



*On the responsibility of the scientist**

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A.S: Dr Nunes dos Santos (1), I know that your background is in Chemical Engineering and that your doctoral dissertation focused on the behaviour of chemical reactors. Given your academic training, what has led you to reflect so extensively on the role and the responsibility of the scientist in modern Western society?

A.M.N.S: While still a young man, and belonging as I did to a highly politicised generation of young people (unfortunately we recognise that the youth of today are all too often uninterested in questions of economic disparity and social inequality), I was always concerned not only with the creation of a more just society but also with the determination of specific strategies which would allow my generation in general to build a more just society. Living, as I did, in an era when science was considered to be a vital force for the development of human society, it was only natural that we imputed to the scientist a particularly significant responsibility in the attainment of that ideal society. Then, as now, I believe that the great enemies of the human species are ignorance, fanaticism, dogmatism, narrow-mindedness and oppression. Each one of these evils, taken separately or together, cause and have in the past caused great harm to our fellow hu-

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man beings; however, the greatest of these harms originates in those who are fully convinced of their infallibility, who proclaim their beliefs as being certainties, and who therefore hold these beliefs as absolute truths. Historically, it was the dictators who were the most obvious examples of such evil, though, sadly, even nowadays the political class has done little to distinguish itself from its dubious past. Notwithstanding these remarks of a contemporary witness and reader of history, the moment that I personally became more deeply aware of the role and the responsibility of the scientist occurred in December 1992, when I attended the commemorative session of the Nuclear Chain Reaction 50th Anniversary, an international meeting held at the Science Museum in London which brought together an audience of 150 individuals. It was during this meeting that two American researchers, Harold Agnew and Warren Nyer, who had participated in the first nuclear chain reaction in 1942 under the aegis of Enrico Fermi, spoke and shared with us their experience. It was impossible not to sense their excitement as they recalled that experience and the extraordinary historical moment they participated in. I sensed then their excitement as they recollected an era marked by superior intellectual stimulus and impetus, the privilege that was theirs in participating in a great and epoch-making event, an event that would culminate in the building of the atomic bomb. It was at that moment that I became much more aware of the following fact: a scientist is an individual who responds to intellectual challenges which seduce the mind and drive his or her research with an almost single-minded devotion much more than by the potential consequences of his or her work. Notwithstanding my awareness that many scientists resisted the utilisation of the atomic bomb, science, crucially situated as it found itself then at the crossroads of research and history, profoundly undermined—tarnished—its “innocence.” Science henceforth became a habitat of death whose shadow could instantaneously spread across a defenceless civilian population: “I am become death, the shatterer of worlds,” Robert Oppenheimer avows, quoting from the *Bhagavad-Gita*, immediately following the historic test of the atomic bomb’s power at Alamogordo on 16 July 1945, at 5:30 a.m. Referring again to Agnew and Nyer’s enthusiasm, I have never since shaken my tremendous sense of shock as I listened to these two reminiscing scientists. For them, the consequences inherent and/or in imminent relation to the successful control of a nuclear chain reaction were far less significant, or even utterly absent from, the sheer factuality of a successful experiment. In a flash, a new way of seeing the world,

of thinking and feeling, and above all, a new way of looking at science took hold of me. Since then I have never been able to separate our human thirst for knowledge from a deep disquiet in the face of the world such knowledge simultaneously creates and threatens.

A.S: I wonder if this entire approach you have developed over time with respect to the role of the scientist today isn't also closely connected with ethical concerns. Would you please discuss how you see this connection manifest itself?

AMNS: Of course, there is a very real relation between the scientist's (and the citizenry's) actions and ethical concerns. Sadly, education in general and in the areas of science, technology, and engineering in particular, never, or at best only very rarely examine these concerns, together with their context, history, and nature. Now, we know that during our first, adolescent stage of self-awareness and engagement with the world, we are confronted with the fact of death, i.e., our ephemerality, and we respond, partly due to this crushing existential situation, with hope, with our utopian belief in the power of ideas, in the gradual clarification of our role and place in the cosmos, in a more peaceful dialogue with others, and, above all, in the possibility of learning through the study of history ways to avoid committing the same mistakes and engaging in the same repugnant and dehumanising actions.

There is another stage, however, which follows the first: our disillusionment at seeing the disheartening results of our hopes and the perpetuation of previously proven destructive actions. We live in an era where sophisticated modes of manipulation subvert not only reason but also in many cases serve to justify (and I'm not even exclusively referring to contemporary political discourse which irresponsibly promulgates an axis of evil in contradistinction to an axis of good) the abuse of fundamental ethical and moral principles in the name of narrowly national interests (characteristically, the economic interests underlying these abuses are seldom invoked). We see that almost without exception the civilian population is kept in a state of ignorance while being controlled to an alarming degree by state propaganda. And, based on this manipulation and control, the state can justify all of its actions, including the most heinous acts perpetrated against other populations (including its own), without any effective

criticism on the part of the citizenry. Observe the dearth of dissident voices in the face of the inhuman calamities occurring around us. And what *effective* actions have educational, judiciary, and other institutions taken? Moreover, those very institutions which should be the guarantor and preserver of the liberty of expression—in service to the securement of social equality—are very often silent before the injustices committed by governments. We must conclude that our very institutions are corrupt and mirror those interests which win the day by way of manipulation and falsehood. Consequently, our citizenry finds itself subjected to a condition of great precariousness (particularly with respect to employment and labour relations in general). In addition, citizens are flooded by information (abetted by our electronic globalization) and, rather than being empowered by these ever-increasing sources of information, feel powerless if not indifferent to, and alienated from, the ongoing “spectacle” of atrocities committed against human beings, against nature herself, of which we are all a part, let us not forget. These are crimes which in the main go unpunished.

I would like to share an excerpt of a magnificent text written by Primo Levi, published in the Italian newspaper *La Stampa* (later part of the volume *Racconti e Saggi [The Mirror Maker]*, which examines the interrelationship between the concepts of responsibility and ethics. The title of the text is “Hatching the Cobra,” and begins with Levi’s reference to Pliny’s writings concerning Phalaris, the tyrant of Agrigento (VIth century B.C.E.) and his cruel craftsman Pirillus. Pirillus had built a bull for Phalaris, promising him that a man locked inside it would bellow when a fire was lit beneath it, thus imitating the sounds produced by the four-legged creature. Levi exhorts scientists in this text “not to fall in love with suspect problems” and to “try to know the end to which [their] work is directed.” He finishes this marvellous text with the paragraph that follows, and which deserves full attention from scientists:

Whether you are a believer or not, whether a ‘patriot’ or not, if you are given a choice do not let yourself be seduced by material or intellectual interests, but choose from the field that which may render less painful and less dangerous the journey of your contemporaries, and of those who come after you. Don’t hide behind the hypocrisy of neutral science: you are educated enough to be able to evaluate whether from the egg you are hatching will issue a dove or a cobra or a chimera or perhaps nothing at all. As for basic research, it can and must continue: if we were to abandon it, we

would betray our nature and our nobility as ‘thinking reeds,’ and the human species would no longer have any reason to exist (“Hatching the Cobra,” in Primo Levi, *The Mirror Maker*, trans. Raymond Rosenthal, London: Abacus, 2002: 214).

AS: What do you believe to be the role of justice in promoting a deeper awareness on the part of the scientist and the lay public in general with respect to fundamental values? I mean those fundamental values which guide our private and collective engagement with the world. How do you see these values promoting a more pacific and more just human community?

AMNS: In my opinion, and in reference to my country, Portugal, although one of the roles attributed to justice is that of cultivating an increased level of trust in the courts’ decisions, which can only be done by way of a greater transparency and rationality with respect to the cases our court system tries, as well as that of providing means that allow us to verify that political and economic powers are subject to the same norms and rules which govern our citizenry, justice must help to safeguard universally recognised human rights. Such recognition gives us faith in our ability to build a society in the future which will be more respectful of those shared values which in their unequivocally humanist scope protect from violation the integrity of human rights. The exercise of justice must be able to act decisively and with singular determination in the face of those forces in society which would seek impunity for crimes of atrocity committed against humanity. If today we witness the difficult task of imputing responsibility to individuals – whether politicians or not – for crimes such as genocide, bombardment of civilian populations, torture, and rape, for example, our sense of justice must persevere in placing humankind at the center of its concerns. With such a humanist conception, human beings come to understand the consequences of their individual behaviour and, above all, to appreciate the value of solidarity. It is my conviction that the values associated with an ethics of solidarity ultimately comprise the very fate of our species and represent that sentiment of mutual belongingness to a species characterised by profound affinities despite and beyond manifest differences. Unfortunately, our common bonds are undermined by the slogans of competitiveness and the routine acceptance of social disparities.

AS: Taking into account that you have led and continue to lead a multi-faceted career both as teacher and researcher as well as, in the recent past, President of the Scientific Council and Dean of the School of Sciences and Technology of the New University of Lisbon, could you tell us a little bit more about the role of education in general as it pertains to the preparation of young minds and specifically in education's underlying goal in encouraging processes of creativity and (self)transformation?

AMNS: I will give you a highly personal view concerning what I feel to be the role of education vis-à-vis the human condition. It will be an intimate self-portrait, so to speak. What does it mean to educate, and what is education for? These are necessarily arduously pondered issues. If on the one hand education holds as its goal the promotion of the fullest self-realisation possible for every human being, i.e., the complete flourishing of human beings in their expressional and behavioural richness and complexity, then education must certainly serve to preserve us as the creative beings we essentially are. Also, we are innately in solidarity with others ('Je suis les liens que je tisse,' the biologist and philosopher Albert Jacquard writes.) We are beings therefore who flourish when allowed to choose freely. We are beings not only definable as works-in-progress but more profoundly as *beings-in-metamorphosis*. If we espouse this view regarding the role of education, then we must accept that education seeks to cultivate the growth of human beings *toward* completeness, for we are creatures who continually learn how to *be*. In this sense education must occur holistically and continuously; education would then serve as a vital springboard for ongoing reflection and action in the lives of human beings. I believe that education must be that *presence* which impels the human individual to attain his or her full self-consciousness as a creator of utopia, as weaver of a utopian thinking that transcends, among other things, dogmatic forms of thinking. Such education would permit each individual to grow in knowledge while integrating that knowledge (by definition specialised, partial, and dynamic) into an ever more complex cultural consciousness.

For a long period of time it was believed that education served to transmit specialised areas of knowledge so that the young bearer of a diploma could have access to a professional activity befitting his or her training. Emphasis was given to a fragmented, diffracted knowledge, and the transmission of knowledge gave priority to rote learning over authentic

comprehension. It is still to a large part true that testing and examinations continue to occupy the most salient aspect of education. So, students were considered to be empty vessels into whom we pour information; they would subsequently parrot answers and test responses according to the specific knowledge domains previously transmitted. Presently, significant changes are occurring in education, and universities are giving an increasing significance to that pair known as teaching and research. But what about the student? What is the ultimate value of the “knowledge” that is transmitted to him or her? I am convinced that the majority of students typically cram for examinations and forget most of the tested material once the examination is over. As a teacher I am disturbed by this. The sense I have of my role as teacher is thus rather ambivalent. If I am unable to instill a critical spirit in my students, if I am unable to recreate in their minds the intellectual environment as it existed in the historical context we are studying (and in the area of the history of ideas in science it is imperative that students grasp the paradigmatic shifts occurring throughout intellectual and social history), if I am unable to convey the crucial role played by creativity and singularity in the evolution of ideas and an authentic passion for posing questions about reality, which is forever a puzzle, then I have failed my mission as a teacher. And even if I am moderately successful in my mission as teacher in the satisfaction of those goals just stated, what does it matter if my colleagues and I are unable to make of the university a privileged site of shared reflection, where as a community we explore not only intellectual perspectives but also economic, political, and ethical ones? After all, these factors also play a determining role in the progress and growth of knowledge. Ideas flourish in an environment of dialogue, where respect for a diversity of opinions and viewpoints must reign (this is valid for every branch of knowledge). If this does not occur, then once again my mission as a teacher will be woefully incomplete.

AS: Well, we have covered a lot of territory here. Would you like to add anything more concerning your interests and beliefs which our readers might find enlightening?

AMNS: Each one of us is the outcome of a long series of influences, experiences, and events. ‘*We are the web we weave with others,*’ to paraphrase

in English Jacquard's poignant declaration. Contemporary humanity is aware that the past cannot be resurrected; the past has sedimented into the immutable, the a-temporal, and the imperturbable. Each generation possesses a historical mission, that of projecting itself imaginatively and effectively into the future; it is called to create the foundations of that future. Unfortunately, political power in Western societies, and I am speaking specifically of European society in this context, no longer possesses truly visionary statesmen and stateswomen. Our politicians' objectives are strictly short-term, and mainly focus on their staying in political office. Today, these so-called modern states have chosen to abandon their inherent social responsibilities, their utopian burden, so to speak, vis-à-vis matters of education and health, the elimination of poverty, the creation of employment opportunities, and the general welfare of citizens. Society has now delegated to the individual the sole responsibility for these matters. But it is precisely over such matters that the individual has little or no control! At the same time, our existential situation and our social habitat have been transformed into languages of quantification and statistics. Life comes with a price; it must be cost-effective. Moreover, there has occurred a fundamental change in our world that will be very difficult to overcome. The generation that immediately preceded my own harboured great expectations with respect to the future. My forbears were deeply convinced that future generations would have a progressively higher standard of living and higher levels of satisfaction both in terms of employment opportunities and personal fulfilment. Presently my generation is experiencing a profound disillusionment and finds itself confronted with the realization that future generations will in fact have a more arduous task than previous generations faced, with ever-greater obstacles to surmount both personally and professionally. The *other* (who is inherently our human neighbour) will increasingly be perceived as our *rival* in terms of individual survival. It saddens me to see that I belong to a society that has not adequately preserved the solid visionary pillars sedimented by the best minds and hearts of previous generations. Dissident voices are scarce. There remain only isolated echoes that are not effectively transformed into a chorus of citizens demanding a reformation of present societal tendencies. Nevertheless, each one of us, and those working in the area of science in particular, continue to work, to do research, to take pleasure in intellectual endeavours, to enjoy the applications of a dynamic technology, and to consume (at times superfluous) goods, without paying due attention to the grave situation we

have created. Doubtless, it is the educational and judiciary institutions, as well as truly constructive forms of intervention such as volunteerism and mutual aid, that must play an important role in the preservation and perpetuation of humanitarian ideals. If we, as a species, give up and abandon these ideals, then there will be very little left for us to be proud of. I fear our present historical moment will, in a manner similar to what has happened in the past, be judged very harshly. (I recall here the great atrocities committed in the twentieth century—the atomic bomb, the World Wars, genocides, invasions of sovereign states, war-driven technologies, etc.—which we unanimously condemn from our present-day vantage point.) Our own historical moment risks being seen as having been woefully useless, even perverse, and, wherever and whenever possible by ethically aware and responsible people, destined to be repudiated (I won't say 'forgotten' since we are always invoked by memory to be witnesses of history). The final verdict regarding our present-day reality will be most implacably and unerringly decided, as always, by the humanity of tomorrow.

Nota

- 1) El Profesor Antonio Manuel Dos Santos es graduado en Ingeniería química industrial en el Instituto Superior Técnico de Lisboa (IST). Consiguió el título de Doctor en Investigación en Ciencias Tecnológicas en la prestigiosa *Politecnica Federale di Zurigo* (Suiza) y de Profesor Agregado en Teoría de las Ciencias y Pensamiento Contemporáneo en la *Universidade de Nova de Lisboa* (UNL). Es profesor Ordinario, fue Vice-Presidente del Consejo Científico de la UN (1996-1999), Es Decano de la Facultad de Ciencias y Tecnologías de la UNL (2003-2006). Ha dirigido varias investigaciones en la *Universidad de Edinburgo* (Escocia) donde comenzó su Doctorado de Investigación; es profesor invitado en la *Universidad de Kent* (Inglaterra). Es coordinador del Centro de Investigaciones en Historia y Filosofía de la Ciencia, uno de los Centros de la *Fondazione per la Scienza e la Tecnologia* en el Ministerio de la Ciencia y de la Tecnología e Instrucción Superior en Portugal. Sus intereses van desde el comportamiento de los reactores químicos hasta la valoración de las ideas científicas en Química (siglos XVIII-XX) y en Física (siglo XX, primera mitad), de la epistemología a la filosofía de la ciencia.