(a) Christianity, Science, and Technology

(i). Historical Situation of Science and Technology

From the very first, homo sapiens had science and technology. Among humanity's great steps forward are certainly to be reckoned the domestication of fire and the invention of the wheel. Agriculture was discovered and developed thanks to constant progress in knowledge of grains, and an as yet anonymous science of genetics. The first technologies of stone and metal required a huge store of scientific knowledge.

During the first human millennia, growth in the sciences and technologies was slow. It accelerated with the foundation of the first empires. But the acceleration was uneven. All peoples had now developed sciences and technologies, but not all had attained that critical mass of scientific knowledge, that level of scientific dynamism, at which each discovery opens the way to new ones.

Only in recent centuries, especially since the seventeenth century, have science, first, and then technology, appeared on the scene no longer in disguise. Earlier science was practically indistinguishable from philosophy or mythology. The first civilizations expressed their self-knowledge through myth. Their myths included scientific data; they were not pure fantasy. But they mixed imagination with reality in such a way as effectively to paralyze the development of intelligence. To the myths, the scientific mentality opposed observation and experimentation, as well as ever more rigorous, and gradually more mathematical, rules for reasoning. At great cost, science learned to prescind from subjectivity, and scientific objectivity was created. At first, human beings projected themselves upon their surroundings in such a way that there was no way to measure those surroundings disinterestedly. Traditional peoples still did their thinking on the basis of observations that projected their mythic view of the world upon the objects of those observations.

Science likewise had to emancipate itself from philosophy. The struggle with myth was also, and principally, taken up by the philosophers. However, philosophers appealed to introspection, and deductive argumentation, as well as to conceptual logic. Ancient Greek philosophy, at any rate, entertained the notion of a universal, total knowledge, and imagined it possible for individuals to assimilate all this knowledge. Ancient philosophers introduced empirical data of genuine scientific value into their systems. However, they sought to deduce these data from their synthetic views, thus distorting the scientific perspective. Later, when new scientific data contradicted their syntheses, they appealed to their intellectual sovereignty to contradict the results of a far more sure-footed science. In fact, the definitive emancipation of the sciences from the fetters of philosophy is a recent phenomenon. Until recently,

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dreamers still sighed after a total synthesis of all knowing, in which philosophy would wear the crown of absolute knowledge.

Almost up to our present century, technology developed independently of science, more often at the hands of persons directly plying the practical arts. The technology of agriculture, the crafts, and industry was invented by persons who had to respond to immediate challenges. Many inventions were all but accidental. All of them came by way of a happy intuition. Inventors knew that the processes they invented functioned, but they were at a loss to explain how. Science had few, if any, technological applications, and little in the way of theoretical foundations. Past civilizations developed extremely sophisticated technologies. Then these disappeared, replaced by still more highly developed technologies, and today even the latter are more highly developed, and accompanied by all manner of theoretical paraphernalia. We need only think of the use of the energies of water, wind, wood, and coal, the instruments of war, oceangoing vessels, or manufacturing techniques.

Ancient technology had no scientific status, and was not studied in the universities, which were devoted to pure theory. After all, theory seemed superior to practice. Today, technology depends more and more on science—on physics, chemistry, biology, and other sciences. The use of atomic energy, electronic technologies, robotics, information manipulation and storage, telematics, would be simply impossible in the absence of antecedent scientific knowledge. In the same way, a great deal of medical therapy today is based on scientific knowledge. Machinery is no longer built on the basis of data furnished by the eyes. Nowadays it is necessary to know things the eye cannot discern.

The meshing of science and technology is a phenomenon of our own century. It grows year by year. Science can no longer be practiced without the machinery furnished it by a very advanced technology, and technology cannot be practiced except on the basis of scientific knowledge.

This fusion enables epistemologists, or philosophers of knowledge, to make a better determination of the status both of science and of technology. It is becoming ever more evident that the ends of science are not purely speculative. The purpose of science is not to afford a representation of the world. More and more such a representation is seen to be impossible. Science is bound up with technology, and both of these are bound up with work. Science is one of a series of activities bearing on a comprehensive task: to place the material world at the service of human life, to render the material world more viable and habitable for humanity, and thereby to render human life more humane, more developed in all its dimensions.

Accordingly, science has ceased to be an activity monopolized by certain curious minds. Instead of proceeding from curiosity, science is now practiced in view of the task of subduing the world and transforming it—the task of humanity as a whole. Science has become a political problem, and indeed, more and more, a basic political problem.

After all, science has ceased to be an individual undertaking. No scientist of our day can do his or her research with the resources available to the individual. Science requires an enormous outlay, which can be furnished only by the state, or
by exceedingly powerful private foundations. The progress of science is a result of political decisions, since it depends on the quantity of resources that a nation decides to reserve for it.

Work, in both its quality and its productivity, necessarily depends on scientific and technological progress. Science and technology have become everyone's problem, then. The life of each and all necessarily depends on the evolution of science and technology.

(ii). The Christian Position

At the time of Christian origins, neither science nor technology was consciously practiced as such. Neither the Bible nor the ancient tradition of the church could have spoken of something that at that point had never attained the level of consciousness. However, there is other content in the Christian message, and indeed in its basic positions, from which Christians can recognize the value of the sciences and technologies.

Contradicting the mythologies that did not dare to posit human origins in matter, the Bible is unhesitating: humanity proceeds from the earth, and its destiny is the earth. We are on earth to cultivate and subdue it. As I have suggested, for the ancient Hebrews and ancient Christians this domination of the earth did not consciously include science and technology, which did not consciously exist. But Jews and Christians were perfectly capable of employing whatever science and technology arose around them.

The people of the Bible had no advanced technology, however, even for the time, and Solomon had to look to the Gentiles for his engineers. Nor did the people of the Bible have scientists. Why? Because God's people were poor, and the poor develop neither science nor technology. However, the poor need not reject out of hand the science and technology used by the powerful to oppress them. There is no such rejection in the Bible. There is no exaltation of an archaic way of life over the use of technological innovations, at least not as a consistent line of thought.

The compatibility between Christian faith, on the one hand, and science and technology, on the other, was based on three very clear arguments. First, Christian anthropology teaches the earthly nature of the human being, and leads humanity to live on the earth, of the earth, and inclined to earth—not with its head in the clouds. Second, two thousand years of Christianity evince the great part played by Christians in scientific and technological discoveries. Numerous priests and monks were scientists and inventors. The role of the monks in the shaping of European history has always leapt from the pages of that history, and with good reason, although of course this scarcely constituted the only factor of progress in the past. Third, science and technology developed continuously, and at an accelerated pace, precisely in Christendom. In other civilizations they encountered obstacles in religion, or in religious philosophy, that stunted their growth. We need only cite the cases of Arab, Muslim, Chinese, or East Indian civilization. It cannot have been by chance that science developed in Christendom. There was conflict, but the conflict did not halt the scientific or technological movement.
Hence Puebla's recognition of the role of science and technology:

_We ask scientists, technical people, and the creators of technological society to nurture their scientific spirit with love for the truth so that they may investigate the riddles of the universe and gain dominion over the earth [1240]._

The formulation is not faultless, and is still somewhat in debt to the old notion of the speculative end of science that the bishops learned in the scholastic philosophy of their seminary days. But the overall sense is clear.

Pope John Paul II, as well, in his encyclical _On Human Work_, eulogizes technology:

_Technology is surely man's ally. . . . Thus, if the words of the Bible, "subdue the earth," addressed to man in the beginning, were to be understood in the context of the whole modern industrial and post-industrial age, they surely would also include a relation to technology—a relation to that world of mechanisms and machines that is the fruit of a labor of human intelligence and the historical confirmation of man's dominion over nature [Laborem Exercens 5]._

(iii). _Conflicts of the Past_

The notion of a compatibility in principle between Christianity and science still provokes bewilderment in many people, especially in Latin America. The intellectual class is still under the misapprehension that science and faith are somehow at odds, and so is persuaded that a scientist cannot be a Christian. Christianity, the intellectual still feels, somehow places limits on scientific research.

However, this persistent opposition to the church in the name of science comes mostly from people to whom actual scientific research is altogether foreign, and whose investigation into the matter at hand is limited to works of popularization often still reflecting the polemics of a century ago.

In the eighteenth century, a mighty assault was launched against Christianity, and especially against the Catholic Church, in the name of science. The ensuing polemics, limited to the world of academe at first, were popularized at the turn of the century and raged in popular milieus all through the course of the nineteenth century. In Latin America, the social and intellectual elite gleefully entered the fray. They read all the French polemical literature, and accepted all anti-Christian criticism in the name of science as scientific dogma. As it happened, this criticism was a phenomenon of the romance-language countries especially, and of France in particular, and so Latin America was particularly receptive. The new governing classes were striving to destroy the power of the old colonial church. Latin scientism, then, came as a welcome ally of political liberalism.

Actually, a great number of scientists of every generation have been Christians or Jews, loyal to their faith, and finding no incompatibility between their faith and
their science. It is true, however, that some measure of justification of the liberal fears was furnished by certain prohibitions and condemnations on the part of the official church, for example the notorious prohibition of the dissection of cadavers, the condemnation of the Copernican system and of Galileo, or the condemnation of transformism.

The church had adopted and perfected the Greek philosophical notion of a total science of all reality. Within this comprehensive science, the sciences of the material world had their place. Thus, they too came to be speculative sciences. After all, they had to be accommodated within the framework of the whole. They too, then, must submit to the deductive method of philosophy and the general propositions held by philosophers as self-evident. Scholasticism's total science embraced, at least ideally, both the concepts of the Bible and the legacy of the philosophers of antiquity. It was with this self-styled comprehensive science that real science entered into conflict, and it was this self-styled comprehensive science that certain elements of the institutional church felt it their mission to defend. In their mind, Christian faith itself called for a commitment to scholasticism.

In that era, however, not even scientists had a clear grasp of the epistemological status of their science. It was not until the twentieth century that science acquired its explicit epistemological foundations, which finally demonstrated the originality of science and its complete autonomy vis-à-vis philosophy. The sciences work out their own methodology. They are not part of a higher, speculative whole. At the Second Vatican Council, the church finally acknowledged the compatibility of faith and science. At last the autonomy of science was unambiguously proclaimed. The “individual sciences or arts” have their “appropriate methods,” the council said.

*Therefore, if methodological investigation within every branch of learning is carried out in a genuinely scientific manner and in accord with moral norms, it never truly conflicts with faith. . . .

Consequently, we cannot but deplore certain habits of mind, sometimes found too among Christians, which do not sufficiently attend to the rightful independence of science [Gadium et Spes. 36].

This does not mean that Christians can never find themselves at odds with science. The Christian message insists on the absolute priority of human beings among creatures. In other words, the sciences have their finality not in themselves, but in human beings. To the extent that they depart from this aim, they will meet with opposition from Christians.

Puebla says:

*We ask [scientists] to avoid the negative effects of a hedonistic society and the technocratic temptation; to apply the power of technology to the creation of goods and the invention of means designed to rescue humanity from underdevelopment [1240].
(b) The Agent of Science and Technology

(i). The Scientific Class

In bygone times, scientists were typically marginalized by society as strange, eccentric individuals, devoted to abstruse, fantastic things. Often they were persons of independent means, or were supported by the generosity of a Maecenas, and hence had no need to earn their daily bread. Nowadays the scientific world is a populous one. Scientists number in the millions, and are not only accepted by society, but are actually in the employ of powerful institutions. Their research is programmed either by the state or by other institutions that furnish its capital, even by scientific business enterprises themselves if they are large and independent. Scientists almost always have some association with the state, as well as, secondarily, with other institutions capable of a huge financial outlay. Their services are most highly prized, and they make up a prestigious, privileged class.

If the state programs science, then at least in principle we should expect science to be somehow under the control of the citizens of the state. In practice, however, scientists enjoy an almost total autonomy vis-à-vis the citizenry. Scientists constitute the privileged repository of a treasure out of reach of everyone but themselves. More and more, science separates the knowledgeable from the ignorant. Whenever they wish to defend either their privileges or their preferences, the former can appeal to reasons the latter do not understand.

In practice, the function of the scientific class is often to justify the privileges of the ruling elite and enhance the authority of the state. Further: the phenomenon of science is not evenly distributed throughout the world. Science and technology have managed to widen still further the gap between rich countries and poor ones. A country excluded from the scientific and technological movement may never again have the opportunity of recouping its losses. It is condemned to dependence on other countries, and will have to work with the most backward and least interesting technologies, those that make no contribution to scientific progress itself. Thus, the wall of separation between those who know and those who do not, grows higher and wider.

(ii). The Multitudes without Science

And so the world today is divided between a minority of persons who have entered the scientific era and a majority still excluded from that era. The underdeveloped nations that are entering the scientific era are themselves divided into two groups: a minority of persons is beginning to share, however dependently, in the benefits of science and technology, while a majority finds itself more excluded than ever. All told, then, a minority of persons in the world practices science, while a majority watches it, in astonishment, on television, if they have television. For the majority of the people of the world, the world of science is another world.

Hence three challenges facing the Third World.

1. Access to more advanced scientific and technological research, lest that research gradually form the basis of a political superiority across the board.
2. The training of the young in scientific skills. Not all will become professional scientists. But in order to have an adequate number of professional scientists, the Third World must train a broader base from which to select the most talented. Without the scientific training of the young there can be no scientific class. But in Third World countries, the pitiful level of popular education prevents all access on the part of the great majorities to the antechambers of the sciences and technologies.

3. Basic scientific and technological inventions require thousands and millions of small discoveries and technological improvements. In the past, farmers and artisans made millions of discoveries. Millions of individuals have contributed, however modestly, to scientific and technical progress. Today, when “development” invades a country ill-prepared to receive it, the result is a total paralysis of the inventive, creative mind. Imported specialists and technologists solve every problem, and no solutions but theirs are seen to have any value. The population is stagnated, and gains nothing, while a minority reaps the benefits of the imported technologies. Here the challenge will be to reactivate the capacity for invention and creation on the part of the ordinary folk of our nations, while shielding them from the premature incursions of a technology or science beyond their abilities or resources. Certain intermediate technologies can guide the masses once again to a state of creativity. Otherwise we shall have reason to fear the continued dehumanization of our marginalized populations. New generations will become accustomed to sitting as spectators at a demonstration of works wrought by others, unable to create anything themselves.

These three challenges may be reduced to one: How are we to enable the peoples to transform themselves into agents—subjects, rather than mere objects—of science and technology?

(c) Dangers of Science and Technology

(i). Scientism

The Second Vatican Council warned against the autonomy of earthly realities: “If the expression, the independence of temporal affairs, is taken to mean that created things do not depend on God, and that man can use them without any reference to their Creator, anyone who acknowledges God will see how false such a meaning is” (GS 36). The council is referring to the old scientism that excluded God in the name of science. The scientism of the eighteenth century actually held that science could one day furnish a complete knowledge of the world, a system capable of replacing all the old systems of representation of the world. A scientific view of the world would now provide us all with a representation that would exclude everything that had not received science’s stamp of approval.

Scientism today is different. It no longer lays claim to a total representation of the world. This is not the finality of science. Instead, science today has become an
intellectual dynamism which, when combined with the development of a technological, industrial, and economic infrastructure, tends to develop "on its own," without reference to any other instance. Scientists tend to accept no nonscientific norm in any area whatever. Thus, science becomes an end in itself.

Indeed, in various scientific circles, anything other than science is an object of contempt, and certainly not regarded as invested with the authority to function as a norm of the practice of science. The only end of science is its own exercise—that is, its endless growth.

This is the way in which science can become out-and-out ideology. If scientists come to power, they will control a great part of the power of state, and will be able to manipulate the resources of their nation for their own emolument. They will be able to shape the national budget to suit their Pharaonic purpose: scientific growth without limit. In today's world of the collapse of traditional values, little is sacred. One of the few things that is, is science. It could happen that a society would seek its ultimate legitimation in science.

(ii). Human Beings and Scientific Objectification

Indeed, where are the limits of science? They lie in the very reason for the success of science. Science is objective. It has succeeded in observing phenomena in an all but total detachment from any interference on the part of the subject. The world it observes is a world without subjectivity, without even the subjectivity of the observer. At least this is the ideal. In practice, there will always be a remnant of subjectivity. It has been this effort of objectivity that has permitted science to slip the bonds that had tied it first to myth, magic, astrology, and the like, and then to philosophy.

But in their attachment to objectivity, scientists run the risk of forgetting the ultimate goal of all science: the life of all humanity. Unless science improves the condition of all women and men, how can its practice be justified? Scientists live further and further removed from common, ordinary folk. Their projects become more and more fragmentary. How can they continue to keep the ultimate goal in view? The danger is the greater, the more remote the immediate connection between scientific projects and any human good. Scientists forget that their science is, before all else, a political affair.

Further: scientific objectivity increasingly consists in the replacement of material reality by mathematical and quasimathematical schemas and structures. Thereby science gains the increased efficiency it will need if it is to achieve precise, prompt, and numerous effects. But this evolution ought to be counterbalanced by a concern for the primacy of the human subject.

Again, the more nearly the sciences approach the human being, the less exact they become. What are human beings in their subjectivity? Science will never know. Science is perfectly adapted to an analysis of nonliving matter. But when its object is life, it can no longer express the whole of its object. And when its object is the human being, it only scratches the surface. Is this a source of anxiety for science? Not in the least; science as such is not interested in what is most human—human worth and dignity, the freedom of the subject, a community of responsible persons. For that matter, the human sciences are inevitably impregnated with myths, philosophy, and
wisdom of a religious origin. But they rarely demonstrate any awareness of this fact. They have sought to be their own exclusive proprietors, after the model of the physical sciences.

(iii). Science and Power

In our day and age, there can no longer be any doubt that science makes for power. Indeed, science will bid fairly soon to become the most important factor in all power. The other factors—natural resources, work, population size, and so on—count less and less as science learns to make more efficient use of them.

In the first place, there has always been a close connection between science and war. Since Archimedes, and surely even earlier, military considerations have always provided scientific research with its most powerful stimulus. And of course this is eminently true today, in our age of nuclear energy, electronics, the mass media, space travel, and so forth. Science enables human beings to manufacture more terrible, more sophisticated weaponry than ever before. The military budget is more and more often the principal terminus of a country's capital, hence the huge proportion of that budget destined for modern scientific research. Nowadays a great deal of such research is done under military contract.

Second, science favors the growth of the state. It favors the development of technologies requiring resources that only the state is capable of supplying or adequately complementing. Science tends to Pharaonic works, and such works reinforce the power of the state. Furthermore, new technologies constantly increase the pressure exerted by the state on the citizenry. Science has abetted totalitarian, tyrannical governments by confining the autonomy of individuals and small entities.

In the third place, science increasingly operates in the interest of the classes in power. Only the latter have the capital to furnish science with its tools, supply it the machinery it needs for research. Thus the powerful are permitted to set science its tasks, problems, and challenges, all of which have less to do with the needs of the impoverished masses than with the aspirations of privileged minorities.

(iv). Science and Social Classes

Science consumes enormous capital. Technology serves only those enterprises with a great deal of capital at their disposal. Groups that control capital can exert strong pressure on science. In societies of the Western type, the state, big business, and science or technology are always in collusion. In the Third World, the large multinational corporations, operating under the patronage of the state, import their own science and technology. So there can be no national science or technology other than that of state enterprises.

Science that develops without any control tends simply to grow—to produce without let or hindrance. This means it must have access to a market of powerful economic resources. In the Third World, only a small minority of persons are in a position to purchase the services of science and technology. The majority are left in the lurch. Under these conditions, scientific development tends to favor that minority and leave the majorities out of account. Science and technology will offer more and more help to the minority, who control such vast resources, and leave the masses
of the people to their own devices. Science augments the privileges of the privileged. Science remarginalizes the marginalized. As the Pope says: "Technology, man's ally, can become his adversary" (Laborem Exercens 5).

WORK
(a) Dignity of the Worker
The dignity of the worker is one of the most constantly recurring themes in the teachings of the magisterium since Rerum Novarum (see, e.g., LE 9). We shall do well, however, to see it in its proper context, especially its historical context. Pius XII still found it unseemly for a priest to work as an industrial laborer. But if work is unworthy of a priest, what dignity will it actually have—all theoretical protests to the contrary notwithstanding? Then Paul VI contradicted his predecessor, actually claiming that it had been the church that had sent priests to work side by side with other laborers in industry (Octogesima Adveniens).