 milliard, less one light-year in kilometres times 30,000, or (9·5 milliard km. × 3 milliard) – (9·5 milliard × 30,000) = 28,499,715,000,000,000,000,000 km. i. e. 28 trilliard 499 trillion 715 billiard kilometres.

The height reached by Gagarin and Titov, 300 kilometres, will be our unit, in the same way as the centimetre travelled by the snail mentioned above served as unity.

This gives us a ratio between the known and the unknown of:

$$\frac{1}{9{,}499{,}905 \times 10^{13}}$$

that is, for one unit of known distance there are 94 trillion 999 billiard 50 million units unknown. This leaves out of account the total volume of the universe, only the distance from the earth to the periphery of the universe being considered.

Snail/Gagarin – Titov Ratio

$$\text{Snail } \frac{1 \text{ unit known}}{4 \times 10^{9} \text{ units unknown}} \quad \frac{1}{9{,}499{,}905 \times 10^{13}} \text{ Gagarin – Titov} = 23$$

milliard 749 million 762 thousand 500.

But should they now attempt to reach the outer periphery of the universe, in order to prove that they did not see God there either, the misguided fools would have their trouble for nothing because, as we have already said, God cannot be seen by human eyes and, apart from that, they would never reach the periphery of the universe, since the spiral nebulae move at 60,000 kilometres per second. As a result of the release of nebulous matter the universe is continually expanding.

A speed $3^{1}/_{6}$ milliard times as fast as light would be required to reach the outer limits of space from the earth, after a non-stop flight of one

year. According to astronomical calculations, the earth is 3 1/6 milliard light-years times 9·5 billion kilometres distant from the periphery of the universe. But God would still not be seen with the naked eye anywhere in the firmament.

Einstein tells us that speed is relative. So, too, are all our measurements. We compare physical phenomena by taking something as standard and comparing other things with the standard chosen. This is called "measuring". Our measure of time, for instance, is derived from a comparison of the rotation of the earth round its own axis and that of the sun. We could also have taken any other observed physical fact to establish a measure of time. This shows that all measurements are relative. On the basis of the validity, in the natural sciences, of a law of universal relativity, we are justified in establishing the following comparison, which may seem unusual, or even droll. But closer study reveals it as entirely serious. The snail's relative speed as it circumnavigates the Equator for the first time we may take to be that of a snail. It crawls, and the earth helps it do so. There is a natural relationship between them. The speed of a snail has been reckoned at 0·0054 kilometres per hour. To crawl completely round the Equator would take a snail 845 years.

To date, astronauts have orbited the earth at an average speed of 28,000 kilometres per hour. Let us round the speed off to 30,000 km. per hour. A journey from earth to the confines of space and back would take 216 billion 892 milliard 808 million 220 thousand years. No one could of course make the journey, because we have left out of consideration the fact that, as mentioned, the universe is expanding at the rate of 60,000 kilometres per second. The periphery would hence never be reached.

It follows that, considering its performance as an earth-bound creature, the snail would reach its destination sooner than the astronaut, with the technical means at his disposal, would, in theory, reach his.

Despite the seas, the snail would crawl round the Equator sooner than a human could arrive at the boundaries of space.

The snail takes 845 years to crawl round the earth. For the outward and return journey, an astronaut travelling from Earth to the periphery of the universe would require 216 billion 892 milliard 808 million 220 thousand years. The snail is 2 milliard 566 million 780 thousand times faster in this relative comparison between natural or artificial abilities and theoretical attainments.

Let us pay due respect to man's achievements. But we shall never get the better of nature. We can certainly think we shall, but disaster is always waiting at the end of such dreams. The Tower of Babel too, was such a dream.

("Kölnische Rundschau" June 10th 1962.)

Pascual Jordan

Television from Mars and Venus?

Only five years ago I was warned by fellow-scientists not to mention in public that plans for space research were to be taken seriously. If I did, they told me, I would risk my reputation as a scientist and be decried as a wild dreamer. A few months after these well-meaning warnings, the first man-made satellite orbited our earth. Today it is common knowledge that it will be only a matter of years till the first man lands on the moon. So rapidly does our modern world change. But before men land on other celestial bodies for the first time, unmanned rockets will land there. Even in the more remote future, when expeditions to the Moon, Mars and Venus have ceased to be merely theoretical projects, the enormous technical and financial resources required will make it necessary to conduct research on these and other neighbouring celestial bodies, mainly by means of unmanned rockets. In all these efforts television will play an important role. Whatever is measured by the instruments attached to these rockets could, it is true, be radioed to earth without presenting such data visually. Our information, however, would necessarily be sketchy and poor if we do not succeed in the not too distant future in getting photographs of other celestial bodies relayed to earth by television.

Those who have to remain on earth will thus be able to share the experience of the very few astronauts, the pioneers of mankind, who land on celestial bodies in outer space. Television will also enable them to see what the unmanned rockets explore with the help of the instruments they carry to the Moon and to Mars. Naturally, it will not be easy to interpret the images thus relayed. The new landscapes to be explored will differ so completely from the scene on earth that we shall have to grow accustomed to seeing them before we can understand them. In the case of the moon, this will perhaps be relatively easy. Lunar landscapes have often been painted by artists with some knowledge of astronomy: pictures of rugged rocks rising from craters. As there is neither air nor water on the moon, there has been no erosion or weathering. All the rocky mountain ranges on the moon have retained their original rugged

forms. As seen today, they have not changed from the state when they took shape at the creation of the moon several thousand million years ago.

Colour television will be really worthwhile for research on Mars. For here, though the atmosphere is extremely rarefied, there are clouds of various hues. And colours can be differentiated on the ground: reddish deserts and areas ranging in tone from grey to green, which seem to be covered by a very thin layer of vegetation, to be measured in fractions of a millimetre. Violent dust storms can often be seen in the reddish desert areas. They will supply effective pictures in colour television. The "yellow" clouds in the atmosphere of Mars seem to be connected with those dust storms. On the other hand, there are also white clouds, probably formed of droplets of water, just like clouds on the earth. It is true that there is very little moisture on Mars, none at all in the greater part of the desert areas and a minimal amount where the thin layer of vegetation seems to cover the ground. When it is winter on Mars, the polar regions there have a coating of white snow or hoar frost, probably also very thin.

Finally, there are also violet clouds in the Martian atmosphere, the significance of which is still quite uncertain. A Russian researcher assumes that these violet clouds are composed of tremendous swarms of tiny living organisms. So far, however, no one has been able to decide whether there is any truth in this assumption or whether it is sheer fantasy.

We shall, of course, know very much more about Mars once human beings can stay long enough on the Moon to permit of the establishment of an observatory there. For there are several reasons why the atmosphere of the earth interferes seriously with the observation of Mars.

In the case of Venus, however, we shall not be able to obtain a close view of conditions there until we can send rockets to that planet. Only then will it be possible to radio the results of measurements from Venus to earth, data which will be instructively illustrated if accompanied by televised photographs. Since Venus is enveloped in clouds without a break, even a telescope directed towards Venus from an observatory on the Moon will only show us the outside of the planet's envelope of cloud.

In the course of the next few years or decades we shall, perhaps, be able to form an idea of these planetary landscapes. And this will be the most astounding as well as the most rewarding result of satellite mechanics combined with television techniques.

("Die Welt", May 31st / June 1st, 1962)

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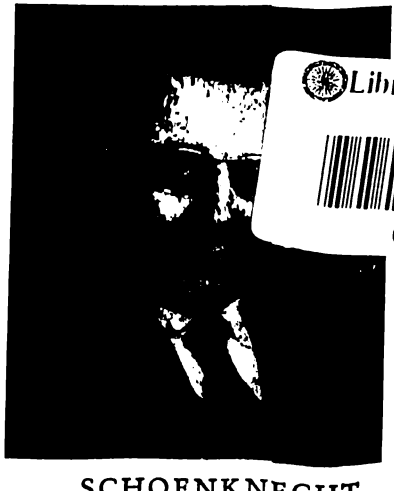

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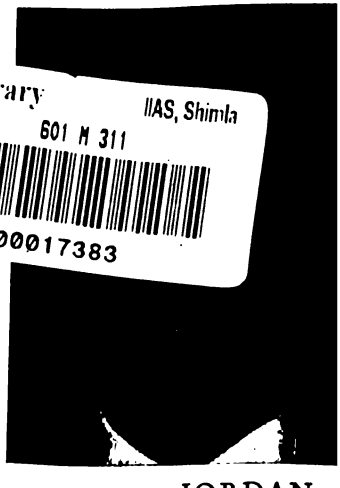

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