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I would not want that the purpose of dealing with philosophy, science and technology in an article in a Review should be considered as a symptom of excessive "self-conceit", as Galileo would say, after rivers of ink have been poured on this argument. But even so the argument cannot be said to be exhausted. I do not therefore believe it will be out of place to still add something more to what has already been written because long personal experience can always bring a contribution also to important themes.

My experience in this field is reaching a half century. It is well-known that in ultimate analysis when very complex phenomena are being investigated, what coincides or at least is nearest one's own baggage of knowledge is specially noticed; so it rarely happens that analyses carried out by two observers entirely coincide. Thus, not to communicate to readers details of my past which might not even interest them, still the information may represent a kind of background or introduction that can justify my statements. When I began my scientific career, I was very young in years as a generic neo-graduate, but not so young as far as mind and mentality were concerned, because I had spent a part of my university years at the front as a miner-engineer during World War One. So I undertook my activity at the Institute of Physics of the Florence University, as assistant of Antonio Garbasso, with much more earnestness and greater maturity than young men have who have not experienced such a hard trial as that of being in trenches excavated in the rock.

It is not the place here to recall the impression that I had getting into direct contact with "scientific" circles which had seemed to me during my student period as a kind of "eden" of serenity and superior

mentality. If I did not retire disgusted, it was because by then I had no illusions concerning the structure of human nature, no matter in whatever category. Thus, even later on when I encountered the "benevolence" of colleagues and superiors, I was already in the frame of mind to expect this and even worse.

I had already experienced such "benevolence" at the time I was at the Pisa University where I obtained my degree in Physics. I had entered with great satisfaction the "Scuola Normale Superiore" and had found good and pleasant companions of study, but only, one could say, as far as human relations were concerned: in the field of studies there was at once a definite hostility between the others and myself. I did not have many companions of study at the Scuola Normale: hardly a dozen, because most of them had been called up during the war (and moreover, "students of the Normale" were few at that time); but my greatest negative quality was to be only a "physicist"; all the others were pure mathematicians and almost all of them became University professors. In their point of view I was an inferior being. I do not hesitate to declare that this attitude was somewhat shared also by the professors of the School. I must also make clear that their appreciation regarding me was certainly not roused or justified as though the course of my studies had not been brilliant; as a matter of fact, judging from the results of my examinations, I was considered one of the best, as confirmed by the "commendable" that was added to my doctorate degree. It was just a feeling of superiority that mathematicians felt towards, so to say, mechanicians who handled tools and instruments in the laboratories of the Physics Institute, while they, the mathematicians, were engaged in higher intellectual elucubrations simply paper and pencil or still more simply a blackboard and chalk.

My "difficult character" did not allow me to accept this show of superiority on the part of mathematicians nor their protection. On the contrary, I never overlooked an occasion to demonstrate to them that they talked a great deal without reaching any results. But now it is time to limit these memoiries of the contempt that young mathematicians unanimously felt for who intended to dedicate himself to studies on nature.

It happened by chance that the Director of the Institute of Physics of the Florence University was completely absorbed by politics, therefore I was, so to say, almost entirely without an authoritative guidance. On the other hand, having accomplished a good part of my universitary studies at the war front, the height or depth of my cultural preparation was not taken into much consideration. But now we will recall the reasons that brought me to study optics. Although my Director kindly

advised me to the contrary, openly underlining the dangers well known to him, that I would encounter, still I decided to carry on boldly and of course this brought upon me another wave of "benevolence" from the "teachers" and colleagues of all the Italian school of Physics. Why? Because I would become according to them a "technician". Optics, according to them, was a closed science, perfect, exhausted. Orso Mario Corbino explicitly expressed this in his inaugural speech at the Congress of the Italian Society for the Progress of Science, at Florence in 1929. Thus being prepared for a scientific career and dedicating oneself to optics meant to be a failure. Therefore, in the circles of physicists, I was considered a failure. For the mathematicians. I didn't even exist. In the meantime I had found a new interferometer (evident indication that there was still something to be done in the field of optics). This interferometer is still widely used all over the world and made me known in optical circles since my youngest years, but for physicists it meant nothing. The reason for all this was to be found in a very evident situation: optics had substancially been abandoned by university circles, and as no one had any knowledge of optics, no one was able to estimate its importance and judge the value of the contributions that could still be achieved.

One physicist alone appreciated my new interferometer: Luigi Puccianti, and it was he who had me present the description of this new instrument in my thesis at the conclusion of my courses at the Scuola Normale Superiore and had it published in the "Annals" of the School. Many persons have appreciated Luigi Puccianti's exceptional intelligence and culture.

But my "difficult character" again kept me from following the general trend of the teachers of physics of that time. After all one could also be a "technician". Of course I did not want to engage in the competitions for a Chair of Physics, and devoted myself to a special and personal activity the founding of the National Institute of Optics.

It meant nothing to the "officials" of science that this Institute flourished magnificently, growing from day to day, rapidly; that it brought incalculable benefits to industry, national economy, military defense. The National Institute of Optics was considered only a technical centre, therefore on an inferior level, consequently of no importance; no physicist, not even one, offered his help, his collaboration, or simply his friendship. The optical school was entirely formed in the Institute, completely ignored by universitary circles. But this, after all, was not harmful; the request of collaboration with other institutes was so great that the life of the Institute of Optics was widely guaranteed and, in its turn, could very well ignore the existence of "scientists".

On the other hand, the Institute was considered to be a confrere of the "technicians" of industries, that is to say a centre of technicians, but a theoretical centre, as a matter of fact it was considered to be too theoretical. The reason for existence of the Institute was just this condition of "technique" of the Italian optical production which, at the time, was very modest indeed; it was admitted that the absence of a centre of higher optical studies (since the University had no interest in this) had a negative impact upon the quality and preparation of technicians with in view industrial production and the new institute had the purpose of filling this gap and that is just what it was doing. The leaders of industries were enthousiastic of it and benefitted considerably by it; but "old" technicians weren't so favourable because they saw their destruction in the new rational and modern trend. Thus another wave of "benevolence" attacked the Institute, but in a sense contrary to the other times. The Institute and myself in particular, as it was I who directed it, were considered "poets", because our mind was bound to theories and formula, while what was wanted practically or what was necessary in order to reach tangible conclusions each time, was known by the "practitioners" who had knocked their head against difficulties for years and years.

I enjoyed it all and never lost an occasion to make high-level "scientists" notice that they could certainly not speak of optics without cutting a poor figure before even the most inexperienced pupil of the Institute; and I would bring to the notice of the "practitioners" that, if things had been as they intended, their leaders would not have absorbed with such greediness all the production of the Institute, in men and technique, up to complete exhaustion.

Thus the Institute kept on flourishing and optical industry grew still more rapidly. The Army Forces trained their "technicians" at the Institute; military optical equipment was then national, but owing to technical priority and not to bureaucratic deliberations, because human life is no joking matter and on battle fields there is the need of instruments that function well no matter where they come from.

Did the Institute attain these results employing optical "science" already perfect and exhausted? This is another interesting argument for us. At first, myself young and a beginner in this subject and my collaborators, still younger and more inexperienced than I myself, believed the judgement of "teachers" of Physics was good and we willingly accepted the modest task of "technicians" and proceeded to apply practically the general rules definitely codified in text-books all over the world, more or less uniformly. Our activity was or wanted to

be modestly "technical" and we had undertaken it just because for various casual reasons, it seemed to be necessary and the fruits of our work showed that we were not mistaken. But since the beginning, when we started studying the practical problems that were proposed, to us, problems that carried an enormous responsability not only on account of the economical interests connected with them, but also for the effects they could have on the outcome of battles and the life of soldiers, we were obliged to reflect that something was wrong. The most synthetic and conclusive problems structural but completely void of reality. For example, no text-book had ever touched the subject of the "good quality" of an optical instrument and we were always called to judge of its quality; and, I will repeat, we could not provide a general or innocuous judgement, as our estimation always bore an enormous responsability.

Optics was not an exhausted and perfect science. Of course there was always somebody who would say that these problems were "technical" and not "scientific"; it was sufficient to answer that if it were so, one would come to the conclusion that only "technology" was valuable and one could do without "science".

But this is not all; as years passed, a complete collapse took place imperiously with the rational and also theoretical solution of problems; the celebrated optical science, that in the opinion of scientists was already exhausted and was to represent one of the columns of the general scientifical edifice, had turned out to be illusory; it descended to the very modest level of a mathematical construction based upon a hypothesis lacking of fundament. While in premises dedicated to "science" optical science continued to be professed, as it was considered a perfect and unquestionable representation of physical reality, in the new "technical" school all its insufficiency was demonstrated and an entirely new "optics" was being constructed, that even if it responds better than before to the needs of industrial production, it has all the characteristics of a scientific construction, simply scientific, that reaches down to the deepest philosophical bases of the general scientific construction.

Perhaps in about a dozen years also scientific circles will realize the errors they are teaching and that a clarifying word has come from a technical sphere eliminating a quantity of misunderstanding and deceptions which essentially form the temporary teaching considered as definitive.

I will ask to be forgiven if I have devoted a few pages to a very synthetic narration of circumstances to which I gave all my energy and the greater part of my life. I will not hesitate to declare that they gave me great satisfaction, though it required hard and continuous work, I am

glad to have done it. Friends who knew the weight that rested on my shoulders would ask: "What are you doing it for?", I would answer laughing: "I am enjoying it so much!"

The reader will forgive these strictly personal considerations: I believe they will be useful to understand the experience and mentality with which I approached and estimated the course of the evolution of scientific thought during centuries, from antiquity to our day. As I have said, each one of us projects, more or less consciously, one's self and experience of arguments observed and takes from this just what is nearest to one's own case.

Beside the activities of the Institute, also during the period in which they had a greater "technical" feature, for reasons that I will not recall so as not to exaggerate in relating personal experiences, I was also interested in the history of science, and of course particularly in the history of optics. This cannot be called a technical activity but I must say that my technical preparation was really very useful to understand many historical events that had entirely been overlooked because they were not understood by all other historians of science, even though professional in the matter (and not amateurs like myself) who had great qualities, vast culture and reputation. Thus, after my intervention, the history of optics that practically had been abandoned everywhere, had regained a particularly important place in the group of history of the various sciences and has had repercussions on the history of the evolution of scientific thought in general. Because in all times vision, owing to its finesse, rapidity and power, has been a subject of study and a means of investigation.

My interest in the history of science has gone on increasing and has brought some considerations that, I think, may also prove attractive to whom has a particular interest for the history of optics.

I will now briefly summarize these considerations.

We should start from a very far period, but I do not want to overdo. The discovery of the technology of bronze and then of iron were events that could be called deeply "scientific" when we think that they actually gave origin to "ages". But I have too few elements to be able to deal with this here, although it would be a useful consideration. The science of the Assirians, Babylonians, of the Phoenicians and Egyptians should be accurately analyzed, but evidently this would bring us too far off: I shall limit myself to point out that for a very long time, thousands of years, man carried out an activity of research, because it was necessary for his livelihood. We have a good deal of information concerning this research especially in military, communication and, above all, medical fields. It is impressive to see the accuracy reached by the Chaldeans in

astronomical measurements that had the purpose of measuring time. It is said that the "week" is actually an antediluvian institution.

But for our analysis the invention of writing is more interesting. The repercussions of this invention have been enormous, not only because it simplified the way to maintain the fruits of experience of so many observers and researchers, but also allowed to transmit them to successors, who thus could start from more advanced stages and progress further on, accumulating and adding their own contributions to those of their predecessors. This was a very difficult task at a time when it was necessary to transmit teachings directly from teacher to pupils, orally and practically.

It was natural, I would say inevitable, to come to the formation of a cast: a cast of those who knew how to read and were trustees of the scientific and cultural patrimony of their predecessors. The enormous power of this cast had political repercussions because its power could not but be felt by political and religious authorities. Often this cast became one with the sacerdotal cast and fluorished alongside with monarchs. It may be (but I would not vouch for it) that a sort of stratification of the cultural environment took place, forming a higher, more powerful and authoritative level, bound to political authorities and, of course, convinced of being the possessors of the synthesis of all human knowledge of the time accumulated by their predecessors and contemporaries and codified in papyruses and vellums. On a lower level were the "artisans" and the "technicians" illiterate of course, who were trained as apprentices and performed practical manual work, made inventions and marvellous discoveries in the fields of constructions, communications and even medicine and chemistry. They discovered new lands travelling audaciously by land and by sea and even attempted to fly. It was they who developed agriculture, mineralogy, metallurgy and, of course, the military art. But they did not write and all traces of this enormous activity has disappeared, because with the exception of a few cases, the "priests" of knowledge and science would not give their attention to all this experimental wealth and so there was no trace of it in their writings. We are not far from the truth if we add that these philosphers, trustees of the knowledge of the past had a purpose in minimizing the importance of the work of artisans and technicians in order to maintain the prestige they had gained from political authorities and the superiority of their status.

This picture may seem a bit harsh. It certainly is too schematic and we must admit that it was not the same all over the world, and that the reactions were different in the various countries and in the different epochs. But generally speaking the trend must have been as described

here. Admission to the sacerdotal class was extremely strict, the young proselytes being chosen according to their intelligence, but above all on the basis of their loyalty, to the proofs they gave of faithful conformism, and also on a basis of criteria of nepotism and social standing.

Even if this long process is only mentioned here, it is interesting to point out the evolution that it underwent during the golden age of Greek philosophy, between the IV and II century b. C. It is known that since some time Greek philosophical and scientifical circles were gaining importance and the studies of mathematics and also of physics were developing enormously. It is not the case to give names here, the list would be too long and would bring no new information. The fact itself that the names of those philosophers are still very well known today after more than two thousand years shows how important their contribution was to human knowledge. But for our subject it is well to call attention to a group of fundamentally important studies that was particularly pursued during that period and that had very great repercussions. We mean the study of the mechanism of knowledge. The question was asked: "How do I get to know the external world?"

But this answer was not sufficient so the philosophers who wanted to take up the question thoroughly, proposed to distinguish for each sense the particularities of its functioning in order to define the essence of each sensation and the philosophical value of the conclusions of the sensorial process. The investigation had a very demanding character: it reached its purpose for all the senses, with the exception of vision; this solution was attained in a very different environment, actually two thousand years later.

But during the course of this research all philosophers reached a conclusion: sensory mechanisms are not perfect, they never guarantee a correspondence between information and objective reality. As a matter of fact, from an enormous and very interesting compound of observations and criticisms it was unanimously deduced that not all senses had the same degree of uncertainty; that is to say, touch was considered the surest sense (though not entirely, as well-known experiments had shown) and vision the least reliable. The unreliability of vision was demonstrated with so many proofs and arguments that vision was condemned to the point that one could only believe what was seen when it was confirmed by touch. This conclusion was stated in a terrible sentence: *Non potest fieri scientia per visum solum,* thus scientific circles were blinded. In fact, if one could not believe in what one saw, if not confirmed by touch, one's capacity of research was brought to the level of that of a blind person.

Plato had the greatest responsability in this approach. He thoroughly

studied the problem of vision in detail and of knowledge in general and reached conclusions that could not be more logical. The apparent world, he thought, is a psychic creation that is reached on the basis of information which reaches the psyche by means of the senses. But this information is never certain; there is no way to select and distinguish true from false information. The psyche however, on its part, can create "ideas" and can discuss them by means of a logical, rational, infallible process. Therefore the "ideas" are to be preferred to the forms of the apparent world, because they are less subject to errors. This brought Platonism, that is to say, the enhancement of mathematics, as pure expression of thought and the devaluation of observation, as being an activity subject to the fallacy of the senses. It is said that Plato judged the value of the various sciences by the degree of mathematization they had attained. At his "Academy", in his teachings he reserved a foremost place to mathematics. At the entrance of the "Academy", was written: "No one shall enter who does not know geometry".

Although Aristotle efficaciously restrained the general statement of Platonism, it is well known that the consequences were considerable. It is sufficient to recall Euclid's *Elements* that prevailed in scientific circles for thousands of years. But it is not the case of calling the reader's attention on this well-known episode, but on the consequences that Platonism had in general in the evaluation of scientific activities. Another stratification was formed which had at its highest peak "philosophers and mathematicians", persons who studied the classical texts, drew from them precious teachings and above all the one that was most important, namely not to rely on the senses, not to rely on appearance, but to philosophize and speculate with one's own mind on philosophical themes even though one would have desired to dedicate oneself to science.

There was still a lower level to which belonged artisans and technicians, ignorant of the great conquests of philosophical speculation, who naively believed in what they commonly saw and heard; they worked experimentally, in practical activities for their living and they validly contributed to the progress of all vital activities, starting from the military art, agriculture, constructions, etc. But they belonged to an inferior class; often the artisans who made discoveries that today would receive highest international rewards, were illiterate and could not write, so now we do not know who made the discoveries, either when or where; and of course philosophers and mathematicians from their ivory tower, would not stoop down to make any mention of them. A typical example, suitable to give an idea of the situation, is the one dealing with spectacles. Towards the end of the XIII century some artisans discovered

that if, in front of the eyes of elderly persons, presbyopic and therefore uncapable of seeing near objects well, discs of polished glass were placed having bulged surfaces like those of a lentil, these persons would be able to see as well as when they were young. It was a sensational discovery of incalculable value that has served mankind, enhancing the use of sight for fine near work greatly handicapped by presbyopia. A discovery that after seven centuries is still in full sway.

Undoubtedly it was a discovery made by artisans. The name itself indicates this, at first sight, because no philosopher or mathematician of the XIII century would have given to his finding the name of a legumen: but these are not the only proofs because necessarily the same conclusion is reached if one thoroughly studies the conditions of the optical science of the time and of the following centuries. Well, mathematicians and philosphers not only were not interested in the discovery of lenses and the benefits they brought to humanity, but they explicitly condemned them, on the basis of the laws of the official philosophy, since touch never confirms images magnified or made smaller or however distorted as they can be seen through lenses.

Thus for three whole centuries, no one, and not even a mathematician or philosopher was interested in lenses nor wrote a word about them; in the whole period from the end of the XIII century to the end of the XVI, lenses have been mentioned six times: once by a poet (Petrarch) and once by a novelist (Saccetti); by two medical men (Guy de Chauliac and Fracastoro): by an architect (Barbaro) and by another medical man (Cardano) who deserves to be mentioned together with an architect for both of them speak of lenses (each one in a few lines) in a passage that has no relation with spectacles. A more absolute unanimity could not be found in the silence of mathematicians and philosphers. But as the artisans who had discovered lenses for presbyotic persons probably were analphabets and wrote nothing about them, their names are completely forgotten and in spite of numerous researches, also carried out during the past centuries, it is absolutely unknown who, where or when, gave such an important gift to mankind. More recent investigations carried out by a specialist particularly accurate and tenacious, have made it possible to establish that lenses came in circulation between 1280 and 1285 and for the first time in the valley of the Arno.

Notwithstanding that lenses were condemned by philosophers and mathematicians, nevertheless artisans continued to make lenses and to apply them for the correction of presbyopia and had found that according to the age of the person lenses of different shapes were necessary (and they graduated them "by age"; lenses for people fifty, sixty years old, etc.). Furthermore they found that also myopia could be corrected

by means of glasses with concave surfaces that today are called diverging lenses but in the XVI century "concave glasses", because they could not be said "lentils" since no one knew of lentils with concave surfaces.

We know absolutely nothing of the artisan who found the means of correcting myopia, neither his name, nor the place or time of the finding. Another important and useful discovery completely ignored by everyone, by all the high-level philosophers and mathematicians.

I have mentioned the course of the discovery of spectacle lenses, not only because it is typical but also because it had been accurately buried, so that it would be forgotten; the effect has been achieved so perfectly, that when one speaks of this nowadays, one is not believed. It seems impossible that high-level knowledge could have been so misled.

I have recalled the course of spectacle lenses with some details (many others more probative, have been published elsewhere) because lenses had a very great part in the revolution at the beginning of the XVII century, that brought the downfall of peripatheticism and established a new natural philosophy.

This great revolution that radically changed the course of the evolution of scientific thought, has been analyzed and commented by a quantity of historians of science and philosophy therefore it is difficult to say something new in this regard, but we can take it into consideration in an unusual manner.

It is a fact that in so many centuries during which philosophy and mathematics claimed to be considered the exclusive trustees of science and of truth, innumerable artisans had accumulated such a quantity of experimental conquests that they no longer were willing to be considered as a lower species of negligible worth. Various times their interference in public life had alarmed scientific authorities, who appealed even to political measures to refrain their expansion.

The support that politics of the time brought the cultural organization must not be underestimated. In a period in which governments were absolute also culture had to be accurately and severely controlled, because scientific rationalism would have caused serious preoccupations also to political leaders. In these conditions nothing better could be devised than convincing all cultured people of the inviolable supremacy of an Aristotle, insuperable and complete master of all parts of knowledge. This supremacy was made still more inviolable by the scepticism professed without limitation, as to the functions of the senses in general and of vision in particular. Science had to consist in the interpretation of Aristotelian texts, and also according to accurately selected and standardized patterns.

Proselytes aspiring to belong to these high-level circles had to

strictly conform to this discipline; eventual rebels risked serious sanctions, the most frequent of which was to be expelled from a scientific career and therefore to have to give up a Chair at the University or any other good position.

But also artisans were watched and when their activity threathened to become preoccupying, without hesitation appeal was made to political justice. The discredit that was cast on magicians, alchemists and astrologers was a demonstration that they were not approved of and were judged to be insufficent. Astrology was somewhat tolerated, because it was not considered very dangerous; but alchemists, who after all were chemists even though their activity was a bit magic and supernatural, were ferociously persecuted; at best they were accused so be in contact with Satan.

Nevertheless, the extremely conservative attitude had not been able to bar the road of technical, or rather experimental progress; all the more so that this kind of progress was absolutely required for the necessities of life. Thus, e. g., the invention of gun-powder that certainly cannot be attributed to the peripatheticians, brought to the construction of artilleries and so implied difficult metallurgical and mechanical problems; but it also led to the study of the motion of projectiles, hence mathematicians were summoned. But, alas, only their incapacity and powerlessness to solve the problems of motion were demonstrated.

The onslaught of artisans kept on growing formidably. The position of the peripatheticians and mathematicians was critical. The situation precipitated when Galileo, his mind open to new ideas and a hundred percent progressive, after a colossal polemic regarding the telescope (which also is set to the credit not of scientists but of the artisan spectacle-makers) demolished the terrible sentence that cast scepticism upon vision and replaced it with complete "faith" not only a direct vision (that is to say, without any optical system between the eye and the object) but also in vision through telescopes and microscopes and other optical instruments, with no necessity of confirmation by means of touch. This radically changed the trend of scientific thought and gave way "officially" to experimental science.

The great revolution of the XVII century can be said to have been a real onset of artisans and technicians upon the ivory tower of old science. A sympton of this intrusion, although indirect, is found in the remark made by various historians, that Galileo wrote most of his books in Italian and did not use Latin, the official scientific language.

It is unbelievable that the powerful organization of mathematicians and philosophers could be considered disrupted and demolished; they retired within the most fortified positions of their citadel and continued

to affirm that experimental research was valueless because weakened by the fallacy of senses. But the new onslaught of artisans constructed its positions, quietly ignoring the pretensions of philosophers and mathematicians and conquered the public's interest with outstanding discoveries that incessantly followed one another in the field of knowledge, through observations and also experiments. As the philosophers' reasoning was impeccable from a logical viewpoint, no scientist of the new onslaught accepted to discuss on that level, not even Galileo; the password was: to ignore the philosophers' scepticism. The criterion was applied with such success that today the mechanism of the knowledge of the outside world is not discussed in any scientific circle, but blindly (this seems a pun), what is seen is "believed", even when it causes gross mistakes.

It is worthwhile to quote a saying that is written over the entrance door of an American Aeronautical Academy: "Given the weight of its body and the aperture of its wings, the hornet would not fly, but it does not know it, and it flies the same".

Philosophers have been reduced to silence by the colossal development of experimental sciences, after their instructions had been ignored. The new science changed the world and also the tenor of life of making.

But in the meantime a stratification was again forming within the circles of the new scientists. The artisans, alchemists, technicians belonging to the various technics had reached the highest levels of culture; they had reached the universities and had attained incalculable benefits no only for themselves, but also for the development of scientifical knowledge and for the progress of industrial applications. Of course not every one had the same success, the same capability, the same possibilities and not all had a vision of the possibilities and effects that issue when one enters into an environment of study and of teaching. Thus, while many continued to be artisans in the true sense of the word, and quite a few "technicians" kept on working rather too empirically, recurring simply to common sense and to the notions that could be learned during apprenticeship, higher level experimentators, felt they had a right to a greater prestige and started to assume an air of superiority; they were the professional "scientists", the others were but artisans and technicians.

At the same time thought right to neglect their predecessors who had been "artisans and technicians", and did not disdain to assume a conservative attitude, also in the scientific field. It is sufficient to recall that the dictatorship known as "newtonianism" was much stronger than the aristotelian one. Also "newtonianism" was demolished by persons outside the academic environment; of these, three are the best

known: a colonel of the French engineering corp, an English medical man, a French engineer constructor of "bridges and reads", confined in a small country village for police reasons. This all happened during the first decade of the XIX century.

The fact is that not every one can do the same things, that is to say, carry out activities of the same kind: there are some persons who are vastly cultured, are interested in general problems, know how to reason theoretically and feel that they are "superior" persons. There are others who prefer to dedicate themselves to more detailed problems, at times even manual work, without claiming hegemonic power. Inevitably the former are able to prevail and impose themselves and convince public opinion that the latter are persons of little worth, almost underserving of consideration: plain, very plain technicians and artisans.

One of the many repercussions due to this mentality was the general tendency, in the less industrialized zones, to advise young people to follow a career of letters jurisprudence, teaching, rather than a technical or professional instruction.

But technology conquered the world and arrived everywhere and is pursued bringing wealth and power. Undoubtedly even nowadays an immense revolution is under way, not very different from that of the XVI and XVII century: in spite of the tenacious opposition of the "Old Guard", theoretic and "scientific", once activities had been given over to artisans and technicians the more elevated centers of culture and teaching were invaded by them and slowly but inexorably, the organization and mentality of cultured circles are undergoing transformation. Because technology is experience and a great teacher.

In science theories are widely used and theories originate, flourish, but always end up by declining. Experience always progresses and never declines. Technology undoubtedly benefits by theories and tries to exploit them the most it can; but not seldom technology, after having exploited theories the most possible, causes them to decline.

I would not want that the expressions used in these pages should give the impression that I feel a certain resentment towards the sphere of "pure science", that at the beginning of my activity was so "benevolent" towards me and the direction I intended to give to my studies, which seemed too original and anticonformist. Although as a rule I am very comprehensive of men's ways (I had learned much in this sense during the First World War), when considerable interests, ambitions and complications of all kinds are involved, I must say that as yet I am not able, after living for so many years in the midst of it all, to define a substancial difference between science and technics and thus justify a worthy comparison. I often discussed this point also at international

meetings, without finding any one who could dismantle my position, and give a distinct inequivocal definition of the limit between these two activities of man. Most times I met very cultivated and intelligent persons who had dedicated their life to studies of a theoretical and abstract character and who spoke unfavourably of "technology" not better defined, which they absolutely did not know, having in mind perhaps the much exploited figure of the workman-machine of a factory, who repeats the same mouvements during eight hours of a day until he become quite a robot.

I have met very worthy, genial and active technicians who speak of a "science" not better defined perhaps thinking of the famous figure of Einstein who creates the theory of relativity. The "technical" activity of the project officer of an industrial establishment can be enormously more creative and abstract than the activity of "scientists", who in a chemical laboratory dully and systematically carry out thousands of fractioned distillations in search of an element.

The delimitation between these forms of activity has become so difficult and uncertain that actually some students of the subject have been able to distinguish them according to what can be obtained from the activity in terms of money.

I believe that it is a useless discussion and if in many centers there has been violent rivalry regarding this, it must be due to what more or less interesting was going on behind the scenes and was not to be known.

I will now terminate this paper on a much discussed question referring to a speech I made about the years ago at the Manchester University. The theme "Optics in Astronomy" had brought together two well distinct groups of relators: one, a group of theorists and the other of experimentators, that is, observers.

I was not the first speaker so I had the opportunity to notice that when the theoricians were speaking, if the experimentators were not actually sleeping, nevertheless they were not very interested and on the other hand the theoricians paid no attention when the experimentators were relating the results of their work.

Then my turn came and I was treating an intermediate argument between theory and experiment and amongst other things I wanted to point out that theory had imposed itself while experiment, once freed from an "inferiority complex", had demolished theory, although it was supported by first class scientists, such as Lord Rayleigh, and at present is accepted in the whole scientific world since over half a century (it was actually question of the theory of the resolving power of optical instruments). I began my technical exposition with these words:

"It is well-known that in all armies there are contrasts. Of course I am not speaking of contrasts between two armies in war with each other, but of those that happen in a same army. One of the most known is the contrast between artillery and infantry. Artillery, during action, fires its guns and then informs the infantry's command that the enemy's position are destroyed and can be occupied, but not seldom infantry, attacking, finds out at its expense that the artillery's conviction had been illusory.

Now also the circle of scholars can be considered as an army, contending against mystery: and also this army has its artillery and infantry. The artillery is formed by theoricians, the infantry by experimentators".

The premiss had an extraordinary success: all the public followed attentively and with interest my demonstration that the theory of resolving power was illusory and conventional and did not in the least correspond to experiment, and afterwards every time an orator spoke, he started his exposition declaring: "I will be on the side of artillery", or "I will be on the side of infantry". And when a young mathematician related a theory of his for which three large blackboards were needed to write out the formulas, a neighbour of mine said to me: "That is actually atomic artillery".

Now, as the artillery and infantry of an army should not be considered as rivals, but corps collaborating to attain victory, so should science and technics collaborate for the welfare of mankind.

My considerations may seem too synthetic and perhaps even a bit naive, I could not be otherwise in so few pages. However if any one compares them with my personal history of the first pages, he will easily recognize a faithful projection of observations of one who has spent his life between technology and science.