Julius Tomin

# Self-knowledge as an imperative

['Self-knowledge as an imperative' is a revised version of 'Human Spiritual Nature and the X of Neurophysiologists' (on www.juliustomin.org). In the past year I had the opportunity to present the Czech version of my paper at the Philosophy Faculty in Plzen in the Czech Republic, then a revised version at the Philosophy Faculty of Charles University in Prague. The discussion on both occasions was very lively, but especially fruitful was my prolonged exchange of views with Jaromír Mysliveček, Professor of Neurophysiology at Charles University, the author of *Základy neurověd* (*Foundations of Neurosciences*) which stimulated me to further revise the text for the present English version.]

The Delphic exhortation 'Know thyself' is as relevant for us today, as it was for Socrates and his contemporaries. Socrates pursued self-knowledge in discussions with people in the city and shunned nature, as he himself explains "I'm a lover of learning, and trees and open country won't teach me anything, whereas men in the town do."[i] Neurophysiology has changed profoundly the framework within which we can best begin our pursuit of self-knowledge. Plato viewed light as a body of gentle fire emanating both from the objects we see and from the eyes, coalescing with each other and propagating the motion caused by light through the eye to the soul. On the basis of this concept of vision, Plato had no problem with our seeing the world outside us as being really outside.[ii] We now know that this is not how our eyes function. The forms of objects in the external world that generate visual stimuli are profoundly transformed as they affect the receptors on the retina. What we see is in its totality created by us on the basis of transformations that the oncoming stimuli undergo in the brain. We are the totality of what we experience, always split in our consciousness into 'me and the outside world'.

It might seem that Plato's Socrates came very near to the realization of this fact in the *Theaetetus*, when he asks whether we dream when we sleep, or whether our waking is nothing but dreaming. However, instead of viewing the experience of dreams as an indicator that we can generate the external world within us, he induced dreams as an argument for doubting the reality of the world we perceive through the senses.[iii] But contrast your most vivid dreams with your taking a walk through the countryside. Observe how the scenery changes with every step you take, how trees and their branches and leaves, the blades of the grass on which you walk, move relative to you and to each other with every step – it all is there, in front of you, behind you, around you, with every step, with every breath you

perceive its real existence – and yet it all is you in so far as you see it, hear it, touch it. It is neurophysiology that enables us to fully appreciate this fascinating experience, firmly embedded as it is in the physical world, in physics, chemistry, biology; the way in which the stimuli from the external world affect our sensory receptors is one of its most important areas of study. There is no better way of examining ourselves than going for a walk and in the light of neurophysiology reflecting on what we truly are by observing the countryside as it unfolds in front of our eyes in all its ever changing variety of shapes, colours, and movements … How then do scientists explain this?

Hawking and Mlodinow in *The Grand Design* describe sight thus: "In vision, one's brain receives a series of signals down the optic nerve. Those signals do not constitute the sort of image you would accept on your television. There is a blind spot where the optic nerve attaches to the retina … And so the raw data sent to the brain are like a badly pixilated picture with a hole in it. Fortunately, the human brain processes that data, combining the input from both eyes, filling in gaps on the assumption that the visual properties of the neighbouring locations are similar and interpolating. Moreover, it reads the two-dimensional array of data from the retina and creates from it the impression of three-dimensional space. The brain, in other words, builds a mental picture or model."[iv]

The authors do not ask whether the brain can create the world of our experience, for there are no scientific instruments that can detect anything in our heads but brain. This question nevertheless must be asked, for the information on the basis of which we perceive the outside world is stored and structured in the brain in a completely different way from the way in which the world we see is structured. The biochemical and electric activities of nerve cells, by means of which information in the brain is processed, proceed completely differently from the way in which our consciousness perceives movements and cessation of movements of objects and of living beings we see around us. When we become aware of the profound discrepancy between our physical brain and the world of our consciousness, we realize that there must be another entity, different from the brain, which transforms the data processed in the brain into the world of our consciousness. The process of this transformation is entirely subconscious. Our conscious activities are focussed on and absorbed by the task of perceiving the world, as constituted by our subconscious activities, as the real world outside us in which we live.

Hawking and Mlodinow maintain that 'the brain is so good at model building that if people are fitted with glasses that turn the images in their eyes upside down, their brains, after a time, change the model so that they again see things the right way up. If the glasses are then removed, they see the world upside down for a while, then again adapt. This shows that what one means when one says "I see a chair" is merely that one has used the light scattered by the chair to build a mental image or model of the chair. If the model is upside down, with luck one's brain will correct it before one tries to sit on the chair.'[v] This experiment underlines the need to ask whether it is the brain on its own that creates for us the world we see. Consider how far reaching 'rewiring' of neural signals in the brain the experiment would involve, if the brain were to execute the remodelling. Turn the page you' reading upside down and consider what it would take for the brain to redirect all the neural pathways involved in viewing the page upside down so as to turn the page visually – not physically – the right way up.

My own deteriorating eyesight has opened for me experiments involving the same problem. When I close my right eye, the lines I see with my left eye are distorted. When I continue to read the text with my right eye closed, the lines gradually straighten up. When I then reopen the right eye and close it again, the lines in front of my left eye are again distorted. If it is the brain that performs the correction of the distorted lines, why does it revert to the distorted view by virtue of my opening and closing the right eye? Both these experiments require an entity that is different from the brain to make sense of them. If this entity is to provide us with a reliable image of the world in front of us and around us, it is essential that it receives the information concerning it as it is actually passed to the brain by our senses. On that basis, face to face with the world outside us, it can perform any required corrections.

Since our brain with all its neurons is located in the skull, this entity must also be located in the skull, for only thus it can transform the data processed by the brain into the world of our consciousness. The nature of this entity, composed as it is of a subconscious and conscious part, must be fundamentally different from the nature of the brain, for the world we are conscious of is not interfered with by the physical processes in the brain, by the electrical currents and chemical transmitters generated by neurons. It follows as a matter of course that this entity cannot be interfered with, detected or manipulated by any physical instruments by means of which science detects physical phenomena in the brain. This entity deserves a name, but names such as 'mind', 'soul', 'psyche', which spring to mind, are misleading in so far as they have been associated with just one pole of our conscious activities, the subjective, the 'I' pole, while neurophysiological data compels us to view our consciousness as

constantly split into ‘me’ and the world ‘outside me’. I therefore propose to name this entity Human Spiritual Nature, or HSN.

It will be asked, how I can claim that neurophysiology allows us, or rather compels us to see the world we perceive, as being created by HSN, when neurophysiologists themselves reject any entity mediating between the brain and the world of human consciousness. Roger Carpenter and Benjamin Reddi write in the first chapter of their *Neurophysiology*: “Conceptually, a neuron is quite simple. But brains are not. On the one hand we have all the unspeakable wonders of our minds, of which we are so inordinately proud; on the other hand, when we open up the skull and peep inside all we see is a porridgy lump containing millions and millions of these untidy little neurons. The fundamental problem of neuroscience is that of linking these two scales together: can we trace the relationship between molecular and cellular mechanisms all the way to what was going on in Michelangelo‘s head as he painted the Sistine Chapel? Very nearly, and the trick is to force yourself to think of the brain as a *machine* that carries out a well-defined job. The job is to turn patterns of stimulation, S, into patterns of response, R: the sight of dinner into attack and jaw-opening; a page of music into finger movements. How it does this is clear, in principle at least. The brain is a sequence of neuronal levels, successive layers of nerve cells that project on to one another. At each level, a pattern of activity in one level gets transformed into a different pattern in the next. Thus the incoming sensory pattern S is transmitted from level to level, modified at each stage until it becomes an entirely different pattern of response R at the output.”[vi]

It looks simple. Stimulus S: the sight of dinner, response R: attack and jaw-opening. Where is there any place for HSN in all this? In fact, the authors misrepresent the stimulus S, for the sight of dinner is something entirely different from what the receptors in the eye apprehend and what the optic nerve conveys to the visual cortex. They write on the following page: “Receptors in the eye convey information about only a miniscule part of the retinal image, in effect a single pixel; but after a few levels have been passed, in the visual cortex, we find units that are able to respond to a specific type of stimulus, such as a moving edge, over wide areas of the visual field[vii]… Cells in the visual cortex code for a wealth of information about the visual world, looking for spots and edges and lines of certain orientation, of a particular length and moving in a particular direction and so on.”[viii]

The sight of dinner is coded more fully in the visual cortex, after a few levels have been passed, but this cannot be the end. For the dinner smells nice, the smell is coded in a different

part of the brain, so the coded 'sight of dinner' must be united with the coded 'smell of it' in a new code that represents 'the dinner that smells nice', coded by nerve cells that are different both from those that are located in the visual cortex and from those in the olfactory part of the brain. Where then in the brain can be located 'the dinner that smells nice, which I see on the table in front of me'? Nowhere, for 'the dinner that smells nice, which I see on the table in front of me' is structured in space and time very differently from the way the coded information concerning it is structured in space and processed in time by chemical and electric activities of thousands of nerve cells in the cerebral cortex involved in its coding. And yet, the 'dinner which I see on the table in front of me and which smells nice' is experienced by me; it must therefore be produced by the HSN, an entity that is different from the brain. If we view as S the optical stimuli affecting the retina in our eyes, then 'the sight of dinner' must be viewed as R, the response of the HSN to the given S. But if we want to view 'the sight of dinner' as S and 'attack and jaw-opening' as R, then we must identify S as an act of the HSN that motivates the given response.

Carpenter and Reddi explain 'all the unspeakable wonders of our minds' by reference to the complexity of brain and to the number of neurons of which it is composed. They write: "The brain is a sequence of neuronal levels, successive layers of nerve cells that project to one another … By joining together billions of units that are each quite intelligent, we end up with something that is astonishingly intelligent."[ix] So we must ask, what does 'intelligence' mean within the neurophysiological framework? The authors say: "The mechanism at the terminal end is as far as we know absolutely identical in all neurons and receptors: depolarization opens voltage-sensitive calcium channels, and the resultant rise in intracellular calcium causes exocytosis of vesicles containing the neurotransmitter that is to act on the next cell along."[x] In neurophysiology the 'intelligence' of nerve cells at any level amounts to nothing other than an interaction between their biochemical and electric activities. The relative significance of the biochemical and electric activities in processing the information appears to be disputed, as can be seen if we compare Carpenter and Reddi's concept of intelligence with the closely related concept of 'information' as it is discussed by the Czech neurophysiologist Jaromír Mysliveček. Mysliveček says that "every activity in the cell becomes information that spreads".[xi] In his view the information is coded and carried by the electric activity of the nerve cells, i.e. by the electrical action potential.[xii] In contrast, Carpenter and Reddi maintain that "the purpose of a neuron is not to generate action potentials – or any other kind of potential – but to *release transmitter in response to stimuli*."[xiii] This reflects the fact that the

action potential is always confined to the given nerve cell – it cannot pass the synapsis to any other nerve cell – so that the information can spread, pass from one cell to another, only by means of chemical transmitters. But *pace* Carpenter and Reddi, chemical transmitters are badly suited for coding information, for they lack the determinate form that the coding of information would require; their production depends on electric action potentials generated by the presynaptic cells, and their effect depends on chemical moderators and on the state of the postsynaptic nerve cells which they affect. In contrast, action potentials are clearly defined by their frequency. But since in our brain the action potential cannot pass from one cell to another, it can have value as information only if apprehended by the subconscious part of HSN.

The inadequacy of the current neurophysiological account of our self-reflection and self-knowledge comes to the fore most strikingly in Carpenter and Reddi's book in the section on "'Mind' and consciousness". The authors open it with a quotation from Charles Lamb: "*Nothing puzzles me more than time and space; and yet nothing troubles me less, as I never think about them"*. They admit that this is "a reaction not very different from that of most neurophysiologists to problems of mind, brain, and consciousness." They open their enquiry into consciousness by stating that "in a nutshell, 'brain versus mind' is no longer a matter for much argument. Functions such as speech and memory, which not so long ago were generally held to be inexplicable in physical terms, have now been irrefutably demonstrated as being carried out by particular parts of the brain, and to a large extent imitable by suitably programmed computers. So far has brain encroached on mind that it is now simply superfluous to invoke anything other than neural circuits to explain every aspect of Man's overt behaviour."[xiv] What can they say about consciousness on this basis?

Viewing the functions of the brain in terms of stimulus S and response R, the authors now enquire whether there is any point in postulating X as an intermediary between the two. They consider three possibilities before making their own proposal:

> (a) "Descartes' dualism proposed some non-material entity – the 'ghost in the machine' – that was provided with sense data by the sensory nerves, analysed them within itself, and then responded with appropriate actions by acting on motor nerves (the mind thus having the same relation to the body as a driver to his car)."[xv]
>
> (b) "Clearly one must modify such a scheme to include the existence of certain automatic reflexes that clearly do not pass through the mind."

> (c) "Modern neurophysiology goes further still, admitting of no other path between stimulus S and response R than unbroken chains of neural connections: X, the ghost in the machine, has finally been laid to rest."

Dissatisfied with (c), the authors assert that "there is still a problem of *consciousness*. However sure I may be that (c) is a fair representation of *your* brain, there remains the obstinate and unshakable conviction that *my* brain is like (a)".[xvi]

Before proceeding any further in exploring the authors' proposal, let me note that the contrast which they postulate between our self-reflection and our view of other people loses its validity if we consider it from the HSN viewpoint. Since we live, move, operate, talk and generally interact with each other in the same world, I can be sure that HSN in your case as in mine transforms the information processed by our brains into our perception of the world around us. At any time I may assure myself of this fact by such simple means as asking you to pass me the salt when we sit around the table. HSN in your case *is* 'you and the outside world' in so far as these two poles taken together form the totality of your experience, and in my case it *is* 'me and the outside world' in so far as these two poles taken together form the totality of my experience.

With this remark, let me return to the authors' view of consciousness. They postulate a new form of X: "the ghost in the machine is not an executive ghost, as it is in (a) and (b), but rather a *spectator*, watching from its seat in the brainstem the play of the activity on the cortex above it. But what about *free will*? The ghost in such a scheme would observe the body's actions being planned, and see the commands being sent off to the muscles before the actions themselves began, and so one can well imagine how it might develop the illusion that because it knew what was going to happen, that it was itself the cause."[xvii]

The authors consider as the most serious objection to their proposal the objection "that it is difficult to see what on earth X is for, since it can't actually do anything." Their answer is: "Perhaps it does just occasionally intervene. But in any case, what is the audience at a concert for? Or the spectators at a football match? The idea that I am being carried around by my body as a kind of perpetual tourist, a spectator of the world's stage, is not – on reflection – so very unattractive."[xviii] But the main objection is that watching 'the world's stage' and 'the play of the activity on the cortex above it' are incongruous propositions. 'The world's stage' is organized in accordance with the space, shapes and movements of objects, animals, activities and interactions of people all around us, and is fundamentally different from the

way in which the fabric of the brain is organized within the space of our skull and from the way in which the activities of neurons proceed in time. 'Watching from its seat in the brainstem the play of the activity on the cortex above it', all the X could 'watch' would be networks of neurons generating and conducting electrical currents, generating, receiving and releasing chemical neurotransmitters.

We are not conscious of the processes by which the biochemical and electric activities in the brain are transformed into the world of our consciousness. Carpenter and Reddi are wrong when they say 'that we are conscious of some kinds of brain activity but not others'.[xix] There are *no* activities of the brain of which we are conscious. The authors confuse what they know about the brains' activities from neurophysiology with what they themselves can possibly be conscious of. The ancients were not even sure whether the perceptions go to the brain. Socrates in his youth enquired whether it is blood that we think with, or air, or fire, or none of these, but that it is the brain that provides the perceptions of hearing and seeing and smelling. His inability to solve such questions contributed to his self-awareness of ignorance.[xx] In Aristotle's view the proper organ of sense perception is the heart to which perceptions proceed from the senses.[xxi]

Neurophysiology has shown that sensory perception in all its stages, beginning with the senses and ending in the brain, does anything but convey into the brain the forms of objects that we see, hear, smell, taste and touch. To make this clear, let me quote Carpenter and Reddi on the sense of vision: "People often get muddled about the difference between the *stimulus* – the pattern of energy falling on receptors – and the *object* that gave rise to that pattern in the first place. Of course it is the object that has to be recognized, not the stimulus: stimulus is, in a sense a coded version of the object that has to be decoded again. And this is the essential problem of recognition, because the same object can give rise to very different stimuli on different occasions. Objects in the real world are perceived at different times under lighting of different intensities and colours, and from different distances and directions. The stimulus is a coded version of the object that gave rise to it, some aspects being *essential*, and due to the object itself, and some being merely *accidental*, and nothing to do with the object at all. A particular retinal image of a cube under particular conditions is as much a coded version of the cube, that has to be deciphered, as are the four letters CUBE: in many ways the latter presents an easier task."[xxii] In spite of this, neurophysiologists maintain that brain embodies a model of the outside world![xxiii] Descartes was entitled to believe that the brain embodied a model of the outside world, for he viewed the rays of light on the analogy to

sticks, which through the eye model the outside world in the brain.[xxiv] But how can such a modelling be supposed to take place once we become aware of 'the difference between the *stimulus* – the pattern of energy falling on receptors – and the *object* that gave rise to that pattern', as the authors put it?

Carpenter and Reddi claim that "functions such as speech and memory … have now been irrefutably demonstrated as being carried out by particular parts of the brain". The only thing they say to supports it concerning speech is that it is "to a large extent imitable by suitably programmed computers".[xxv] Suitably programmed computers can undoubtedly store in their memory immense amounts of words with a great range of meanings, which they can combine according to syntactic rules into meaningful sentences. Yet there is nothing in computers that amounts to an understanding of what they compose.

Consider the word 'spring' and its meanings in the *Oxford Advanced Learner's Dictionary*: 'Flowers that bloom in spring', 'There's a feeling of spring in the air today', 'A spring is a twisted piece of metal that can be pushed, pressed or pulled but which always returns to its original shape or position afterwards', 'Spring is a place where water comes naturally to the surface from under the ground', 'She walked along with a spring in her step', 'With a spring, the cat sprang on the table', 'I'm sorry to spring it on you, but I've been offered another job', 'Tears spring to her eyes', 'Plans to spring the hostages have failed', 'Spring into action', 'Spring to life', 'The town springs into life during the carnival', 'Spring a leak', 'Spring a trap', 'Spring for something', 'I'll spring for the drinks tonight', 'The idea for a novel sprang from a trip to India', 'Where on earth did you spring from?' … Suitable equivalents for all these meanings could be found in Czech, German, Russian, or Chinese and stored in a computer so that it could translate all of them without making mistakes. Nevertheless, that would be very different from understanding the word 'spring' in English and the corresponding words and expressions in those other languages. Let me take as an example my native Czech. To translate 'Flowers blossom in spring' I would have to use the word 'jaro'. To translate 'Spring is a twisted piece of metal…' I would have to use either the word 'pero', or 'pružina'. To translate 'Spring is a place where water comes naturally to the surface from under the ground' I would have to use the word 'pramen'. For each of these Czech words I could find idiosyncratic Czech usages, as I did for the word 'spring' in English. Each of these words with its different meanings is rooted in different ways of reflecting the world in the English language and in the Czech language. No imitation by suitably programmed computers can alter the fact that computers do not have any

understanding of the words they compute in digitalized form, whereas human beings cannot properly use their speech without understanding what they say and what they are told when spoken to.[xxvi]

As for memory, Carpenter and Reddi explain it as follows: "All learning by the brain must amount, in the end, to the formation of physical connections between neurons in such a way as to mirror the associations that exist in the real world between the stimuli that those same neurons code for. Memory, the process that models the world within our heads, must operate through synaptic plasticity." The experimental foundation for this mechanism the authors derive from "Pavlov's famous experiments on dogs, which for the first time showed that learning could be quantified and treated as a thoroughly scientific phenomenon. A dog is trained by frequent association of sound and food to salivate when a bell is rung."[xxvii]

Let us examine more closely Carpenter and Reddi's explanation of Pavlov's experiments. The authors denote as A the neural path that links food, that is the unconditional stimulus, to salivation, i.e. to response, and as B the path that connects the conditional stimulus to response, that is the ring of the bell to salivation. They say that on the A pathway "there must be at least one neuron – the one that actually innervates the salivary gland, if no other – that is common to both pathways and where they first come together; this is the cell X… What we observe is that after sufficient pairings of food with bell, the bell alone eventually produces salivation. Translating this into what is happening in the region of X, this means that the more often A (and hence X) fires at the same time as B, the stronger becomes the connection from B to X, until in the end B is able to fire X all by itself… What it amounts to is *fire together, wire together*: neurons representing things that tend to happen together get physically linked together, so that brain eventually embodies a model of the outside world."[xxviii] *Pace* Carpenter and Reddi, in Pavlov's experiments, as far as I can remember,[xxix] the conditional stimulus preceded the unconditional stimulus; Pavlov engineered varied time-gaps between the two.

The authors write that *fire together, wire together* 'is the secret of cerebral cortex: it provides a mechanism for creating physical connections between neurons that are often active simultaneously.'[xxx] But the neural mechanism of *fire together, wire together* cannot explain Pavlov's experiments on dogs, let alone constitute a model of the outside world in the brain. Why is it that neurophysiologists so greatly overplay its role in the working of the nervous

system? Is it because *fire together, wire together* is the only principle that has been ascertained experimentally, for the biochemical mechanism that underlies the formation of the connection between unconditional and conditional stimuli has been established only in cases where the nerves carrying the conditional and unconditional stimuli *fire together*?[xxxi]

An even more fundamental distortion of neurophysiological mechanisms of memory is caused by the reduction of all memory to synaptic plasticity. In the chapter on 'Associational cortex and memory' Carpenter and Reddi admit that in Man associations between stimuli and responses, which constitute memory, cannot be experimentally elicited: 'in Man … most areas of the cortex neither respond in an obvious way to simple sensory stimulation, nor produce movements when electrically activated'. This they explain as follows: 'Because a neuron at any level is activated only by a particular pattern of activity in the preceding layer, as we penetrate deeper into the sensory side we find that individual neurons become fussier and fussier what they respond to, and eventually the chance of our finding out, in an experiment of finite duration, what they *do* actually do becomes vanishingly small.'[xxxii] But concerning memory in Man, what we must try to understand in the first place is the neuronal mechanism which makes speech possible. This cannot be explained by 'neurons becoming fussier and fussier what they respond to'. The task is to find the neuronal mechanism which codes and retains words in its memory; a response to any word is an option. Seeing a written word I can simply read it; my understanding it testifies to the fact that it is registered in my memory. My remembering the word can be performed only if there is a nerve cell to which the afferent optical pathway leads, the nerve cell in which the neural code of the word had been formed and has been preserved. This cannot be explained by synaptic plasticity, for synapses are concerned with passing information from one nerve cell to another nerve cell or cells. The claim of neurophysiologists that 'all of the different kinds of memory and learning that the brain is capable of' can be explained 'by postulating changes in synaptic effectiveness that are a function of the patterns of activity that the pre- and postsynaptic cells have experienced', [xxxiii] is untenable.

Concerning speech, the most important task which the nervous system must perform is long retention and storage of words. The biochemical activities in neural synapses are essentially fluid, subject to many influences and undergoing constant changes.[xxxiv] In my view, there is only one structure in the nerve cells that can form and preserve coded versions of linguistic phenomena, the deoxyribonucleic acid, or DNA. It can perform this function, for the nerve cells do not divide.[xxxv] Liberated from its genetic function, the DNA in nerve cells can code

and retain in its memory the vocabulary and grammar of any language we may learn. But we think in words, not in the versions of words that are coded in the DNA of nerve cells. These coded versions of words must therefore be transformed by our HSN into words that enter our consciousness. We are not conscious of the underlying transformations; they are performed by the subconscious part of the HSN. In the interplay between the conscious and subconscious part of the HSN are formed concepts to which words refer and which in their turn find their expression in words. Words as such cannot be stored in our nerve system, they must be retained in the HSN memory, for whether they enter our consciousness in the spoken or written form, or simply as thoughts, they do so in forms which cannot be physically constituted in nerve cells.

From this follows the question how has the HSN acquired the capacity to transform the information supplied by our senses and coded in the brain into the world of our consciousness. The answer must be sought in evolution; the human spiritual nature that re-produces us and the world in which we live in our consciousness is the result of an evolutionary process that goes back to the first living organisms capable of sensing and avoiding external danger, and of sensing sources of sustenance and moving towards those sources. The only way that living beings can apprehend the world external to them is by reproducing it within themselves. The physical matter of which living organisms are made provides no internal space in which the outside world could be modelled and no material with which it could be done. The solution therefore had to be provided by a fundamentally different entity, existing in the same space as the organism, registering the changes by which the outside world affects the organism, and on that basis reproducing that external environment within itself. Through the course of evolution living organisms developed an ever more intricate nervous system, with the DNA in nerve cells coding and retaining in its memory ever more minute and delicate influences coming from the environment, so that the organisms became able to combine actual sensory stimuli with past experience, as their spiritual nature reproduced the environment ever better and more fully.

The interplay between the brain and HSN, the needs we feel on the basis of that interplay, and the wishes, intentions and choices with which we respond to them, all play their part in the way we make our choices and determine our behaviour. We determine our actions with some purpose in mind, and this too must be viewed within the framework of evolution. Living beings direct their attention to that which attracts or threatens them, which they can reach or escape, obtain or avoid, in other words to something that is at any given moment

possible, but not yet realized, which is in future that they can co-determine by their preferences, by their actions and inactions. This aspect of spiritual nature contrasts with 'scientific determinism', to which Hawking and Mlodinow refer as the sole cause of all our actions. They write: "It is Laplace who is usually credited with first clearly postulating scientific determinism: given the state of the universe at one time, a complete set of laws fully determines both the future and the past … It is, in fact, the basis of all modern science … Since people live in the universe and interact with the other objects in it, scientific determinism must hold for people as well … It is hard to imagine how free will can operate if our behaviour is determined by physical law, so it seems that we are no more than biological machines and the free will is just an illusion. … If we have free will, where in the evolutionary tree did it develop? Do blue-green algae or bacteria have free will … what about the roundworm called *Caenorhabditis elegans* – a simple creature made of only 959 cells? It probably never thinks, 'That was damn nasty bacteria I got to dine on back there', yet it too has a definite preference in food and will either settle for an unattractive meal or go foraging for something better, depending on recent experience. Is that the exercise of free will?"[xxxvi]

Within the framework of evolution, the preferences of *Caenorhabditis elegans* can be viewed as a step on the long road leading to the development of HSN. From its evolutionary beginnings, spiritual nature is open to causation that is fundamentally different from the determinism that modern science recognizes as the only causal principle. The behaviour of living beings is co-determined by possibilities. What possibilities a living being chooses face to face with its environment in any given situation is determined by its preferences, which correspond to the state in which it finds itself.

The view 'that we are no more than biological machines and the free will is just an illusion' distorts our self-knowledge, undermines our sense of responsibility, and negatively affects our ability to act. The perspective that 'scientific determinism' opens for us is outlined by Carpenter and Reddi: "Why, in fact, do we bother to do anything at all? The answer is basically to do with income and expenditure, of energy. Even at rest, we are remorselessly expending energy: if we don't replace this energy, we die. If like corals or sea-anemones we were lucky enough to live in an environment where we were bombarded by food, we could just glue ourselves to rock and keep our mouths open. But for the big spenders, warm-blooded animals like us, the only way of keeping in surplus is to *gamble*. We spend a lot of energy as a *stake*, in order to perform actions from which we hope to get more in return, rather like a business investing some of its profit in the hope of even huger profits in the

future. In a sense this decision-making – *to do or not to do* – is the most difficult task an organism has to undertake … the whole of the brain can usefully be thought of as a mechanism for reducing the risk, by making more and more accurate *predictions* about the likely result of any particular course of action, on the basis of past experience, stored not just in our brains, but in our books. To put it another way, we need to apply the principles of *homeostasis*, which loom so large in general physiology, not just to the milieu intérieur but to the outside world as well. In addition to *internal* homeostasis, controlled by hormones and the autonomic nervous system, we have to add *external* homeostasis, controlled by the brain, achieved sometimes by literally altering our environment (wearing a pullover, for instance), but more often by moving to somewhere nicer, or by engulfing or penetrating things we like."[xxxvii]

Although homeostasis is composed of the ancient Greek *homoios*, 'similar', and *stasis* 'standing still', it is a relatively new invention. Although the Greeks did not have the word *homoiostasis*, the concept of doing only the minimum necessary to get along in life, the propensity to avoid aspiring to something better and higher, was not new to them. It comes to the fore in a humorous way in Plato's *Euthydemus* in an exchange between Socrates and two sophists, Euthydemus and Dionysodorus. The two sophists professed to teach virtue better and quicker than anyone else (273d8-9), so Socrates asked them to make a trial of Clinias, a beautiful youngster whom everyone wished to become as accomplished as possible. When the two responded by a display of sophistry, Socrates attempted to show them that true education strives for the Good, attains wisdom. Dionysodorus riposted: "You wish the young man to become wise and not ignorant? You wish him to be what he is not, and no longer to be what he is?" When Socrates answered positively, Dionysodorus declared triumphantly: "You wish him no longer to be what he is, which can only mean that you wish him to perish. Pretty lovers and friends they must be who want their favourite not to be, or to perish!"[xxxviii] Socrates replied: "if you know how to destroy men in such a way as to make good and sensible men out of bad and foolish ones, destroy the youth and make him wise, and all of us with him".[xxxix]

Aristotle realized that the problem of change involved in education and in cognitive activities deserved serious consideration. He distinguished two kinds of changes involved in these activities. Firstly, the change to which a potential knower is subjected who in the process of learning abandons the state of his ignorance; secondly, the change undergone by a knower activating knowledge which is in his possession. In the second case, he insists, either no

change is involved at all (*hoper ê ouk estin alloiousthai*) or 'a different kind of change' (*ê heteron genos alloiôseôs*) takes place. The notion of 'change' expressed by the verb *alloiousthai*, meant 'to become different', which involved *paschein,* 'to be acted on', and had negative connotations played on by Euthydemus and Dionysodorus in Plato's dialogue. Aristotle does not say what 'different kind of change' he has in mind in the second case, for it is clear that the change involved in that case is free of any negativity. He develops the notion of the 'different kind of change' when he discusses the change that a potential knower undergoes in the process of learning. This change is undergone by virtue of acquiring positive qualities and fulfilling one's nature (*metabolên epi tas hexeis kai tên phusin*).[xl] From this perspective, the pursuit of self-knowledge is a life-long task of self-transcendence and thus of fulfilling one's nature. From this perspective I should like to point to thoughts of Socrates, Plato, Aristotle, and Jesus concerning man and God.

Socrates viewed the Delphic inscription 'Know thyself' as a divine command directing men towards God. Defending himself against the accusations of impiety and of corrupting the youth of Athens, Socrates put his obedience to God and his care for the soul at the centre of his defence: "Men of Athens, I honour and love you, but I shall obey God rather than you, and while I have life and strength I shall never cease from the practice and teaching of philosophy, exhorting any one whom I meet and saying to him after my manner: You, my friend, - a citizen of the great and wise city of Athens, - are you not ashamed of heaping up the greatest amount of money and honour and reputation, and caring so little about wisdom and truth and the greatest improvement of the soul, which you never regard or heed at all?"[xli] In Plato's *Alcibiades* Socrates argues that "the human being is the soul" (130c5-6) so that "commanding us to know ourselves God commands us to know our soul" (130e8-9). "If the soul wants to know itself, it must look into the soul, and more specifically into that region of the soul in which virtue, that is wisdom, is generated" (133b7-10). There is nothing more divine in the soul than that which is concerned with knowledge and thought (133c1-2). If we look at God we will be using that most splendid mirror, and look into the soul's excellence, and thus we will best see and know ourselves (*Alc.* 133c13-16). In other words, directing us to God, the Delphic inscription directs us to that which is best in us.

Aristotle's God is the unmoved principle of motion, the first mover, eternally unchanged (*Met*. XII, 1073a23-4), desirable and knowable (*Met*. XII, 1072a26); he moves everything by being desired (*Met*. XII, 10-70b35, 1072b3). Being pure intellect (*nous*), his being consists of eternal, continuous, self-reflective thinking of thought (*Met*. XII, 1072b19-20): "On such a

principle, then, depend the heavens and the world of nature … If, then, God is always in that good state in which we sometimes are, this compels our wonder; and if in a better this compels it yet more. And God is in a better state. And life also belongs to God; for the actuality of thought is life, and God is that actuality; and God's self-dependent actuality is life most good and eternal. We say therefore that God is a living being, eternal, most good, so that life and duration continuous and eternal belong to God; for this *is* God."[xlii] "If reason is divine, then, in comparison with man, the life according to it is divine in comparison with human life. But we must not follow those who advise us, being men, to think of human things, and, being mortal, of mortal things, but must, so far as we can, make ourselves immortal, and strain every nerve to live in accordance with the best thing in us."[xliii]

Jesus derived from and related to God all positive human effort: "You must be perfect (*teleioi*) as your heavenly father is perfect (*teleios*)" (*Matthew* 5, 48). In doing so he does not ask the impossible, he does not exhort his followers to acquire divine perfection, but rather asks them to reach their human perfection, just as God has divine perfection. *Teleios* means: 'accomplished, perfect in his kind'.[xliv] Jesus introduced his command "You must be perfect as your heavenly father is perfect" by exhorting his disciples: "Love (*agapate*) your enemies" (*tous echthrous humôn*, *Matthew* 5. 44). We can properly appreciate the significance of this command when we fully realize that everybody with whom we come into contact can be encountered, seen, and be talked to by us only in so far as we re-create them inside us on the basis of the activities of our brains. 'Your enemies' translates *tous echthrous humôn*; *echthros* is used in Greek both in a passive and in an active sense, 'hated' and 'hating'. If we hate a person that hates us, we recreate that person in us both in his or her being hated by us and in their hating us. The more one hates another person, the more one damages oneself. By removing hatred from our hearts we become liberated from it and thus more wholesome. 'Love' translates the Greek *agapate*, which means 'regard', 'treat with proper respect'. Treating those who hate us with proper regard is the best we can do to change their hatred for us into a reciprocal regard for us. This does not mean that we should stop objecting to those who are objectionable. Jesus did not mince his words in rejecting those whom he found doing wrong.

Enriched by self-knowledge that allows us to see ourselves in the totality of our spiritual existence – divided as we always are in our everyday existence into us and the outside world – we can draw on the spiritual riches accumulated by all those outstanding historical personalities who cultivated their souls, the 'I' pole of their existence. Throughout millennia,

the endeavour to become as perfect as is humanly possible found its expression in various conceptions of God. The God of Socrates, Plato, Aristotle, and Jesus calls upon us to achieve our best. Atheists who transcend the homeostatic tendencies of the brain and strive to attain self-perfection deserve our deepest regard. But the widespread atheistic propaganda that intends to save the world by getting rid of God is wrong. Human spiritual nature with its drive to self-transcendence points to God as the end towards which it is outstretched.

---

[i] Plato, *Phaedrus* 230d3-5, tr. R. Hackforth.

[ii] In the *Timaeus* Plato describes the creation of the sense of vision by gods and its function as follows: "And of the organs they first contrived the eyes to give light, and the principle according to which they were inserted was as follows: So much fire as would not burn, but gave a gentle light, they formed into a substance akin to the light of every-day life; and the pure fire which is within us and related thereto they made to flow through the eyes in a stream smooth and dense, compressing the whole eye, and especially the central part, so that it kept out everything of a coarser nature, and allowed to pass only this pure element. When the light of day surrounds the stream of vision, then like falls upon like, and they coalesce, and one body is formed by natural affinity in the line of vision, wherever the light that falls from within meets with an external object. And the whole stream of vision, being similarly affected in virtue of similarity, diffuses the motions of what it touches or what touches it over the whole body, until they reach the soul, causing that perception which we call sight." 45b2-d3, tr. B. Jowett.

[iii] Socrates raises a question whether things we perceive exist in reality: 'Well, there is one dispute about them, especially about sleeping and waking, which you can surely call to mind, can't you?' Theaetetus: 'What sort of dispute? Socrates: 'Something I imagine you've often heard people asking: what evidence one would be able to point to, if someone asked at this very moment whether we're asleep and dreaming everything that we have in mind, or awake and having a waking discussion with each other. Theaetetus: 'Yes, Socrates, it certainly is difficult to see what evidence one should use to prove it; because all the features of the two states correspond exactly, like counterparts. The discussion we've just had could equally well have been one that we seemed, in our sleep, to be having with each other; and when, in a dream, we seem to be telling our dreams, the similarity between the two sets of occurrences is extraordinary. Socrates: 'Well then, you see that it isn't hard to get a dispute going, since there are disputes even about whether we're awake or sleep. What's more, the time we're asleep is equal to the time we're awake, and during each period our minds contend that what seems to be the case at the moment is certainly true; so we spend equal periods of time saying that each of the two sets of things are things which are, with similar insistence in each case.' Plato, Theaetetus 158b5-d6, tr. J. McDowell.

[iv] Stephen Hawking & Leonard Mlodinow, *The Grand Design*, Transworld Publishers, 2011, pp. 62-3.

[v] Hawking & Mlodinow, p. 63.

[vi] Roger Carpenter and Benjamin Reddi, *Neurophysiology, A conceptual approach*, 5 edition, Hodder Arnold, London 2012, p. 9.

[vii] Carpenter and Reddi, p. 10.

[viii] Carpenter and Reddi, p. 252.

[ix] Carpenter and Reddi, p. 9

[x] Carpenter and Reddi, p. 47.

[xi] Jaromír Mysliveček a kol., *Základy neurověd*, TRITON, Praha 2009, p. 55.

[xii] Mysliveček pp. 19-20.

[xiii] Carpenter and Reddi, p. 47.

[xiv] Carpenter and Reddi, p. 294.

[xv] In fact, in Descartes' view the interactions between human beings and the world around them proceed automatically, without any involvement of the human soul. (See Descartes, *Traité de la Lumière*, *Ouevres,* ed. Ch. Adam and P. Tannery, Paris 1897-1909, vol. XI, p. 48.) The world of nature in his view consists of homogenous matter differentiated by motion, rest, and geometrically defined shapes, which make their imprints in the brain; as wax receives the imprint of a seal, so the bodily imagination receives the imprints of objects surrounding the body. (See Descartes' commentary to his twelfth rule, *Ren. Cartesii Regulae de*

*Inquirenda Veritate*, *Ouevres* X, Paris 1908, pp. 412-415.) Memory consists of the retention of geometrical forms imprinted on the bodily imagination. In response to sensory imprints the body moves and acts. Descartes' people talk, laugh, cry, scream with pain, conceive and give birth without any interference of their souls; the functions of the body-machine follow as naturally from the position of its organs, as the movements of a clock follow the disposition of weights and the various wheels of which it is made. (See Descartes, *Traité de l'Homme*, *Oeuvres* XI, pp. 200-202.) This view of nature and the human body compelled Descartes to view the human soul as a completely different entity. As far as sensory stimuli and bodily responses to these are concerned, Descartes' position is in principle identical with Carpenter and Reddi's (c). Descartes' immaterial soul is akin to their X, which has its seat in the brainstem, merely observes, and perhaps just occasionally intervenes.

All Descartes' works, which I have cited, were published posthumously. His world of nature was held in motion by the Earth revolving around the Sun, and just when he was about to publish his work entitled *The World*, composed of his *Treatise on Light* and his *Treatise on Man*, he learnt about the prosecution of Galilei. The Church decree passed in 1620 allowed the contemplation of Copernicus' heliocentric view of the world on the condition that it was not presented as the truth. This is why Descartes placed his world and man into an imaginary space in his *Monde*. The Church decree of 1633 deprived Descartes even of this way of presenting his views to the public.

[xvi] Carpenter and Reddi, p. 294.

[xvii] Carpenter and Reddi, p. 296.

[xviii] Carpenter and Reddi, p. 296.

[xix] Carpenter and Reddi, p. 295.

[xx] Plato, *Phaedo* 96a-c.

[xxi] See Aristotle, *Peri zôês kai thanatou*, *Peri zôiôn geneseôs*, *Peri zôiôn moriôn*, as referred to in H. Bonitz, *Index Aristotelicus*, s.v. *kardia*, i. *animae facultates quae in corde sedem habent*.

The ancients did not have any word for the subconscious, and so the sceptics could argue against the possibility of knowledge as follows: "The argument is compounded of judgements, but compound things cannot exist unless their component elements mutually co-exist, as is pre-evident from the case of a bed and similar objects; but the parts of an argument do not mutually coexist. For when we are stating the first premise, neither the second premise nor the inference is as yet in existence; and when we are stating the second premise, the first is no longer existent and the inference is not yet existent; and when we announce the inference, its premises are no longer in being. Therefore the parts of the argument do not mutually co-exist; and hence the argument too will seem to be non-existent." (Sextus Empiricus, *Outlines of Pyrrhonism*, II. 144, tr. R. G. Bury.) This argument illustrates the narrow straits within which consciousness apprehends the unfolding of speech. As one speaks and as one listens, sentences emerge from the subconscious into consciousness, where they acquire their form, while the posterior part of the train of thought gets submerged into the subconscious. Thus in the interplay between the subconscious and consciousness the understanding of what is said is being constituted.

[xxii] Carpenter and Reddi, p. 253.

[xxiii] Carpenter and Reddi, p. 258.

[xxiv] Descartes appears to have conceived of the nature of light in analogy to a stick, which enabled him to view light as a material potency that acted at any distance at one and the same moment, in his commentary to his Nineth rule, *Regulae*, *Oeuvres* X, p. 402. Cf. Descartes, *La Dioptrique*, *Oeuvres* VI, pp. 83-86 and *Traité d'Homme*, *Oeuvres* XI, pp. 151-163.

[xxv] Carpenter and Reddi, p. 294.

[xxvi] The concepts which we use when we think and speak about objects in the external world form the perceptual 'content' delivered to us by our senses, although we become aware of this only on rare occasions of careful conceptual analysis. The well-known optical illusions, namely 'rabbit and duck' and 'reversible figures and vase', enable us to get a glimpse of the interplay between concepts and the sensory content they encompass. Our concepts of things, plants, animals and human beings permeate everything we perceive by our senses, and everything we perceive by our senses enriches our concepts. Plato realized that human speech presupposes conceptual forms that are prior to any act of speech and as such make speech possible. He says that "human beings must understand according to form that which is spoken for it comes from a multiplicity of perceptions which is brought into one by reason". (Plato, *Phaedrus* 249b6-c1.) Kant realized that our empirical perceptions (*empirische Anschauungen*) are organized (*geordnet*) within the framework of conceptual representations (*Vorstellungen*) of extension and shape (*Ausdehnung und Gestalt*), of space and time (*Raum*

*und Zeit*), which are prior to all our empirical perceptions. (Immanuel Kant, *Kritik der reinen Vernunft*, Felix Meiner, Hamburg 1956, pp. 63-65.)

[xxvii] Carpenter and Reddi, p. 258.

[xxviii] Carpenter and Reddi, p. 258.

[xxix] 'As far as I remember' takes me back some fifty five years, in Czechoslovakia. Inspired by Tolstoy's doctrine of non-violent resistance to evil, I refused military service and was imprisoned. I began my imprisonment by a protest hunger-strike and on the second day was force-fed in the infirmary by a doctor, himself a prisoner, under the supervision of the prison doctor. Since I was a vegetarian I refused to eat meat and so was taken to the infirmary again. The prison doctor ordered extra portions of milk for me. Since the doctor was interested in following my health, I was often in the infirmary. After a few visits the doctor who was himself a prisoner donated to me I. P. Pavlov's *Izbrannye Sochinenia* (*Selected works*) in Russian. Pavlov fascinated me. When I was released from prison, I borrowed from the university library Pavlov's *Sobranie Sochinenij* (*Collected works*) in four volumes, which I read avidly all through. As I followed one experiment after another, I became more and more convinced that Pavlov's attempts to explain the dogs' performances purely in terms of the dogs' brains were faulty. I was particularly impressed by the conditional reflexes induced by visual stimuli. Pavlov would show a dog a circle on a screen for a few seconds then withdraw the circle and after a short period would present the dog with food. After several trials the dog would begin to salivate after seeing the circle on the screen. Pavlov would then present the dog with an ellipsis, the dog would salivate, but no food would come; the food would follow only if the dog was presented with a circle. After a few experiments the dog learnt to differentiate, would salivate only when presented with a circle. Pavlov approximated the ellipsis nearer and nearer to the circle, and thus tested the discriminatory abilities of the dog. – I was convinced that the dog *saw* the circle, *saw* the ellipsis, and I could not see how the dog could *see* these objects inside his brain. Pavlov's experiments compelled me to postulate doggy-X, which saw the circle and ellipses in close connection with and on the basis of the processes in dog's brain.
Since then I have not returned to read any of Pavlov's writings.

[xxx] Carpenter and Reddi, p. 252.

[xxxi] Carpenter and Reddi describe the biochemical mechanism by which the conditioning takes place. As an example they consider 'A and B synapses for Pavlovian conditioning. Both release glutamate, but the receptors under A [activated by the UCS, that is the unconditional stimulus –the food. JT.] are of the AMPA [α-amino-5-hydroxy-3-methyl-4-isoxazole propionic acid] type [ones that require only the presence of glutamate to produce depolarization], and thus always cause excitation, whereas those under B [activated by the CS, that is the conditional stimulus – the ringing of the bell, JT] are – initially – only of the NMDA [N-methyl-d-aspartate] type [with their long-term potentiation or LTP. The principle of their operation is simple … whereas conventional ionic channels are either voltage- or ligand-gated, the NMDA receptor is *both*. The condition for it to penis both that the postsynaptic cell is depolarized, and also that the transmitter, glutamate, is present. If both conditions are met, calcium enters the postsynaptic cell, where it appears to turn on cellular machinery for the manufacture of more glutamate receptors: not NMDA ones, but conventional α-amino-5-hydroxy-3-methyl-4-isoxazole propionic acid (AMPA) ones that require only the presence of glutamate to produce depolarization; existing AMPA receptors are also potentiated. Eventually, if this sequence of events is repeated, the synapse will be strong enough to fire the postsynaptic cell on its own.] Thus in the naïve state, only the UCS [unconditional stimulus] activating A, will cause salivation. Now imagine what will happen during conditioning: A and B frequently fire together, so that the conditions are met (activity of B combined with postsynaptic depolarization) for calcium to enter, triggering the production of AMPA receptors under B. After sufficient training, there will be enough of them for the CS [conditional stimulus] to be able to generate the response all by itself.'

[xxxii] Carpenter and Reddi, p. 248.

[xxxiii] Carpenter and Reddi, p. 64. Mysliveček is much more cautious; he recognizes that 'molecular mechanisms of memory' is 'the sphere which is explored the least'. He describes in detail the long term potentiation on by virtue of glutamate transmission on synapses, refers to defects in cholinergic transmission in connection with memory defects in Alzheimer's decease just as Carpenter and Reddi do (cf. C. & R, p. 288), and undoubtedly rightly maintains that neurotransmitters play an irreplaceable role in the creation of memory traces [or 'memory imprints': 'neurotransmitery mají v tvorbě paměťové stopy nezastupitelnou úlohu'. Mysliveček p. 164.

[xxxiv] Carpenter and Reddi explain synapses as follows: 'Central neurons are driven not by sensory stimuli in the outside world but by the activity of other neurons that make contact with them at specialized regions, the *synapses*. At a typical synapse, a branch of the afferent axon forms a swelling, the terminal *bouton*, the further

side of which forms an enlarged area of intimate contact with the postsynaptic cell body: in the case of the neuromuscular synapse, the *muscle endplate*, this area is much increased by the presence of invaginating folds. In most cases there is a clear *synaptic cleft* between the pre- and postsynaptic membranes, typically some 20nm wide. Transmitter is released from the presynaptic and diffuses to the postsynaptic side, where it causes permeability changes through the various mechanisms already outlined.' (p. 51). Some of the 'mechanisms already outlined' are the following: 'This is a good moment to say hello to calcium, an ion which is used as a form of intracellular communication by very many kinds of cells apart from neurons and muscles. The significance of calcium lies in the fact that its concentration inside cells is normally very low indeed, something of the order of 0.1 μM, because of specific calcium pumps, by its sequestration within the cell, and in some cases because of its storage in organelles that act as internal stores. Because cellular calcium concentration is effectively zero, the sudden appearance of even a tiny amount of free calcium inside is a spectacular event. Often the cell uses this as a means of telling the interior that something has happened at the membrane surface, very like ringing the cell's doorbell. There are two ways in which this signalling can occur. Calcium can enter from outside, through channels triggered either by a transmitter or hormone or by voltage, or these signals may operate indirectly, for instance by causing the production of a second messenger such as inositol triphosphate, that causes calcium to be released from the internal stores … the same transmitter may have quite different effects on different cells: there is no logical or necessary connection between the identity of a transmitter and what it does to the cell – everything depends on what receptors are expressed in the target membrane … in general a receptor "designed" for a particular transmitter will in general also respond to a range of other substances that may mimic the transmitter, or block it by becoming attached but refusing to budge, or in more complex ways.' (pp. 50-51).

[xxxv] See e.g. Mysliveček, p. 21.

[xxxvi] Hawking & Mlodinow, pp. 43-5

[xxxvii] Carpenter and Reddi, p. 274.

[xxxviii] Plato, *Euthydemus*, 283d5-8, tr. B. Jowett.

[xxxix] Plato, *Euthydemus*, 285a6-b7, tr. B. Jowett.

[xl] Aristotle, *On the Soul*, 417a21-b16.

[xli] Plato, *Apology* 29d2-e3, tr. B. Jowett.

[xlii] Aristotle, Metaphysics XII, 1072b13-30, tr. W. D. Ross.

[xliii] Aristotle, *Nicomachean Ethics*, X, 7. 1177b19-34, tr. W. D. Ross.

[xliv] See Liddell & Scott, *A Greek-English Lexicon s.v.*