

Essays on Cognitive Physical Science
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Traditional thinking, physical science, and the brain
An essay about a “Parallel-Systems Mind Model”

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Preface

The main text of this essay starts with traditional sub-Saharan African thinking, and concludes with the author’s “Parallel-Systems Mind Model”. The Parallel-Systems Mind Model is one of the outcomes of the author’s research that is aimed at re-evaluating physical science (i.e. physics and chemistry, in combination with mathematics) from a cognitive perspective (i.e. from the perspective of neuroscience, psychology, evolutionary biology, developmental science, anthropology, and other human sciences), and at drawing conclusions for science teaching to a multi-cultural populace as in South Africa. The particular relevance for South Africa derives from the fact that South African universities, being top-ranked in Africa, are very popular with students from across the continent; also the physical science faculties, where incompatibility with traditional thinking has immediate consequences.

The Parallel-Systems Mind Model is a model of the mind in which the mind is equated to an "ensemble of embodied private conceptual subsystems programmed into a person’s forebrain under evolution-favoured constraints by using information from four sources: own experiences, communicated experiences, own imaginations, communicated imaginations". These private conceptual subsystems are the unavoidable consequence of any individual's development from the foetal stage, thereby constituting the 'parallel systems' referred to in the term Parallel-Systems Mind Model. In general, these parallel private conceptual subsystems are not mutually compatible, but one of them becomes dominant at the adult state. The latter is referred to as 'the' private conceptual system in this essay, but must be understood to be merely the dominant one among two or more.

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Hence, when 'the private conceptual system' is referred to in the essay, it is to be equated not to the mind as a whole, but to the dominant part of the mind.

In this essay, traditional thinking in sub-Saharan African oral cultures is contrasted with traditional thinking in East Asian literate cultures, which has been strongly and lastingly influenced by innovative thinking of wise men such as Confucius and Buddha. I like to think of traditional thinking in East Asia as being a modification of an earlier traditional thinking of the type found in sub-Saharan Africa, and I like to think of the latter as being representative of a proto thinking of man (not only, but also because proto thinking tends to be better preserved in oral than in literate cultures, for the simple reason that in oral cultures, innovative, but unpopular, thinking is soon forgotten after the thinker's demise; the consensual traditional world view prevails). This proto thinking could have arrived from Africa with the migration of early men into Asia. But, being proto thinking, it is more likely to have arisen independently in Africa and Asia, and elsewhere, in different cultures and at different times again and again.

While the same must pertain to Europe, there is no point in trying to retrace the development of the, now superseded, pre-scientific traditional thinking in Europe. Instead, I focus on the singular event of the emergence of scientific thinking in Ancient Greece.

In all of the above, I concentrate on key concepts which are foundational for both traditional thinking and physical-science-based thinking, and which (key foundational concepts) can be directly linked to the physiology of the forebrain and from there to the Parallel-Systems Mind Model. I do this linking as we proceed through the text, first on traditional thinking, then on the comparison of the key foundational concepts, and thereafter on the emergence of scientific thinking, i.e. before I have presented my Parallel-Systems Mind Model in one piece. This is not believed to be a disadvantage, but is seen as a means of gradually making the reader aware of the cognitive background of all of man's thinking and behaviour. The eventual presentation of the complete Parallel-Systems Mind Model will then - so I hope - become an "of-course" experience. This theory explains (1) the formation of man's private conceptual system representing his/her mind-conceived physical "reality", (2) the inherent (largely hidden) drives, limitations, and strategies behind both traditional and science-based thinking, (3) the rise of the latter from the former, (4) the interaction of the conscious and subconscious levels, and (5) the mystification process inherent in both traditional and science-based thinking (which threatens the future development of physics).

The deficiencies that still exist in understanding the interaction of the conscious and subconscious levels of the mind are highlighted by the ongoing discussion about 'free' will (Chapter 7). The Parallel-Systems Mind Model eliminates these deficiencies.

The initial stimulus for this research came from the plausibility deficits which the author had in connection with many "facts of nature" discovered by physical science. It was then, that the idea was born to view these "facts" from a cognitive perspective. Therefore, a critical consideration of at least some of these "facts" is an essential part of this essay. It

precedes the presentation of the Parallel-Systems Mind Model, and must be seen as the beginning of a long process of rethinking of physical science from a cognitive perspective.

A summary of this essay was presented in the form of two seminar lectures at the Physics Department of the University of Pretoria on 29.7.2010 and 5.8.2010 under the respective titles “Traditional Thinking, Physical Science, and the Brain” and “Can Physical Science Do Without the Cognitive Sciences?” Particular aspects of the eight-year research which led to the Parallel-Systems Mind Model have been the subject of eight other seminar lectures between 2002 and 2010.

A word of caution: Presently, the Parallel-Systems Mind Model is at a conceptual state only. It is formulated by a physicist, primarily for physicists and science teachers, by use of concepts and terminology which physicists are not normally accustomed to. Moreover, the author has introduced unconventional concepts and definitions, including an unconventional definition of mind (as specified and elaborated above). The reader should recall this definition of mind, whenever the author refers to either of the terms 'mind' and 'private conceptual system'. No effort has been made to write this essay in compliance with philosophical standards. It has been written for purposes of creating an awareness of the importance of re-evaluating traditional thinking as well as physical science from a cognitive perspective.

A correct cognitive perspective requires the reader to avoid too close an analogy of forebrain and hardwired computer. For instance, the secrets of reasoning are associated with the configuration of the synaptic linkages between neurons in the brain, whence - to use IT terminology - this neural network represents both hardware and software simultaneously. I.e., the physical growth of the network generates passageways for neural signals, and by so doing in a certain configuration, it also generates a programme for dealing with incoming neural signals. This and other significant differences between computer and brain are summarised in an Appendix.

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1. Introduction to mind, witchcraft and folk philosophies

1.1 Some axioms and key features of the Parallel-Systems Mind Model

Every theory rests on some assumptions that either are self-evident to the theorist (not necessarily to others) or are part of the ‘knowledge’ of the theorist’s cultural group, or are simply assumptions of convenience for propping up the theory. The Parallel-Systems Mind Model, to be developed and explained in this essay, makes little distinction between the three, whence I shall make no effort to find excuses for my choice of axioms, except to state that I rest these axioms on the theory of evolution and on the neuro-scientific finding that the secrets of reasoning are somehow associated with the configuration of the synaptic linkages in the brain.

Neuroscience tells us that, from a functional point of view, the brain can be thought of as being subdivided into three parts:

The brain stem, which is responsible for the life functions,
the interbrain, which is responsible for the inherited behaviour, and
the forebrain, which is responsible for the learned behaviour.

Brain stem and interbrain are pre-programmed, while the forebrain is programmable through interaction of the forebrain-carrying creature with its environment. The far-off precursors of man had to make do with small or no forebrains at all, as most of the living creatures in existence to day. The dominant role played by man in every type of environment on earth is proof of the evolutionary advantage of having a large programmable forebrain.

But the evolutionary process has also ensured that the programming of the forebrain is primarily directed towards optimising man’s chances of survival. “Johnnies-Head-in-the-Air” have always been rarities. So, while, on the one hand, the forebrain cannot choose not to think, it is, on the other hand, not free to think just everything. In other words, the forebrain is coached in its self-programming. Exactly how the forebrain is coached into programming itself into this direction is not yet known, but it must be inheritable. And, being inheritable, coaching must remain a dominant characteristic of the self-programming also in an environment in which the constant threat to life is less acute than in the Stone Age.

This forebrain coaching is aimed at enabling every newcomer on earth to avoid challenges to health and life, to satisfy hunger and thirst, and to (eventually) reproduce. The level of coaching is sufficient if the survival of the species is ensured, not that of every individual. Yet, in order to reach this goal, every individual can be assumed to be equipped with a rather similar set of coaching “tools” in his forebrain. Whence I propose as one of my key axioms, that the basic intellectual capabilities of man have remained unchanged from the emergence of homo sapiens. In other words, I propose that the Stone Age had the same share of above-average thinkers as we have today, and that these wise men of old were responsible for the innovations in technology as well as in thinking,

just as today. For purposes of this essay, I am interested in the innovative theorists of old rather than the technologists. And it is these theorists that I have in mind when referring to 'wise man'.

Back to the aims of the coached self-programming of the forebrain (which programme is, in the following, also referred to as mind).

The newborn experiences his/her environment as chaotic. Only some aspects of the mother are familiar from the womb, viz. voice, heart beat, movements, moods. The primary aim of the coached self-programming is to bring order into this apparent chaos. Key to the ordering is to learn how to categorise and to identify causes (based on the categories). To know how to categorise is not unique to man. But the categories that animals have to know (in order to avoid danger and to identify food and mates) is predominantly pre-programmed in the interbrain, rather than part of the coached self-programming of the forebrain, as in man.

The chaos of the initial stages of life on earth becomes unravelled as categorisation progresses, enabling causes of occurrences to be identified in a more general way. This then opens the way for making inferences by analogies and metaphoric reasoning. In fact, inferring by analogy and metaphoric reasoning becomes and remains the key strategy of the forebrain for thinking throughout life. Analogy and metaphoric reasoning is favoured simply because this type of thinking economises the investment of forebrain-available resources (material and energy) for a satisfactory (because plausible) result. At the same time, inferring by analogy and metaphoric reasoning shortens processing time of incoming information (invaluable in a critical situation). And, also for reasons of economic use of resources as well as for faster processing, the forebrain caricatures the incoming information as far as possible. These key forebrain strategies have an important bearing on the topic of this essay, and will be elaborated on at a later stage.

The coached self-programming of the forebrain results eventually (after many years of resources investment) in a configuration of synaptic linkages in the forebrain which becomes manifest as mind² in form of, what I prefer to call, the private conceptual system

² To dispel any misunderstanding about what I mean when I refer to the forebrain or the mind as performing some (evolution-assigned) function, I want this to be understood to refer to the fact that neuroscience has identified the forebrain as being the seat of neural activity for this function, and that the mind is the neural activity itself. And, I use the expression "embodied mind" in the sense of a neural activity involving the organism as a whole, where this neural activity is primarily identifiable with the transmission and interaction of electro-chemical signals within the organism. And, when I associate mind with the configuration of synaptic linkages in the forebrain, then this configuration is supposed to include the contributions made by the interlinked neurons themselves. These contributions, deriving from the genetic material (DNA) within every neuron, attain a strong individual component by the bio-chemical on-off switching of genes due to individual-specific environmental influences (studied in Epigenetics). In other words, the epigenetic behaviour of DNA in neurons contributes in significant measure to the privateness of the private conceptual system.

of the individual. This private conceptual system constitutes the individual's private physical 'reality', his personal view of order of his world.

The structure and contents of this private conceptual system derive from four sources: own experience, communicated experience of others, own imagination, communicated imagination of others. The communicated experiences and imaginations of others are key contributors to a fast-track programming of the forebrain, and have an enormous influence on the private conceptual system of an individual. These communications strongly affect the interpretation of one's own experience as well as one's own imaginations. Without them, the private conceptual system could not benefit from the accumulated knowledge of previous generations; but it could also not be deceived into incorporating the strangest of imaginations.

Again though, there are limitations on how the private conceptual system can develop and, once developed, on how it can be modified. Without going into the details of my theory of conceptual subsystems (to be elaborated as part of the "Parallel-Systems Mind Model" in Chapter 9), here only a few key features: In order for the mental processing of information not to end up in paradoxes, the private conceptual system must be intrinsically self-consistent. This state is sensed as plausibility; departure from this state is sensed as (what psychologists call) "cognitive dissonance" (i.e. mental stress). And, although a private conceptual system can be further developed and modified throughout life, the forebrain tends to resist the incorporation of ill-fitting new information so as to avoid having to find resources for re-establishing overall self-consistency. This resistance is overcome only if resources are readily available (as for full-time students), and if the reward for a reprogramming looks promising (like a university degree).

A drastic re-programming of a self-consistent (and hence plausible) conceptual system is virtually impossible to achieve. Apart from the enormous expenditure of resources for reprogramming (which is certain to be long drawn-out), there is the danger of a neurotic crisis arising from a constant high level of cognitive dissonance and from the associated lack of readiness to decide and act. Small wonder then that an adult will consider his established private conceptual system as his most treasured possession, which it is worthwhile to defend by all means at his/her disposal (even by suicide bombing).

For the structure and contents of the private conceptual system of an adult, and for its further development, it is, thus, of cardinal importance of where the communications comes from during its formative stages. There, the individual has little choice. This information comes from the cultural environment that the individual is born into, in particular from the private conceptual systems of parents and mentors. And, through these, way back from wise men, whose thoughts became popular within the respective cultural group. What has remained of these thoughts is known as folk philosophies.

In oral cultures, where the spoken word is the only means of transmitting thought, exactness of oral communication is of prime importance. But even then, details of the original thought are lost or modified in transmission from one generation to the next. Further on, I shall refer to this process as mystification. Here it is not the mystification

aspect which is of interest, but the diversification that a particular folk philosophy must have undergone when a cultural group has split up, as it certainly has occurred very often in human history. When then, as is the case in sub-Saharan Africa, the folk philosophies of about three thousand tribes are still as similar as they reportedly are, and that after more generations (around 100 000) then anywhere else (Africa being the cradle of mankind) and over so vast and migration-unfriendly a sub-continent, then it is more plausible to suspect these folk philosophies to have arisen from proto-typical thinking of man in different cultural groups and at different times (i.e. independently from one another), rather than in one cultural proto group only. This argument is also supported by the fact that in every new generation there are a number of new candidate wise men eager to spread their own wisdom.

In other words, the self-programming of man's forebrain is coached not only towards bringing mental order into the chaos of perception (viz. by categorising, cause identification, and analogical and metaphoric reasoning), but also towards a folk-philosophical proto thinking of the type found in sub-Saharan Africa. The belief in witchcraft is part of this folk-philosophical proto thinking. And the fact that this belief is of (almost) global extent, is thought to support the idea that traditional sub-Saharan African thinking may be representative of the proto thinking of man everywhere.

1.2 Belief in witchcraft as evidence of proto-type traditional thinking

When finalising this essay, I had, obviously, formed a self-consistent private conceptual subsystem of my Parallel-Systems Mind Model, and of what I intended to convey. In particular, I want the following text to convey my conclusion that the belief in witchcraft in traditional sub-Saharan African cultures is part of a rational conceptualisation of the world as "seen" by wise men of old. And that I view the belief in witchcraft in non-traditional cultural environments (as in Europe, for instance) as (non-rational) mystifications of traditional beliefs.

In April 2010, Professor Claude Mararike of the University of Zimbabwe's Sociology Department presented a paper titled "*Socio-historical analysis of Southern African cultures and linkages to health and well-being: lessons for the "modern" world in addressing HIV*" at an SAfAIDS conference in South Africa, in which he emphasised that everyone engaged in HIV prevention and treatment would have to "understand the cultural circumstances under which the disease or ill-health is caused or is perceived to be caused", and that "we need to harmonise traditional health delivery systems and Western medical systems if we are to successfully prevent and treat HIV within the cultural contexts of Southern Africa". He added that "the problem is not African cultures, but the misunderstanding and misinterpretation of cultures".

The significance for this essay of what Mararike said concerning Western physical-science-based medicine in Southern Africa is that Mararike's statements can easily be generalised to the introduction of modern physical science into traditional Southern

African cultures. Is such a generalisation admissible, and if not, why not? To answer this question, we first need more (in fact, much more) background information.

On a first reading, Mararike appears to emphasise the importance of cultural context in communication between cultures, here those of Southern Africa (from Malawi to South Africa) vs. those of the West. This can surely be subscribed to by representatives of both cultural main streams. On further enquiry, however, it emerges that Mararike, who is also chairman of the Zimbabwe Traditional Medical Practitioners Council, had more in mind than to make the Western medical system more acceptable to rural patients in Southern Africa - as a Western reader would automatically imply. In fact, it turns out that Mararike believes in witchcraft and is actively promoting its acceptance, as does - according to many sources - the majority of the populace in his country.

This emerges from a number of statements of Mararike in 2006, when - in reaction to the 2006 amendment of the Witchcraft Suppression Act of 1899 - he is reported (“The Herald” May 10, 2006) to have lauded the amendment as a recognition that witchcraft does, indeed, exist and is practiced in Zimbabwe. He is also quoted (elsewhere) to have said that “we as Africans recognise the existence of witches and witchcraft”. And he is also reported (again “The Herald” May 10, 2006) to see a number of positive applications for witchcraft, e.g. for the protection of property and crops. Similar sentiments were expressed by Professor Gordon Chavunduka, also a sociologist and former vice chancellor of the University of Zimbabwe, and president of the Zimbabwe National Traditional Healers Association, when he stated (again “The Herald” May 10, 2006) that the amendment was “a giant step in recognising the cultural belief of the majority of the people in the country . . . trampled upon by successive colonial governments”. And an unnamed analyst is quoted (again “The Herald” May 10, 2006) with the view that “by rejecting the existence of witchcraft, whites managed to destroy one of the tenets of African traditional beliefs as a way of disenfranchising the blacks of their religious bedrock”.

The situation in South Africa has been investigated by a Commission of Inquiry for the Northern Province, which reported (Human Sciences Research Council report by Ralushai et al., 1996) that most inhabitants of this province believe in the existence of witches and in witchcraft, and which is quoted (by L. J. Teffo and A. P. J. Roux in P. H. Coetzee and A. P. J. Roux (eds.): *Philosophy from Africa*, Oxford University Press, 1998) with “witchcraft is a factor to be reckoned with in other regions of South Africa . . . witchcraft beliefs occur among people of all levels”.

In an attempt to further check the validity of the alleged - rather sweeping - statement of Mararike “we as Africans recognise the existence of witches and witchcraft”, I interviewed African physical scientists from South Africa, Mozambique, and Zimbabwe, in addition to looking for recent reports of witch hunting. These physical scientists confirmed this statement to be valid for the great majority of the rural populace still steeped in a traditional world view, and one of them did not exclude the possibility that it may apply even to some physical scientists. Mararike and Chavunduka testify to the fact

that the statement is valid for at least some academicians outside the physical science faculties, and, thus, also for urbanites.

And the reports of deadly witch hunts which make it into the media show the phenomenon to be prevalent not only in Southern Africa but in sub-Saharan Africa in general (incl. Nigeria, Gambia, Ghana, Cameroon, Kenya, Tanzania, Central African Republic, Democratic Republic of the Congo), but also in parts of India and Papua New Guinea. The belief in witches is more widespread than the reported incidences of witch hunt, including Islamic cultures in Africa and Asia (in which witch persecution is left to the judiciary), as well as native-American cultures (north as well as south of the equator).

To better understand this information, one must know that anthropologists distinguish between witches and sorcerers, where the latter are seen as those individuals who wilfully, and in full realisation of the intended consequences, invoke their 'magic' to harm others (personally, but also by way of natural disasters), while witches are seen as individuals who harm others without being necessarily aware of their magic power (International African Institute: *African Systems of Thought*, Oxford University Press, 1965). And 'magic' is seen as ritual acts directed towards the influencing of forces that are believed to govern the course of events.

Obviously, magic can be used not only for destructive purposes ('black magic'), but also for productive, protective, and curative purposes ('white magic'). And it is - normally - the task of the witch-doctor ('traditional healer' or 'traditional medical practitioner', as he/she prefers to be called) to apply 'white magic' to offset the alleged harmful effects of 'black magic'. Outside traditional thinking, witch-doctors have acquired a bad name for their choice of 'medicine' (known as charm or muti), which - for increased potency - may include human body-parts. The latest example thereof made it into the South African TV feature "Third Degree" on 15.6.2010, when increasing numbers of deadly attacks on albinos in Tanzania were reported, said to be motivated by the increasing demand for strong muti against, primarily, economic misfortune (such as crop losses and dwindling fish resources).

One can assume that the reference to witches and witchcraft by Mararike, Chavunduka, and the Zimbabwe press includes sorcerers. Therefore, the latter will, in the following, not be referred to separately. The harmful actions of witches (and sorcerers) are seen by traditional thinkers distinct from punitive actions by ancestral spirits who are believed to show in this way their displeasure with poor performance of the living. It is left to the affected to separate the one from the other. And then, there are the resident animistic spirits who react unkindly to disturbance of their localities, and there are wandering spirits with a generally unkind disposition, who can be held responsible for non-recurring misfortunes.

The foregoing background information suggests that the typical traditional conceptual system in sub-Saharan Africa is likely to be at least as tight-nit and self-consistent as the typical conceptual system in the West, which - meanwhile - is predominantly based on modern physical science. Hence, either system has its own plausibility which is not easily

transferable - if at all - from one to the other. This is certain to be part of the reason why Christian missionaries and colonial governments have not succeeded in a wide-spread replacement of traditional thinking by modern thinking (a fact lamented already by Christian missionaries and rulers in pagan Europe). These missionaries and governments underestimated the task; they were not aware of the fact that a private conceptual system, once established, can - for biophysical reasons - not be drastically reconstructed, let alone be completely replaced. For these same reasons, an individual's private conceptual system is his/her most treasured possession, which the individual is neither inclined nor free to give up. In other words, a traditional-thinking-based private conceptual system cannot simply be replaced by an alternative conceptual system that is non-compatible with the former (as evidenced by the declarations of the Zimbabwe academicians).

From this point of view, one can understand the reported lament that "by rejecting the existence of witchcraft, whites managed to destroy one of the tenets of African traditional beliefs as a way of disenfranchising the blacks of their religious bedrock", where it is not so much the religious bedrock that the indigenous peoples have been 'disenfranchised' of, but rather the secular bedrock of their traditional world view. And, of course, the indigenous peoples have not really allowed themselves to be disenfranchised; why else would the traditional belief still be so wide-spread. Rather, traditional peoples have managed to Africanise the new Christian and Islamic religions; very much like pagan European belief has left its distinct mark on original Christian teaching, and traditional Chinese belief has left its mark on original Buddhist teaching (e.g. in Mahayana Buddhism).

When considering the belief in witches and witchcraft as evidence of proto-type traditional thinking, one must look at the phenomenon in the wider context of belief in supernatural powers in general and spirits in particular; be they gods, ancestral spirits, animistic spirits, wandering spirits, angles, saints, the Devil, and the like. And this belief in spirits is indeed a global phenomenon. In fact, it is one of the so-called 'universals' that ethnologists and sociologists are looking for in different cultures right across man's history.

Of significance here is the observation that in East Asia (e.g. in China, Vietnam, Korea and Japan), where the belief in ancestral, animistic and wandering spirits is wide-spread and rather openly admitted, the belief in witches and witchcraft is insignificant compared to other parts of the world. This is evidenced, for instance, by the typical traditional approach to medical treatment in these parts of Asia. According to Oskar Weggel (*Die Asiaten*, Beck, 1990), this approach is holistic rather than specific, in that pharmaceutical (herbal) as well as magic treatment is combined in which an influence by witches is not at all considered. Rather, the illness is seen as a disturbance of the patient's inner and environmental-related equilibria, best treated by re-establishment of these equilibria, certainly not by the identification of witches.

In pagan Europe, the belief in spirits, witches and witchcraft has - according to historians - been a commonplace idea in pre-Christian religions. The belief in witchcraft was repudiated by early missionaries such as Boniface (just as it was repudiated by later

Western missionaries in Africa). And Charlemagne is reported to have decreed that the burning of supposed witches was a pagan custom that would be punished by the death penalty. Yet the belief in witchcraft has remained an influential part of European cultures until the Renaissance. And the Church partook in the frenzy of witch hunting in the 14th and 15th centuries, after the witchcraft repudiation in Canon law of the early years was repealed (in 1320 to be exact).

There are obvious parallels thereto in the more recent history in certain parts of sub-Saharan Africa, even as regards participation of clergy in witch hunting (for instance, Christian pastors in Nigeria are reported to have been implicated in the torturing and killing of children accused of witchcraft). In other words, European history repeats itself in sub-Saharan Africa, and probably also in India and Papua New Guinea. An apparent difference between sub-Saharan African and European witches would seem to be that traditional African thinking acknowledges that witches are not necessarily aware of their magic powers, whereas European witches were forced under torture to admit their wilful partnership with the Devil. In other words, in traditional African thinking, witches are regarded as being - unintentionally and unawares, temporarily or permanently - in a psychological state with unfavourable consequences for the community.

It has been suggested that the real driving force behind witch hunting in sub-Saharan Africa is envy, i.e. envy of the better fortunes or fewer misfortunes of certain members of the family or tribe. While it is true that it is common for a witchcraft “victim” and his witch-doctor to suspect an individual from his/her close environment (members of the “victim’s” family in particular) of being the witch responsible for his/her ills, envy would appear to be too simple an explanation, which seriously underestimates the rationale of traditional African thinking. Rather, one must see this rationale to be essentially similar to that of East Asian thinking. And that is that all members of a family or tribe live under the same (social and physical) environmental conditions, whence fortunes and misfortunes should be shared by all in equal measure. Hence, both the fortune-favoured and the misfortune-plagued individual is out of harmony with his environment, with the social environment in particular. The fortune-favoured individual solves this problem by sharing his fortunes with family and tribe. The misfortune-plagued individual requires treatment. In East Asia by restoring his inner balance (of yin and yang in Chinese philosophy), in sub-Saharan Africa by the warding-off of external causes, preferably witches. That these witches are often suspected to be among those better-to-dos who are reluctant to share, is not surprising.

In Chapter 2 (Aspects of folk philosophies in East Asia) I refer to the East Asian tendency to think contextually and to shy away from confrontational discussion and from seeking fault with others rather than with oneself, and that I regard this tendency - according to the Parallel-Systems Mind Model - as untypical of proto thinking of man. I also explain why I hold Confucianism responsible for the East Asian departure from proto thinking. Identifying a witch means putting blame on others, and is typical of a proto thinking in which external influences are held responsible for one’s own misfortunes. Hence, for proto thinking the following picture emerges:

- The belief in supernatural entities in general and spirits in particular is a global phenomenon.
- The belief in supernatural power (of various degree) being possessed by supernatural entities, including spirits, is associated therewith.
- The belief in human ability to counter evil influences of spirits is also global (traditional healers).
- The belief in witches (the living equivalent of spirits), being gifted with certain supernatural power, is a logical consequence of these beliefs.
- The belief in witches is a consequence of man's inclination to find fault with others rather than oneself.
- The failure of a traditional healer in his (further) function as a witch-doctor (i.e. to counter the evil influence of a witch) may trigger individual or communal counteraction (witch-hunt).

In Chapter 3 (Aspects of folk philosophies in sub-Saharan Africa) I focus on the folk philosophical background of the belief in witches and witchcraft, emphasising the premise that the thinking which led to a folk philosophy was systematic and critical with respect to the body of knowledge available at the time. One cannot claim, therefore, the mental causal link established in traditional thinking between a particular misfortune and a witch to be - within the prevailing cultural contexts - more arbitrary and less logical than causal links established within modern juridical argument and within modern physical science; in particular when juridical argument relies on circumstantial evidence, and when physical science relies on indirect evidence. In fact, in court cases against witches in medieval Europe, the juridical argument advanced by the state or church was - within the cultural context of the time, and on average - not lacking anything of the logic and rigour that one finds in courts of today. The essential difference between then and now is that the cultural context has changed to a point where circumstantial evidence has been significantly downgraded against what is considered to be direct evidence. But even this "direct" evidence will, in the following, be seen to be lacking persuasiveness when considered from a cognitive point of view

2. Aspects of folk philosophies in East Asia

2.1 Why East Asians do not believe in witches and witchcraft

To quote a passage from sub-chapter 1.2 re. social traditional thinking in East Asia and in sub-Saharan Africa: All members of a family or tribe live under the same (social and physical) environmental conditions, whence fortunes and misfortunes should be shared by all in equal measure. In East Asian traditional thinking, both the fortune-favoured and the misfortune-plagued individual is out of harmony with his environment, with the social environment in particular. The fortune-favoured individual solves this problem by sharing his fortunes with family and tribe. The misfortune-plagued individual requires treatment. In East Asia by restoring his inner balance (of yin and yang in Chinese philosophy), in sub-Saharan Africa by the warding-off of external causes, preferably witches.

The question is of why East Asians believe in the inner imbalance theory, whereas elsewhere the existence of witches were or are still being invoked. A plausible explanation is that the strong influence of Confucian (secular rational) teachings in China and its conquered territories (Korea, Japan) discouraged the belief in witches (which must have existed as part of proto thinking, prior to Confucius). Confucius, 551 to 479 BC, was the most influential of all Chinese philosophers, as important to the thinking of East Asians as were the contemporary Ancient Greek philosophers to the thinking of Europeans. In fact, Confucian ideas became the moral and political doctrine of the state with the rise to power of the Han Dynasty in 206 BC, and during the Tang Dynasty (618 to 907) they became the basis of the civil service examinations for administrative office. Thus, Confucian ideas took hold in Chinese society long before the physical-science ideas of Ancient Greece took hold in Europe. And, the Confucian ideas were imposed by the state, whereas the physical-science ideas were - in collusion with the Church - long suppressed by the state.

Confucius was not a religious person, and he discouraged reverence for spirits, though he favoured reverence for ancestors. The belief in witches was not part of his world view. He formulated rules for society, which were designed to avoid conflict by a harmonious coexistence both within the family and the state. He saw conflict avoidance within the family - by solidarity, but also by respect of elders by their children - as exemplary for conflict avoidance within the state. His most famous rule, known as the Golden Rule, a precursor to Christian teaching as well as Kantian philosophy, recommends to never impose onto others what one would not choose for oneself. In other words, at least since Confucius, conflict avoidance within the family was achieved by earliest possible provident education emphasising the own contribution to harmony, instead of by later rectifying action which seeks the fault with others. And witch hunting can, indeed, be seen as such a rectifying action.

Buddhism, which originated in India at about the same time as Confucianism in China and which, nowadays, is the foremost religion in East Asia, has also no place for witches

in its philosophy. While rejecting the idea that the world is created and ruled by a God (www.religionfacts.com), the branch of Mahayana Buddhism (the other - more traditional - branch being Theravada Buddhism) accepts that there may be sub-supreme supernatural entities such as dedicated gods, deities, spirits, angles, and the likes. These are said to originate from Hinduism as well as other cultures which adopted Buddhism (e.g. China, Tibet, Thailand). While not as specific as Confucianism about how individuals should behave towards one another in the interest of maximum harmony, also Buddhism encourages harmony for the purpose of reducing and - eventually - eliminating “dukkha”, which translates as suffering, pain, sorrow, affliction, anxiety, dissatisfaction, discomfort, anguish, stress, misery, and frustration (Wikipedia).

It is not surprising, therefore, that - in contrast to Western custom - in East Asia the interest of the individual is not supposed to take preference over that of others in general, and that of the family or community in particular; whence the focus on human rights of the individual in the West is often regarded as misguided. Leaders should arise from a harmonious social interaction, not from an individual craving for power. This is an experience which Westerners make again and again in joint committee work with Chinese or Japanese delegates, where in discussions the latter take care that the opponents “safe face” at all times, whereas Westerners entertain a culture of confrontational discussion (“I am right and you are wrong.”). This tendency towards confrontational discussion, and towards seeking fault with others rather than with oneself is not only typical in the West, but is common outside of East Asia in general. In fact, this tendency can be explained in terms of the Parallel-Systems Mind Model, making it a characteristic of proto thinking, and leading one to conclude that state-enforced Confucian secular teaching together with Buddhist religious teaching made the witchcraft aspects of proto thinking redundant in East Asia.

In the West, belief in witches and witchcraft - associated with the church-sanctioned religious concept of the Devil - survived much longer than in East Asia, and legislation against the belief was not effective as long as physical science, with its emphasis on natural explanations, did not completely permeate primary school teaching. The examples of East Asia and the West show that elimination of the belief in witches and witchcraft depends on exposing the child to a teaching aimed at establishing a private conceptual system which can do without this belief, be it the East Asian way (Confucianism-Buddhism) or the Western way (physical science). The encounter of traditional cultures with Christianity and Islam was obviously less successful for eliminating the belief in witches and witchcraft.

2.2 ‘Physical’ and metaphysical traditional thinking in East Asia

The distinction between physical and metaphysical thinking depends on one’s point of view. To a traditional sub-Saharan African thinker, witches and witchcraft are real, hence both are physical and not metaphysical. To a traditional East Asian thinker, demons are real, hence they are physical and not metaphysical; but witches and witchcraft are metaphysical. I have chosen to treat ‘physical’ and metaphysical traditional thinking

together without attempting a classification. And I am referring to those aspects only which have a bearing on, either or both, the establishment of a private conceptual system and the introduction of physical science into traditional cultures.

The self-limitation of self-interest and the respect of elders in Confucian thinking has certainly helped to avoid conflict, but has put East Asia for long at a disadvantage in the area of scientific innovation (where critical original thinking by young scientists is an important factor). This disadvantage has been increased by another corner stone of Confucian thinking, viz. that everything is interlinked with everything else, and that the truth cannot be found by looking at a single object or experience in isolation. This view is also contained in the Impermanence Doctrine of Buddhism, which alleges that all objects and experiences are inconstant, unsteady and impermanent, are constantly coming into being and ceasing to be. Thus, Confucianism and Buddhism alike account for a holistic in-context³ thinking in East Asia instead of the analytical in-isolation thinking of the West.

That this holistic in-context thinking must have significant consequences for, either or both, the establishment of a private conceptual system and the introduction of physical science into traditional cultures, is obvious. Psychologist Richard E. Nisbett (*The Geography of Thought*, Free Press, 2003) refers to this in-context thinking as a wide-angle view of the world by East Asians, contrasting it with what he calls a tunnel vision of Westerners. His choice of terminology derives from the fact that Westerners tend to focus on one conspicuous aspect of a composite sensory experience (event, image), often with complete disregard for context, whereas East Asians observe this same aspect in context. This characteristic of East Asians includes social context, of course. Surprised by the self-centred behaviour of European American spectators with regard to those seated behind them, a Japanese student of Nisbett told him that in Japan everyone learns from an early age to make sure that what one does, does not impinge on the pleasure and convenience of others. This considerate attitude is not only uncommon in the U.S., but throughout the West, and also in sub-Saharan Africa.

This wide-angle view of the world by East Asians gives (so Nisbett) rise to the notion that the world is a complex place (composed of continuous substances), understandable in terms of the whole rather than in terms of the parts, and unlikely to be subject to personal control. In contrast, the tunnel vision of the Westerner gives rise to the notion that the world is a relatively simple place (composed of discrete objects), that can be understood without undue attention to context, and highly subject to personal control (“I can take charge!”). The implication (again Nisbett) is that, in East Asia, the categorisation of objects according to object-specific attributes is of lower importance than in the West, whereas the interdependence of objects from different categories is of higher importance than in the West.

³ The term ‘context’ in this essay to be understood in the Oxford-Dictionary sense of ‘circumstances in which an event occurs’, whence an in-context type of thinking is one in which the circumstances are given as much consideration as the event itself.

The context concern of East Asians also has the consequence (so Nisbett) that any attempt at de-contextualising any item under consideration is met with distrust; whence abstract theories, in general, and formalised rules, like in logic, are disliked. To quote Nisbett, “East Asians are more likely to set logic aside in favour of typicality and plausibility of conclusions. They are also more likely to set logic aside in favour of the desirability of conclusions”, where “more likely” is intended to mean “more likely than Westerners”.

Directly related to the context concern of East Asians is what I like to call a ‘contradiction tolerance’ of East Asians as opposed to a ‘contradiction intolerance’ of Westerners. Nisbett describes the phenomenon as deriving from the East Asian Principle of Contradiction, which proposes that contradictions, oppositions, paradoxes and anomalies are continuously being created because the world is constantly changing (as mentioned earlier). In East Asian view, therefore, there is no escape from contradictions, and the best way to deal therewith is to tolerate contradictions and to find a Middle Way between contradictions. Modern Western philosophers (Hegel in particular, but also Marx) felt the need to modify this ‘Eastern dialectics’ into a ‘Western dialectics’ of Thesis-Antithesis-Synthesis structure intended to eliminate the contradictions (thesis and antithesis) in favour of a single substitute for both (the synthesis)⁴. In other words, Westerners are not prepared to suffer the contradictions; they are contradiction-intolerant.

Applied to the (in the West) much discussed dual physical behaviour of light (as a wave, but also as a particle), one would expect the (contradiction-tolerant) East Asian to have less of a problem with this behaviour than a (contradiction-intolerant) Westerner. And, the former may consider the controversial discussion of Western physical scientists about the Copenhagen Interpretation of quantum behaviour as ‘much ado about nothing’.

We now turn to the effect of context concern of East Asians on their views about causality. Nisbett generalises from a number of examples by stating that “Chinese are inclined to attribute behaviour to context, and Americans tend to attribute the same behaviour to the actor”, where Chinese are representative of East Asians in general, and Americans are meant to be European Americans. Nisbett quotes a study by historian Masako Watanabe about the teaching of historical events in Japan and in the U.S.. Because of the emphasis on context rather than actors in Japan, the detailed description of the initial and final situation is vague about any specific chain of causes for a given (again contextual) outcome. The description is in chronological order. In the U.S., the chronological order is reversed and the context is minimised by putting emphasis on a definite causal chain which is retraced from a chosen outcome backwards in time.

In other words, the “certainty” of the Western mind about the actors in a chain of events, and the technique of time reversal allow this mind to “identify” any cause at any point in the past. This is how modern physical science has - on assumption of a linear history -

⁴ The Parallel-systems mind model rejects both forms of dialectics for incompatible private conceptual systems. The recommendation is to accept the East Asian Principle of Contradiction without compromising either in an attempt to find a Middle Way. One of the incompatible private conceptual systems will become dominant in time.

come to the hypothesis of a Big-Bang start of our Universe. The context concern of East Asians would not allow such bold reasoning.

Another complication re. causality arises from the fact, reported by Oskar Weggel (*Die Asiaten*, Beck, 1990), that teleological thinking as typical for Central and East Asians. In other words, the cause of an event may lie not only in the past (as taken for granted in Western scientific thinking) but also, alternatively, in the future; a certain pre-determined outcome may require a certain event to occur now. The spectrum of causes considered by East Asians is much wider than in Western scientific thinking. To quote an example given by Weggel: A broken dam may be attributed to (1) shoddy work, (2) the wrath of a local demon, (3) bad government (in the sense of a disturbance of universal harmony), (4) Karma (merit-and-demerit accounting over all previous existences, when Buddhists or Hindi are involved), and (5) unfathomable divine decision; the explanations in brackets being mine.

A central concept of modern physical science, intimately related to causality, is 'chance occurrence'. Weggel concludes that in a holistic worlds view (in which everything is believed to be linked with everything else), there is no place for chance occurrence in a Western scientific sense. I am not persuaded by this conclusion, however, for the simple reason that also in a holistic world view there must be allowance for linkages ranging from very close and direct to very remote and indirect. Hence, there must be at least some events which cannot really be linked in a cause-vs.-effect sequence.

Despite these rather significant differences between traditional East Asian and physical-science-based Western thinking, physical science teaching appears to be successful in East Asia. I know too little about science teaching in East Asia to advance a definite reason for this success. Weggel emphasises the fact that learning by heart is the preferred way of learning throughout East Asia. This is, of course, also a form of collateral learning (refer Chapter 6, Introduction of physical science into traditional cultures) as proposed by the Parallel-Systems Mind Model, in which physical science is established as a second private conceptual subsystem in parallel to the dominant traditional private conceptual system. This explanation appears plausible to me (obviously!), because it agrees with the Parallel-Systems Mind Model.

I left Brahmanism, Hinduism, Daoism and other Asian 'isms' out of my considerations for Asia, because the point about the otherness of thinking in traditional cultures in Asia has been made.

3. Aspects of folk philosophies in sub-Saharan Africa

3.1 'Physical' and metaphysical traditional thinking

The introductory remarks of sub-chapter 2.2 (1st paragraph) pertain.

Traditional sub-Saharan African cultures are oral cultures. As pointed out earlier, in oral cultures, traditional thinking in the form of folk philosophies tends to remain mainstream for much longer than in literate cultures. That is because in oral cultures, innovative, but unpopular, thinking is soon forgotten after the thinker's demise; the consensual traditional world view prevails. In literate cultures, the innovative thinker comes to prominence sometimes long after his death, like the atomists of Ancient Greece, who laid the foundation of modern physical science, causing traditional thinking to take a significant turn in Renaissance Europe. East Asia would seem to provide examples of traditional thinking having become "upgraded" already during or soon after the thinkers' lifetimes, in the persons of Confucius, Gautama Buddha, and others.

Sub-Saharan Africans have not been that "lucky", but have nonetheless survived all challenges without departing from traditional thinking. In particular, they were not subjected to Confucian and Buddhist teachings, which would seem to be (as suggested earlier) responsible for the focus on context of East Asians. Therefore, focus on context as in East Asia should not be - and is, indeed, not - found in sub-Saharan Africa.

Traditional sub-Saharan African cultures must have had their own wise men of old, who felt compelled and able to formulate plausible conceptual systems of their worlds, and which conceptual systems, in time, turned into folk philosophies. It can be assumed that the thinking which led to a folk philosophy was, at its conception, both systematic and critical with respect to the body of knowledge available at the time. And any notion which equates folk philosophies with "beliefs not subjected to systematic and critical analysis" (philosopher Kwame A. Appiah in P. H. Coetzee and A. P. J. Roux (eds.): *Philosophy from Africa*, Oxford University Press, 1998) underestimates the homo-sapiens-typical brain-inherent drive for a comprehensive and self-consistent conceptualisation of the world.

The notion is wide-spread that the folk philosophies of the oral cultures of sub-Saharan Africa can be lumped together into one overall folk philosophy for the sub-continent. This is an oversimplification of the facts, contributed to by early anthropologists by generalising from punctual observation (by, for instance, referring to "the African", when, in fact, reporting about the Akan). John S. Mbiti (*African Religions and Philosophy*, Heinemann, 1989), in particular, laments this generalisation by pointing out, that there are about three thousand African tribes, with everyone of them having its own system of thought.

Mbiti explains this state of diversity of thought by pointing out that the great number of beliefs and practices found in any African society are not formulated into a systematic set

of dogmas, but that “people simply assimilate whatever religious ideas and practices are held or observed by their families or communities”, where “each generation takes them up with modifications suitable to its own historical situation and needs”. Another reason for the diversity of thought is, according to Mbiti, that “traditional religions have no missionaries to propagate them”, “there is no conversion from one traditional religion to another”, and “a person has to be born in a particular society in order to assimilate the religious system of the society to which he belongs”.

At this stage, I must take issue with Mbiti over the fact that he refers to the African systems of thought as religious systems, my argument being that use of the term ‘religious’ implies that the objects of these systems are supernatural. They are supernatural in Western thinking, of course, but in African thinking they are as real as is, for instance, energy in Western thinking (i.e. everyone believes in its existence, and even pays for it, though no one really knows what it is). That Mbiti himself may be aware of this problem can be inferred from his statement, “Because traditional religions permeate all the departments of life, there is no formal distinction between the sacred and the secular, between the religious and non-religious, between the spiritual and the material areas of life”. And, again Mbiti, “A person cannot detach himself from the religion of his group, for to do so is to be severed from his roots, his foundation, his context of security, his kinship and the entire group of those who make him aware of his own existence”. This last statement applies more to one’s conceptual system of physical ‘reality’ than to one’s religious beliefs.

My point about the African systems of thought being folk philosophies rather than religious systems is also supported by another statement of Mbiti’s, viz. that “African religions have neither founders nor reformers”. And that, because religious founders tend to be remembered, wise men of old not. Further support for my position comes also from Mbiti, when he reports that although “belief in the continuation of life after death is found in all African societies, this belief does not constitute a hope for a future and better life”, “the soul of man does not long for spiritual redemption, or for closer contact with God in the next world” (which, by the way, is “conceived in materialistic and physical terms”). Rather, “to live here and now is the most important concern of African religious activities and beliefs”. This may have been the reason, why the acceptance of Christianity was pragmatic rather than enthusiastic; a second after-life insurance, so to speak.

At this stage, a brief reflection on Mbiti’s reasons for the diversity of thought, in general, and the lenient attitude of Africans towards this fact, in particular, is in order. This attitude is significantly different from that of Westerners. Namely, whereas in the West, theological as well as scientific thinking is stringently disciplined either by dogmas or by the definitions and laws of physical science, African thinking is not disciplined nearly as stringently. In other words, the African is tolerant of deviations from his own world view, while the Westerner is not. Although African traditional thinking entertains no Principle of Contradiction as East Asian thinking does (see Chapter 2, Aspects of folk philosophies in East Asia), one can describe the African attitude as pragmatic rather than theoretical, as intermediate between the ‘contradiction tolerance’ of East Asians and the ‘contradiction intolerance’ of Westerners, and of (and that of importance here) the

‘contradiction intolerance’ of physical science. This pragmatic attitude is likely to be a complicating factor in the introduction of physical science into traditional sub-Saharan African Cultures.

After having quoted Mbiti at length on why there is a diversity of African folk philosophies, we now return to the common elements, of which there are surprisingly many, as even Mbiti admits. In the words of philosophers L. J. Teffo and A. P. J. Roux (in P. H. Coetzee and A. P. J. Roux (eds.): *Philosophy from Africa*, Oxford University Press, 1998), “We argue that metaphysical thinking in Africa has features which make it a particular way of conceptualising reality”. And it is exactly these features which have to be identified for purposes of this essay, and which point to this “ particular way of conceptualising reality” as proto thinking.

These common features are not always easy to come by. Firstly, the folk philosophies have been “preserved” in works of art and in verbal form, the latter primarily in educational sayings and educational tales, which are all open to different interpretations. In other words, the folk philosophy of a tribe is actually an ensemble of the private philosophies of the individual tribesmen. The construction of a representative folk philosophy from these private philosophies is about as effective as would be, for instance, the reconstruction of Marxist dialectics from the discussion at meetings of the Communist Party in the absence of a written form of language. Secondly, the overwhelming majority of anthropological research findings of colonial and post-colonial times come from researchers of foreign origin, who came with their own ready-developed Western-culture-biased private conceptual systems, reliably communicable only in their respective home languages. What they understood of the indigenous concepts, and then translated into their home languages, gave - of necessity - rise to rather different reports. Yet, there is satisfactory agreement on the following to be considered as common features. One must concede, however, that what is said may be more correct for some individuals than for others, more correct for rural than for urban populace, more correct for some tribes than for others, more correct for West Africa than for Central, East or Southern Africa.

One of the common characteristics of African world views is (naturally) the man-centred outlook, and the belief in a hierarchical order of objects of sensory perception (man, animals, plants, non-biological environmental objects) as well as objects of thought (God, spirits). Mbiti, who has field-researched in East Africa (Uganda, Tanzania and Kenya), classifies these objects into five categories as follows, in order of their diminishing importance or rank:

- God, “the ultimate explanation of the genesis and sustenance of both man and all things”;
- Spirits, “extra-human beings and the spirits of men who died a long time ago”;
- Man, “human beings who are alive and about to be born”;
- Animals, plants and the remainder of biological life;
- Phenomena and objects without biological life.

This classification is conspicuous for the absence of spirits of men who died not a long time ago, but more recently. One must know (Placide Frans Tempels: *Bantu Philosophy*, Présence Africaine, 1959), that the men who died a long time ago are extraordinary because they had the distinction of being the first men to be created by God. Hence, those born and deceased thereafter are ordinary ancestors of a lower rank, and have to be inserted as a separate category “spirits of deceased ordinary ancestors” in third place. This adapted (now) six-level hierarchy, reported in similar form by various researchers also for West, Central and Southern Africa, is of importance for subsequent elaborations:

- God, the ultimate explanation of the genesis and sustenance of both man and all things;
- Spirits, extra-human beings and the spirits of the first-created, and hence extraordinary, ancestors;
- Spirits of deceased ordinary ancestors;
- Man, human beings who are alive and about to be born;
- Animals, plants and the remainder of biological life;
- Phenomena and objects without biological life (henceforth referred to as ‘mineral’).

Mbiti adds, “In addition to the five (now six) categories, there seems to be a force, power or energy permeating the whole universe. God is the source and ultimate controller of this force; but the spirits have access to some of it. A few human beings have the knowledge and ability to tap, manipulate and use it”. These include traditional healers, priests, sorcerers, witches, rainmakers. Small wonder, that Europeans, who came with steam ships, automobiles and rifles, were considered as sorcerers and witches.

The “universe-permeating force” which Mbiti refers to here, was not elaborated on by Mbiti. But it turns out to be of cardinal importance for purposes of this essay. In order to learn more about it, we now turn from (Mbiti’s) East Africa to Central Africa and to a book by missionary Placide Frans Tempels (*Bantu Philosophy*, Présence Africaine, 1959), which, since its first appearance in French in 1945, is considered a milestone of research on African thinking, not only for Central Africa. Since it continues to be referred to by researchers to this day, including African philosophers, and its main findings are not disputed, I have no hesitation to use it as a major source of reference. Because Tempels had worked for 12 years in the Congo region prior to publication of his book, his findings pertain essentially to Central Africa. In fact, Mbiti doubts that Tempels’ key findings are relevant for East Africa.

Tempels, on the other hand, refers to reactions of support from fellow missionaries, who confirmed his findings for Central Africa, but also from anthropologists, who detected significant similarities to their own research findings for West Africa, as well as for Haiti, Brazil, and Surinam (among the population of West African origin). Anthropologist Geoffrey Parrinder, who is a much-cited author on traditional thinking in West Africa (*West African Psychology*, Lutterworth, 1951) has no doubts about the validity of Tempels’ findings also for West Africa. And Tempels cites an earlier book by linguist and anthropologist Diedrich Westermann (*The African Today and Tomorrow*, Oxford University Press, 1939), which came to his attention only after publication of his book,

and about which he said to have “had the very agreeable surprise of finding in it the fundamental principles of my theory of forces”. And, South African theologian Gabriel M. Setiloane reports very similarly about Southern African folk philosophies (*African Theology*, Skotaville Publishers, 1986).

Central to Tempels’ book is the “vital force” thesis and the ‘theory of muntu’. The “vital force” thesis of Tempels alleges that for the Bantu (of Central Africa) the nature of ‘being’ is something which, for want of a more appropriate term, is translated as “vital force”, where this force is in an identity relationship with ‘being’ such that “force is being, and being is force”. Other English translations for this African concept are strength, life, vital energy. From the context it can be assumed that the term ‘being’ is used not in the sense of existence as such, but in the (Oxford-Dictionary) sense of ‘something that exists and has life, especially a person’. For Westerners to come to grips with this African concept, it is necessary to circumscribe it by means of the properties ascribed thereto, and by contrasting it with the Western understanding of being. In order to call to mind the identity between ‘vital force’ and ‘being’, Tempels also uses the term ‘forcebeing’. All three of these terms are used in the following.

According to Tempels, the creation of a new being at its conception is identical with the gift of a new vital force by the supreme being (God). The outward manifestation of this vital force can appear to be strengthened or diminished due to interaction with other vital forces, but it can never again cease to exist (except by God’s will). To quote Tempels, “Existence which comes from God cannot be taken from a creature by any created force”. This new being or new vital force is, however, not thought of as a separate, independent individual in the Western sense. Rather, the new being becomes part of an interacting universe of beings, i.e. the new vital force becomes part of an interacting universe of vital forces. Tempels, “Nothing moves in this universe of forces without influencing other forces by its movements”. (This is not unlike the concept of ‘field’ in modern physical science.)

Different vital forces in the universal web of vital forces are not, however, of equal magnitude (as a physicist would say) or of equal power (as expressed by Tempels), but the magnitude is ranked, viz. coarse-ranked in accordance with the six-level hierarchy shown above (with God’s vital force being of unlimited magnitude), and finer-ranked within each of the five discrete levels below God. For man, the intra-level ranking extends from the tribal chief or priest or healer down to the youngest child. Tempels, “The older force ever dominates the younger”. Within the family, the progenitor’s vital force exceeds that of the progeny. Among the progeny, the first-born vital force exceeds that of the later-born. And, at the progenitor’s death, it is the eldest male progeny, the new family head, who inherits also - according to the principle of primogeniture - the vital force of the dead forbear. According to Tempels’ description, it would appear that the “upgrading” of the new family head’s vital force would depend on the dead forbear’s willingness to share, from the beyond, the vital force which he took with him into the beyond. That is why ancestor “contact” and worship is of “vital” importance.

Tempels has identified three “laws” governing the interaction of forcebeings. Tempels calls these the General Laws of Vital Causality. In Tempels’ words,

1. “Man (dead or living) can directly reinforce or diminish the being (the vital force) of another man.”
2. “The vital human force can directly influence inferior forcebeings (animal, vegetable, or mineral) in their being itself.”
3. “A rational being (spirit, ancestral spirit, or living) can act indirectly upon another rational being by communicating his vital influence to an inferior force (animal, vegetable, or mineral) through the intermediacy of which it influences the rational being. The lower force is excluded from exercising by its own initiative any vital action upon a higher force.”

So much on the hierarchical interaction of forcebeings. Because life is considered to be a continuous interaction of vital forces, Tempels regards the African concept of ‘being’ as dynamic, whereas he sees its Western equivalent as rather static in comparison. Translated into the terminology of modern physical science, Tempels could have said that for (Central and West) Africans, ‘being’ is at all times in a state of unstable equilibrium, whereas for Westerners it is most of the time in a state of stable equilibrium.

The African concept of vital force is closely associated with the concept of “muntu” (a term in the Baluba language of the Congo region where Tempels undertook his researches). Tempels calls his ‘theory of muntu’ also ‘Bantu psychology’, thereby suggesting that the concept of ‘muntu’ is of overriding importance in the study of the mind of the Bantu (here that of the Bantu of the Baluba language group). Again, there is a problem of translation of ‘muntu’ into English. Tempels calls it “the person”, but also “an active causal agent who exercises vital influence”.

From Tempels’ further circumscriptions I tend to the translation ‘charisma’, which in English (Oxford Dictionary) stands for ‘power to inspire devotion and enthusiasm’, but which in African thinking is actually much more, viz. ‘power to influence, by means of one’s own vital force, all other vital forces which according to the (above) six-level hierarchy of ranking are of equal or lower vital force’. This reduces to the Westerner’s understanding of charisma only when it comes to man-man interaction, and then only when no witchcraft is involved. In fact, it is, in African thinking, through the ‘muntu’ power (as just defined) over animals, plants, and mineral objects, that some men are able to attain more ‘vital force’ and, hence, more ‘muntu’ or charisma than others; these men are chiefs, traditional healers, priests, sorcerers, witches, rainmakers.

An individual endowed with more ‘muntu’ than others is not expected to easily find his equal, at least not within his group or tribe; hence, chiefs remain chiefs for life; and, since ‘muntu’ is passed from progenitor to his progeny, the chieftom is hereditary. In other words, thinking in terms of ‘muntu’ is neither democratic, nor is it helpful for the introduction of modern physical science into ‘muntu’-adhering societies.

The (Central) African idea of ‘muntu’ being hereditary is likely to derive from the observation that the traits of a progenitor often reappear in his progeny. And if there is a

physiognomic or other physical resemblance to a deceased ancestor, then the idea of a reincarnation is not remote. In fact, anthropologist Geoffrey Parrinder reports (*West African Psychology*, Lutterworth, 1951) a firm belief in reincarnation “by most of the West African peoples”. Despite differences about details of reincarnation from tribe to tribe, there is - in contrast to East Asian thinking - “general agreement that reincarnation is a most desirable thing, the reward of the righteous; punishment for misdeeds take the form of a prolonged interval between births or, worst of all, complete prohibition of rebirth”, and “Reward and punishment are usually held not to be carried over into a new existence on earth. Sickness and misfortune are much more likely to be attributed to the machinations of witches, than to the wrongdoing of a previous existence”. In other words, concerning reincarnation, (West) African philosophy is certainly on a par with East Asian philosophy.

So much on Tempels’ ‘vital force’ thesis and the ‘theory of muntu’. Both definitely pertain to Central and West Africa. To my knowledge, the validity for Southern Africa of Tempels’ findings has not been disputed. In fact, philosophers from Southern Africa refer approvingly to Tempels in their works. And also South African theologian Gabriel M. Setiloane (*African Theology*, Skotaville Publishers, 1986) refers to “vital force” and “umuntu” as being central concepts in Southern African folk philosophies.

Although I shall treat the concept of ‘free’ will in some detail in Chapter 7 (‘Free’ will and the conscious and subconscious levels of mind), an exposition of the traditional sub-Saharan African view of this concept fits in rather well with the current text. According to Tempels, ‘free’ will is understood by the Baluba of Central Africa in the context of vital force, viz. as the freedom to decide between using one’s vital force for good or for evil. The chief, the priest, and the healer are expected to use their vital force for the good of the tribesmen, the evil-willed for evil purposes. In Tempels words, “His evil will (hatred, envy, jealousy) will have repercussions upon the vital force of weaker beings through his mere willing a reduction of their vital power”. This concept of ‘free’ will is directed at social interaction rather than at the acquisition of knowledge by the method of critical and innovative thinking. Such thinking by a young tribesman is not encouraged, because it would mean that a weaker force being challenges the stronger (because elder) force beings who are entrusted with the preservation of the tribes’ traditions. That the elder tribesmen represent a larger magnitude of vital force follows - quite logically - from the fact that their existence proves that over their (long) lifetimes they have resisted all challenges by hostile vital forces. The result is that the young tribesmen never develop the self-assuredness which is necessary for any existing ‘free’ will to think beyond the confines of tradition.

Also appropriate here is a comparison of Western belief in the effectiveness of medicine and the African belief in the curative power of medicine which has been rendered effective by the mere willing of, and ceremonial handling by, the traditional healer. What actually is the difference to the preparation procedure which homeopathic medicine in the West is subjected to in order to “potentiate” its effectiveness? Homeopathy, invented two hundred years ago by Samuel Hahnemann as an alternative to the crude, and often deadly, medical treatments of the time, continues to enjoy a large following in Europe,

the US, and India (*Der Spiegel*, 28/2010), despite the scientific untenability of the medicine preparation (which consists of diluting the active ingredient to - often - below the natural impurity level of the diluting water, and by intermittent violent shaking of the solution to cause the active ingredient to “transfer” its allegedly curative property to the water). Many health insurance companies continue to pay for homeopathic medicines despite the (rather recent) finding that their effectiveness is at the placebo level, which finding has caused the British Medical Association to refer (in May 2010) to homeopathy as witchcraft (a damning statement for Westerners, but not necessarily so for Africans).

Interestingly, Hahnemann blamed the cause of illnesses on a “*Verstimmung der geistartigen, den Koerper des Menschen belebenden Kraft*” (*Der Spiegel*, 28/2010), i.e. on a “detuning of the body’s life-giving vital force”. This is traditional sub-Saharan African thinking at its best.

Finally, a thought in favour of my speculation that sub-Saharan African thinking may be representative of proto thinking of man, i.e. a type of thinking peculiar to pre-modern man, due to the coached self-programming of man’s forebrain, and pioneered by wise men in different places and at different times during man’s long existence at Stone Age level: The suggestion is not plausible that traditional thinking arose once only in over 100 000 generations of Stone Age existence, whence it migrated with man throughout Africa, and from there to Europe, Asia, the Americas and Australia. The similarity of key elements of traditional thinking worldwide is too great for this scenario to be persuasive. The emergence of plenty of candidate wise men in every new generation of man would have led to a diversification beyond recognition if Stone-Age thinking were not of a proto type. Take the belief in reincarnation in both Africa and Asia. This is likely to have arisen from the observation that certain physical and mental features of the progenitor re-appear on the progeny. The idea of a reincarnation of the progenitor is not far off and is, thus, unlikely to be a once-only idea which would require spreading by human migration. Also the idea of metamorphosis of man into animal, and vice versa, as is wide-spread in sub-Saharan Africa, is not a once-only idea, which would require human migration for getting to Asia. Rather, its origin can be retraced to an illusion at dawn or dusk or in a moonlit night deriving from scanty optical information to a brain struggling to identify a possible challenge in the bush. While Africans have kept the two concepts separate, religious thinking in Asia has combined the two into an ontology and an instrument of ethics.

4. Categorising, causality, time

4.1 Categorising

From the foregoing chapters one can conclude that traditional thinking, as evidenced in folk philosophies, cannot be legislated away, nor can it be eroded away by a process in which concepts from physical-science-based thinking are substituted for folk-philosophical concepts. The reason being, that either, traditional thinking or physical-science-based thinking, is (after many years of education) enshrined in a forebrain-self-programmed private conceptual system which constitutes the private physical ‘reality’ of the individual, which this individual is neither free to give up for another ‘reality’, nor to modify in any significant way which is detrimental to the self-consistency of the established private conceptual system. What this means for the introduction of physical science into traditional cultures is discussed in some detail in Chapter 6 (Introducing physical science into traditional cultures). Here we shall focus on a few foundational concepts which are of cardinal importance in traditional thinking as well as in physical-science-based thinking, viz. on categorising, on causality, and on time.

Categorising is of prime importance for linking cause to effect. In visible nature, where no two objects are identical in all respects, categorisation is by similarity to a prototype. This is what traditional thinking is used to. In the mind-invented world of physical science, objects tend to be imagined as identical. In visible nature, a mistake in categorisation may be deadly; not so in the mind-invented world of physical science. But folk philosophies do also have a mind-invented world. In sub-Saharan Africa, this world consists of forcebeings, belonging to one of six categories (as explained earlier). These are not part of physical-science-based thinking. Also not part of physical-science-based thinking is the traditional concept of biological metamorphosis of, for instance, man into crocodile, and vice versa. In East Asia, categorisation is affected by the context-rather-than-object focus of thinking. Additionally, there is reported (Nesbitt) to be a categorisation bias towards the material that an object consists of rather than on its shape (as in the West). And so one can go on looking for differences already at the categorisation level.

With so much difference already at the categorisation level, there is little hope of finding commonality between traditional and physical-science-based thinking when it comes to associating cause and effect. Fortunately, the psychological sense of time appears to be similar, if not identical, so that the time order of events is not in question. What is in question, though, is whether a cause can lie in the future. In physical-science-based thinking it can not, in traditional teleological thinking it can.

4.2 Causality

I shall start the discussion of causality from the cognitive perspective of what I call ‘invented cause’, which reveals a peculiarity of man’s thinking. Take the concept of a

supreme being, God, for example. The newborn has no inkling of this concept. Yet, the majority of earthlings believe in His existence. Why? Because man's mind (elsewhere equated to man's self-programmed private conceptual system) regards His existence as plausible for a variety of reasons. Take the argument of an ordered environment, for instance. That is the argument that the order that man observes must derive from an intelligent supreme being. Yet, the order that man observes is part of his personal mind-conceived 'reality' of his environment, i.e. his private conceptual system. In fact, man's mind categorises order into this reality, which appears to be totally chaotic at birth. And why does the mind categorise order into this reality? Because the evolutionary process has left no other choice. Those who didn't or couldn't categorise, did not survive, whereas those who did categorise had a chance to survive; not because there is necessarily the ordered reality as mind-conceived, but because man's acting and reacting within the mind-conceived reality gave him the edge also within the What Is. Hence, the foregoing reasoning makes God a mental consequence - an 'invented cause' - of the evolution-driven tasking of the mind to categorise order into an essentially non-ordered world. There are other invented causes, of course.

One can argue, of course, that there must be a reality, a What Is, which is sufficiently similar to the mind-conceived ordered 'reality' to give man this edge. But the point is that the game of evolution is diversity and not order, and that one must be aware of the possibility of being misled into the wrong conclusion.

The evolution-driven tasking of the mind to categorise order into an essentially non-ordered world is complemented by two further taskings. Viz. the tasking of assembling the mind-conceived categorised entities into a self-consistent (i.e. plausible) conceived-order-identical conceptual system of the environment (i.e. man's private physical 'reality'). And then, the tasking of identifying causes and of associating cause and effect. The latter tasking is of utmost physical significance when the cause is a real entity which can challenge man. It is of (only) psychological significance when the cause is an imagined entity, an invented cause, like God. These taskings of the mind (elsewhere referred to as coached self-programming of the forebrain) are innate to man, and continue to dominate man's mental activities throughout life. In other words, the mind is primed for finding causes (as evidenced by the prominence which causality has in man's communications). I don't need to emphasise the importance of a correct identification of cause and the correct association of cause and effect for the formulation of models, theories and laws of physical science, if these models, theories and laws are claimed to represent What Is.

Now first to the concept of causality in traditional sub-Saharan African thinking:

We have encountered causality already in the General Laws of Vital Causality described by Tempels in the context of the African hierarchy of forcebeings. The cause-vs.-effect relationships deriving from this concept are applied whenever man (i.e. the forcebeing of central importance) is involved, and something extraordinary (such as death by lightning) happens to him unexpectedly. Under these circumstances, the extraordinary 'effect' is

attributed to the causation by a (stronger) forcebeing. The question is asked “Why him?” and “Who is responsible?”, not “What is responsible?”.

This is different for ordinary and expected events (to be defined in a moment), even if they involve man, except that one then tends to be fatalistic rather than inquisitive about the causes. In other words, the traditional thinker distinguishes between extraordinary-and-unexpected events and ordinary-and-expected events. The former require to be explained in terms of the forcebeings concept, the latter in terms of physical (non-spiritual) explanations.

Kwame Gyekye (*An Essay on African Philosophical Thought*, Cambridge University Press, 1987), referring to the Akan in West Africa, defines the ordinary-and-expected events as those which, according to the Akan conception of the world, fall within God’s intended order of nature. This intended order includes the normal, uneven, up-and-down succession of events, floods and drought, surplus and famine, growth and decay, even the fatality of certain diseases. Examples of extraordinary-and-unexpected events named by Gyekye are: an unusually long period of drought, death by a falling tree⁵ or by a snakebite. The latter would be considered extraordinary because the fall of a tree or the bite of a snake is not regularly accompanied by the death of a person.

Although the Akan believe that for everything there is a cause, the non-spiritual (physical) causes of ordinary events are of lesser interest (because God-given and, hence, unalterable) than spiritual (forcebeings) causes of extraordinary events (because these can be influenced). This contrasts strongly with physical-science-based thinking, where the physical causes of ordinary events are of prime interest, and the extraordinary-and-unexpected events are often explained as chance occurrences (explainable as being due to extraordinary causes, or as unrelated coincidences). From Gyekye’s description of the Akan conception of an orderly and totally interlinked universe it would appear that the Akan rule out the possibility of unrelated coincidences. In other words, the Akan might (!?) accept the “octopus oracle”⁶ of the 2010 Soccer World Cup as meaningful and reliable.

⁵ To a physical-science-trained mind, the killing of an inattentive passer-by by a falling tree, can be explained by the rare interaction of three causes: the act of passing by, the weak state of an over-aged tree and a burst of wind. The traditional African thinker would invoke a further contributory factor; the willing of a witch.

⁶ The “octopus oracle” was widely reported in the media at the 2010 soccer world-cup competition on South Africa. Here, the preference of an octopus at a public aquarium in Germany for one of two dishes of food decorated with the national flags of two competing teams respectively was found to correctly “predict” the outcome of eight games in succession. If one excludes psychological effects on the competing teams via the media reporting of the “oracle” predictions, there is, to a physical-science-trained mind, absolutely no linkage between the two patterns of events, i.e. between the octopus’s choice of food and the outcome of the soccer games. The exact correspondence between the two patterns of events is a chance occurrence with a (certainly not exceptional) statistical probability of $0,5^8 = 0.0039$. Exactly the same coincidental correspondence is reported for the eight winning candidates for the US presidency between 1932 and 1960 and the fact that they had longer names than their opponents.

In summary, the traditional sub-Saharan African thinker distinguishes between ordinary-and-expectable occurrences and extraordinary-and-unexpected occurrences. The causes of the former are concealed in a God-willed destiny, implying the teleological belief that this destiny predetermines the causes (i.e. the ultimate causes, the hidden causes behind the observed causes), and the causes of the latter occurrences are associated with ‘vital forces’.

Now to the concept of causality in traditional East Asian thinking:

Also in East Asia, a distinction is made between ordinary-and-expectable occurrences and extraordinary-and-unexpected occurrences. Also there, the causes of the former are concealed in a (karmal) destiny, implying the belief that this destiny predetermines the causes teleologically (i.e. the ultimate causes, the hidden causes behind the observed causes), while the latter occurrences are blamed on one or more of a whole spectrum of possible causes, the majority of which are contextual, vague, and non-physical (such as wrath of a demon, disturbance of universal harmony, Karma, divine decision).

As mentioned earlier, the focus on context (rather than the actor) in East Asian thinking, does seldom allow the identification of a definite cause. And, East Asian dialectics (belief in a world full of contradictions, paradoxes and anomalies) runs counter to a belief in definite cause-vs.-effect relationships. And, concerning chance occurrences, the holistic world view implies that the unrelatedness of coincident occurrences is denied, and the above-mentioned causes for ‘extraordinary-and-unexpected occurrences’ are being invoked.

4.3 Time

Man requires memory and a sense of time for identifying causes. Even in teleological thinking (in which ultimate causes are identified), an observed effect must be preceded by an observable cause. For identifying and remembered causes, man has an “inner biological clock”⁷ which is responsible for tagging memorisable events in the order in which they are memorised. We don’t have to go into the details thereof. But this biological clock together the early experiences of mother’s heartbeat and the later experiences of an even succession of days, prepare man for sensing time as a basic property of nature with quasi-linear characteristics. In idealisation thereof, man has defined a mathematical time which is strictly linear, and which extends from an infinite past to an infinite future. Wise men and astro-physicists (not necessarily identical) dispute the infinite property by either invoking a genesis or a Big Bang as the start of time in man’s universe. The problem that man has with the infinite property is that the mind can neither plausibly conceive of an infinite time nor of a finite time.

In memory, man develops also a sense of “psychological” time. The psychological time is sensed as “uneven”; it is even only during time intervals devoid of memorable (out-of-the-ordinary) events; the occurrence of memorable events make it uneven, i.e. either

⁷ In fact, physiology tells us that virtually every body cell contains a genetic “clock”.

longer or shorter than the eventless intervals. There would seem to be a natural tendency to sense time as suddenly appearing in the present out of a hidden future and proceeding in a straight line into a past, where the past is intermittently “illuminated” by memorised events (self-experienced or being told about). The “past” branch of psychological time would fade away into the obscurity of no-memorised-events were it not for man’s invention of a genesis from which psychological time is supposed to start. Similarly, future time becomes intermittently “illuminated” by forthcoming out-of-the-ordinary events that one happens to know are going to occur.

Both the psychological sense of time and the linearly even sense of time are found in traditional thinking. Take traditional sub-Saharan African thinking:

John S. Mbiti (*African Religions and Philosophy*, Heinemann, 1989) gives an extensive description of time as perceived by the East African tribes studied by him. It is essentially similar to the psychological time as just described. A detailed analysis of Mbiti’s description would add nothing to the points already made. In contrast therewith, philosopher Kwame Gyekye reports (*An Essay on African Philosophical Thought*, Cambridge University Press, 1987) a time concept of the Akan in West Africa which appears to agree with the linearly even sense of time. To quote Gyekye, “In Akan thought, it is not events that compose time; it is not events that generate the awareness of the existence of time. Rather, it is time, conceived as objectively existing, within which such events and changes take place and which makes possible the dating of these events”. This is also how time is sensed among the Basotho in Southern Africa (communication from Cable Moji).

Concerning the sensing of time in East Asia, there is a misunderstanding about reports that claim that East Asians sense time as cyclic. For instance, Richard E. Nisbett (*The Geography of Thought*, Free Press, 2003) reports of a Chinese student of psychology at a U.S. university to have pointed out that, “Westerners think of the world as progressing along a line, while Chinese believe things to always change in circles back to a prior state”. This would appear to only pertain to a learned view of history though, and definitely not to the basic sensing of time. In fact, in an interview with a group of four South African university students of Taiwanese parentage, it turned out that all confessed to sensing time essentially as psychological time, regardless of the (rather different) educational standard of their Taiwanese parents. In other words, East Asians experience time in the same way as anyone else does, except that they see history as repeating itself (in repetitive cycles, each running - in Chinese view - from a high-ranking “Golden Age” down to a low-ranking “Iron Age”)⁸. And a South African physicist of Hindu-Indian background also had no other interpretation for the Hindu-Indian sensing of time.

⁸ The “running down” within individual cycles conforms to the pessimistic outlook on future in East Asia, where every cycle starts from a state of perfection, and where change means loss of perfection. This contrasts with the optimistic outlook on future in the West (probably due to the concept of a Christian paradise), and with a rather neutral outlook on future in Africa (where life is here and now, and paradise is an unknown concept).

In conclusion, therefore, the traditional sensing of time would not seem to be a problem in the introduction of physical science into traditional cultures.

5. Emergence of physical science

When philosopher Karl Popper wrote “science must begin with myths, and with the criticism of myths”, then he was obviously referring to the situation in Ancient Greece which gave rise to the emergence of scientific thinking. But it takes more than myth to convert from traditional thinking to science-based thinking. On basis of the Parallel-Systems Mind Model I am proposing a set of conditions which have to come together, and which came together in Ancient Greece, to make this conversion a sustainable phenomenon. Mystification (defined as the act of creating a myth by making obscure or mysterious) is but one of these conditions.

I propose, that mystification is a process that all rational thinking is subject to, even physical-science-based thinking. The mystification of the latter is dealt with in Chapter 8 (Object creation, misconceptions and mystification in physical science). Here the focus is on the general phenomenon.

I argue, that folk philosophies were the product of the thinking of individual wise men, which (thinking), driven by the forebrain-inherent urge for self-programming a self-consistent conceptualisation of the environment, was rational, systematic, and critical with respect to the knowledge available at the time. The originally rational thinking became mystified over time on account of a cognitive phenomenon that all rational thinking is subject to, viz. the process of knowledge transfer by chains of communication in which - unavoidably - essential details of the rationality of the original thinking is lost, leading first to dogmatisation, and then to mystification. Also, over time, new facts may emerge that discredit the rationality of the original thinking. In either case, the private conceptual system upon which reasoning is based, becomes self-consistency-deficient, and, hence, plausibility-deficient. This raises the level of cognitive dissonance, urging the forebrain to seek plausibility restitution.

Plausibility restitution can take two forms: Either by retracing the mystification process to the original rationale (recommended for mystified aspects of physical science), or by development of an alternative rational conceptual system. The latter happened in Ancient Greece.

The emergence of physical science in Ancient Greece has been linked to the affluence of Greek society (deriving from successful trading around the Mediterranean Sea), to the leisure-dominated life of the well-to-do (made possible by slave labour), and to the freedom of expression (brought about by the democratic political system and the absence of organised repressive religion). These circumstances have certainly contributed to the emergence, but do not explain the singular process in its entirety and not at the mind level. At that level we have to consider the evolution-driven priming of the mind for causal thinking (mentioned in Chapter 4) and the economical investment of forebrain-available resources for programming and operation of forebrain (explained in Chapter 1). It is in these two areas where the most drastic differences arise between traditional thinking and physical-science-based thinking.

Namely, whereas traditional thinking makes do with rather few holistically related causes retraceable to a single supreme cause, physical science is characterised by a multitude of widely different causes for different occurrences. For instance, in traditional sub-Saharan African thinking, God is the fundamental cause of destiny, as well as of the ‘vital force’ which man can fall back onto for an explanation of all extraordinary-and-unexpected occurrences. The ‘vital force’ hypothesis is the “world formula”, so to speak, of traditional sub-Saharan African thinking. In other words, the mind holding a holistic world view tends to invoke a few-causes explanation, or even a single-cause explanation, for its self-conceived physical ‘reality’.

This is totally different for physical-science-based thinking. Here, every physical occurrence is considered in isolation and attempts are made to find all its natural causes. And there are many occurrences in nature waiting to be explained in the scientific way. And these explanations must be rendered plausibly compatible to the highest possible degree. In other words, a physical-science-based private conceptual system is - unavoidably - of much higher complexity than a folk-philosophy-based private conceptual system, whence the investment of forebrain-available resources into the former has to be many times that required for the latter. And, the concepts in both conceptual systems are incompatible to an extent which makes it impossible for the latter to become gradually substituted by the former; both have to coexist for some time until the physical-science-based conceptual system becomes the dominant one.

It is obvious then, that a number of favourable factors and incentives have to come together, to induce the forebrain to start generating a further, now scientific-thinking-based, conceptual subsystem alongside the already established traditional-thinking-based conceptual system. These favourable factors include sufficiency of fore-brain-available resources, absence of distraction from science-focused contemplations, freedom of thought and communication, plenty of time for growing and strengthening the necessary new neural network, and for eliminating inconsistencies. In Ancient Greece, these factors were maintained for a sufficiently long time of almost a millennium (600 BC to 300 AC) by the living conditions mentioned before (affluence, leisure, democracy). This period of time was sufficiently long for physical-science-based thinking to develop over generations from the initial status of a minor conceptual subsystem to a full-grown sustainable conceptual system (certainly not in every Greek, but certainly in graduates of elite schools).

The incentives are a reduced cognitive dissonance through plausibility restitution, and a status gain as a wise man, mentor, or teacher. In Ancient Greece, the incentive for plausibility restitution was certainly a strong dissatisfaction with the degree of mystification of traditional thinking.

In summary, conditions in Ancient Greece were indeed uniquely favourable for a new, radically different, rational conceptualisation of the world from a few-causes traditional thinking to a multiple-causes scientific thinking.

6. Introducing physical science into traditional cultures

In Chapter 5 (Emergence of physical science) the circumstantial factors and incentives were identified which made it possible for physical science to emerge sustainably within traditional Ancient Greek culture. Here we are concerned ‘only’ with the introduction of a fully functional and largely self-consistent physical science into traditional cultures. This reduces the problem of introduction somewhat, but key difficulties and the essential differences between physical-science-based thinking and traditional thinking remain.

One key difficulty is the non-compatibility of certain foundational concepts in the two ways of thinking, which disallows a teaching approach aimed at a gradual substitution of physical-science-based thinking into traditional thinking. This is bound to be unsuccessful also on account of the fact (emphasised in Chapter 5) that traditional thinking is a few-causes holistic thinking, while physical-science-based thinking is a multiple-causes analytical thinking.

All evidence presented so far leads to the conclusion that for a successful introduction of physical science into traditional cultures the folk-philosophical thinking must be left untouched, while physical-science-based thinking is introduced as a completely separate alternative way of interpreting experiences in the learner’s environment. This side-by-side (collateral) development and long-term accommodation of different conceptual systems is not unnatural, but is, in fact, the normal way in which man’s mind - according to the Parallel-Systems Mind Model - develops (see Chapter 9).

Attempts at a substitutional rather than collateral type of learning have always led to unsatisfactory results, e.g. to the introduction of pre-Christian and pre-Buddhist beliefs into Christian and Buddhist teachings, or to Africanised churches as a result of missionary work in Africa. An Africanised physical science is certainly in nobody’s interest.

The recommendations for a collateral learning, which come from the above comparison of traditional and physical-science-based thinking in combination with the Parallel-Systems Mind Model, lend support to the collateral learning approach known as “cultural border crossing” for teaching physical science to pupils having to “cope with disparate worldviews . . . by transcending cultural borders between their everyday culture and the culture of science” (Olugbemiro J. Jegede and Glen S. Aikenhead, *Research in Science & Technological Education*, vol. 17, 1999, 45 – 66). But only if certain indispensable conditions apply. These conditions, called ‘implications’ rather than ‘conditions’ by Jegede and Aikenhead, are (according to these authors) that the discourse with pupils should be “without cultural violence”, “either in the pupils’ indigenous life-world culture or the culture of science”, “cognizant about which culture they are talking in at any given time”. These ‘implications’ are, in fact, actually the crux of the matter, and one gets the impression that other authors writing about this learning method are either not aware of these ‘implications’ or not aware of their cardinal importance.

But even in collateral learning, the essential differences between traditional thinking and physical-science-based thinking remain, namely (1) that the former needs only a few causes for explaining all occurrences, whereas the latter requires an overwhelming multitude of causes for explaining the same occurrences (namely one or more different one's for every occurrence), and (2) that for a holistic thinking student (i.e. one for whom the reduction of an occurrence to a definite cause-vs.-effect relationship is a foreign idea) the analytical arguments of physical science are inherently difficult to follow.

There is evidence of these difficulties, as described by an African physicist from Lesotho as follows: There is an exceptionally high interest of Lesotho students in studying physics at the University of Lesotho as a consequence of, firstly, the widespread absence of serious physics teaching at school (denying them the possibility of an early introduction to physics as a career subject), and, secondly, the encouragement given to good school performers in mathematics to take up physics at University. These students then perform well when asked to solve numerical problems, but do badly when questioned about the concepts of physics; the latter being attributable to traditional thinking getting into the way of physical-science-based reasoning.

7. 'Free' will and the conscious and subconscious levels of mind

7.1 Dependence on private conceptual system

One of the key messages of Chapter 1 (Introduction to mind, witchcraft and folk philosophies) is that an established self-consistent private conceptual system (i.e. the individual's mind) tends to resist the incorporation of ill-fitting new information, and to inhibit any drastic re-programming of this system. At the conscious level, the self-consistency is sensed as "I am right, and everyone else is wrong who disagrees with me!", and the resistance to change is sensed as the cognition of a threat to mental harmony. The choice to reject an ill-fitting new information for a better-fitting one is sensed as 'free' will (or self-will). The conscious level is never informed that the real reasons behind this sense of 'free' will are evolution-favoured constraints on the programming and re-programming of the private conceptual system, which include also the economic use of forebrain-available resources. In other words, one should speak of an 'evolution-constrained will' rather than of a 'free' will, or in equivalent terminology of an 'evolution-constrained self-determination' rather than of a self-determination of man.

The constraints on 'free' will are encountered daily, particularly in mixed-culture societies. Take the following situation which Kurdish migrant families in Germany may find themselves in: The parents came from Turkey as adults, and have lived law-abidingly in the country for 30 and more years. Their children, born and raised in Germany, have been exposed to both Kurdish and German values. Girls often prefer the German value of gender equality and may decide to choose their partners from a non-Kurdish background. The conflict between daughter and parents escalates when the girl moves in with the partner, when the parents feel deeply dishonoured according to their Kurdish value system. In a number of instances, the escalation has led to the (well planned) killing of the girl at the hands of a brother, under coercion from the parents and regardless of the legal consequences. That is the 'free' will which parents as well as the brother have (namely to decide for or against the killing). But they do not have the 'free' will to feel approvingly instead of disapprovingly towards the girl's choice. The culture-primed private conceptual systems of parents and brother don't allow this decision.

7.2 The Libet problem and its (easy) solution

The private-conceptual-system-dependence leaves man with a will and self-determination, though 'evolution-constrained' as explained, were it not for a finding by physiologist Benjamin Libet in the early nineteen eighties which appears to rob man also of any remaining self-will and self-determination. What Libet found was that the motor response to a sensory stimulus is not triggered by a conscious decision but subconsciously, and this well ahead of man's conscious "decision" to trigger the response. In other words, by the time that man "decides" consciously on a motor response, this action is already underway. Put in yet another way, the same forebrain that decides subconsciously on what to do, and then initiates the action, informs the conscious level of

this initiation in such a way that at the conscious level - as well as in memory - the impression is created that the go-ahead came from the conscious level. Does the forebrain fool itself, or is there a plausible explanation for this apparent contradiction?

In the context of the Parallel-Systems Mind Model, there certainly is a plausible explanation. But there has been none before. Rather, ever since the Libet finding, the reaction (also in public TV expert discussions involving neuroscientists, psychologists, lawyers, philosophers and others) has been that man's 'free' will was an illusion altogether, that man's responsibility for his deeds would have to be redefined, and that the law would have to be rewritten. This discussion was revitalised in 2008 when psychologist John-Dylan Haynes followed-up the Libet experiments with investigations of his own, in which Libet's finding was fully confirmed. Yet, no plausible explanation for this apparent total loss of 'free' will has been forthcoming. This, to me, is an indication of an outdated thinking about the mind, in which the subconscious level is regarded as an opponent of the conscious level on a majority of matters concerning the two. But, the evolutionary process would never have allowed such a development to succeed.

The matter was taken up again in a very recent review article by psychologists R. Custers and H. Aarts (*Science*, vol. 239 of 2.7.2010, 47-50), in which a mechanism was proposed by which an "unconscious will, outside of conscious awareness" was considered possible. Again, this echoes the old notion of an independent operation of conscious and subconscious levels of mind, retraceable to the Freudian, rather sinister, view of the "unconscious".

Fact is that one must distinguish between matters contemplated by the forebrain alone - i.e. matters of learning and reasoning - and matters deriving from the interbrain, i.e. matters of instinct. It is the regular conflict between the latter and social reasoning which has given a bad name to the subconscious state of the brain. This vision of conflict is unjustly extended to forebrain matters not involving the interbrain. In the forebrain, the subconscious level of the mind cannot be in conflict with the conscious level because - by design - the former serves the latter. And, not only can there be no conflict between these different levels of the mind in the forebrain, there must be a close cooperation between these levels. This is not a matter of choice; it is this specific design of nature (in which the mind is embodied, and in which the subconscious and conscious levels of mind cooperate) which has been favoured by the process of evolution. Now what is the nature of this cooperation between the subconscious and conscious levels?

From my viewpoint (my hypothesis, if you will) - in which the forebrain has but one function, viz. to develop for the individual a private conceptual system which identifies with his mind - the conscious level has a controlling function both in the development and in the use of this private conceptual system. That most of this private conceptual system is at the subconscious level most of the time is in the interest of fast mental processing of neural information, and is not detrimental to the quality of its output. From this viewpoint, I argue that - over the years - the conscious level had sufficient opportunity to check and recheck most - if not all - entries into this system. Whence it is

of little importance if a response to a sensory stimulus is decided on at the subconscious or conscious levels of the forebrain; it is still the individual's decision. In other words, the order of communication between subconscious and conscious levels of man's private conceptual system is of no significance regarding the question of self-will or self-determination of man. And the question remains valid as to how self-determined man is within the evolutionary constraints.

We are now ready to answer the above question of whether the forebrain is fooling itself when - on the one hand - the forebrain decides subconsciously on what to do and initiates a motor action, and then - on the other hand - informs the conscious level of this initiation in such a way that at the conscious level - as well as in memory - the impression is created that the go-ahead came from the conscious level. In the light of my hypothesis - that in matters involving only the forebrain the subconscious level serves the conscious level - this is certainly no indication that the forebrain is fooling itself. Rather, this must be seen as a clever arrangement whereby valuable time is saved between sensory stimulation and motor response. This arrangement is such (and this is another of my hypotheses) that if such action is not immediately vetoed by the conscious level it is registered in memory as having been initiated by the conscious level, whereas it is registered in memory as a rejected option if it is vetoed, and thereby "stopped in its tracks".

8. Object creation, misconceptions and mystification in physical science

8.1 Object creation and misconceptions

Communication starts with name-giving, i.e. giving names to concepts in mind which derive either from one's own sensory experiences or from own imaginations. Name-giving and language then enable an individual to 'benefit' from communicated experiences and communicated imaginations. The information from all of these four sources flows into the development of one's private conceptual system.

Name-giving has the effect of concretising a concept into an object which in one's own initial experience has not been an object. Examples thereof are numbers, infinity, atoms, spirits, gods. Take numbers. Before man invented names for numbers, nobody would have thought of 1, 2, 3, . . . as being objects on their own. In mathematics they are treated as such, although it is obviously unjustified, as well as unnecessary, to regard numbers as having physical existence simply because they are used for counting physical objects. Take infinity. We speak of "at infinity" as if it were a place that one can eventually come to. But infinity is the exact opposite of a definite place.

In other words, name-giving, being necessary for communication, is fine as long as one keeps in mind how the object creation came about. If the creation becomes obscured, we have a case of mystification.

Some object creations are simply misconceptions, but not all misconceptions are also object creations in the sense described. An example of the latter is the conceptualisation of a 'body' of knowledge, such as a folk philosophy, by the 'container metaphor', suggesting that the 'body' of knowledge is a single 'container' in which all that is to know about the folk philosophy is deposited, for everybody to help himself. Rather, there is a multitude of different individual mental 'containers' - one for every individual adhering to the particular folk philosophy - that are filled with information of varied quality and to different levels, viz. the private conceptual systems referred to above. Sometimes an outsider is allowed to look into such a private container, if the owner thereof communicates part of its contents (only verbally in oral cultures, and also in writing in literate cultures). This same situation pertains to the 'body' of knowledge of physical science, except that here one has, besides oral communication, also written means of communication. But, even then, the 'body' of knowledge essentially consists of a large ensemble of generally rather different, and often disagreeing, private conceptual systems.

There are many more examples of object creation and misconceptions in physical science. These are not at the focus of attention in this essay. The focus here is the phenomenon of mystification, which I believe to have the capacity for eventually turning parts of physical science into belief.

8.2 Mystification

As mentioned earlier (Chapter 5, Emergence of physical science), mystification is defined as the act of creating a myth by making obscure or mysterious. As also explained there, mystification is an unavoidable process that all originally rational thinking is subjected to due to loss of essential details of the rationality of the original thinking during knowledge transfer by chains of communication. This loss is likely to be more severe in oral than in literate cultures; at least one cannot be so sure of a chain of oral communication. But, as will be seen in the following, literacy is no guarantee for absence of mystification in physical science.

If essential details of the rationality of the original thinking are not lost, then new facts may emerge that discredit the rationality of the original thinking. This is also a form of mystification, viz. by rendering the original thinking plausibility-deficient by the new understanding. This has happened with much of the rationality of early scientific thinking in Ancient Greece (e.g. with Aristotelian rationality). And, it is happening right here in this essay, as exemplified by a new rational explanation for the Libet finding (Chapter 7, 'Free' will and the conscious and subconscious levels of mind). Also here, the recognition of relevance of various findings of cognitive science for understanding reasoning in general, and of scientific reasoning in particular, is an example of a discrediting of the rationality of earlier thinking. And also, the Parallel-Systems Mind Model discredits the rationality of earlier thinking.

But there are also concepts in physical science which were mystical (because plausibility-deficient) right from their invention. An example thereof is the postulation of the Big Bang event without a plausible explanation of the chance occurrence of an almost infinite quantity of energy at a singular point, without a plausible explanation of why this event should represent a minimum of entropy, hence, maximum of statistical order, in an infinitely small and infinitely hot universe undergoing compositional changes at an infinitely rapid rate (when the Boltzmann condition of non-interacting particles are not satisfied, not even in approximation), and without a plausible explanation for the alleged super-luminous (faster than light) cosmic inflation of the young universe. It is likely, therefore, that the Big-Bang concept will remain mythical forever.

In the following, I shall move away from the latter two types of mystification, and focus on the mystification proper, which is due to loss of essential details of the rationality of the original thinking during knowledge transfer by chains of communication. This is the type of mystification which worsens with the length of chain, and which I believe to have the capacity for eventually turning parts of physical science into belief.

There are three key factors which contribute towards loss of essential details of the rationality of original thinking during knowledge transfer by chains of communication: (1) the inconvenience of access to original papers about innovative thinking, (2) the reluctance of physical scientists to expose their complete reasoning which led them to a published finding, and

(3) the tendency to attribute a finding to nature rather than to the mind construction of a physical ‘reality’ (i.e. to the private conceptual system).

Key factor (2) was lamented by astronomer Hermann Bondi (*Assumption and Myth in Physical Theory*, Cambridge University Press, 1967) when he said, “scientific papers have become stylised to an extent which preclude an exposition of the author’s real train of reasoning that lead him to the problem and from there to a solution”. Because of the lack of this vital information, Bondi went as far as calling papers with this deficiency - and this is the great majority - a “swindle”. Indeed - in general - the impression is created in these “stylised” papers that problem and/or solution are the result of a sudden intuition rather than of an extensive deductive process in which analogy and metaphoric conceptualisation play a major role.

What is being withheld in these “stylised” scientific papers is sometimes revealed elsewhere, like in the following passage from Werner Heisenberg’s *Quantentheorie und Philosophie* (Reclam, 1979, p. 23) in which he described how he and colleagues proceeded to develop models for quantum physics in 1924, “Man gewoehnte sich daran, dass die Begriffe und Bilder, die man aus der frueheren Physik in den Bereich der Atome uebertragen hatte, dort nur halb richtig und halb falsch sind. Unsere Anstrengungen konzentrierten sich darauf, die richtigen mathematischen Beziehungen zwar nicht abzuleiten, wohl aber aus der Aehnlichkeit zu den Formeln der klassischen Theorie zu erraten”. In translation: “One became accustomed to the fact that concepts and mental images from earlier physics were half right and half wrong in the domain of atoms. Our efforts were (therefore) focussed not on (directly) deriving correct mathematical descriptions, but on guessing these from similarities to formulae of classical theory”. This is, undoubtedly, a purely metaphoric approach. And anyone using these formulae must know their origin.

Key factor (1) has the effect that the origin, though originally well documented, is, in time, all but forgotten. One glaring example is the famous Schroedinger equation, which has become dogmatised and mystified, because few scientists seem to be aware of the fact that it is a (metaphoric) reformulation of the plane-wave equation of wave optics (shown in detail in Hans Adolf Bauer’s *Grundlagen der Atomphysik*, Springer, 1951), triggered by the de Broglie hypothesis. This equation, derived by Erwin Schroedinger in 1926, and still the key equation for many calculations of wave-property-related aspects of quantum objects, is widely believed to have been pulled out of a hat⁹. Instead, the derivation of the Schroedinger equation is typical for the approach followed by theoreticians when developing new tools for new problems, viz. by use of analogy. Or to put it differently, a metaphoric conceptualisation is attempted by selecting a source domain on explored terrain (here in classical wave optics) for application to a target domain on unexplored terrain (here the matter-wave property of a quantum object).

⁹ Richard Feynman, physicist and Nobel laureate, is reported to have said, “Where did we get that [equation] from? Nowhere! It is not possible to derive it from anything you know. It came out of the mind of Schroedinger.” (Quoted in T. Hey and P. Walter: *The New Quantum Universe*, Cambridge University Press, 2003).

This fact about the derivation of the Schroedinger equation is of decisive importance for explaining why it can describe the matter-wave properties of a quantum object, viz. because it is a wave equation by origin (and has not been pulled out of a hat!). However it should be able to describe only the matter-wave properties of a quantum object, and nothing else. If it is used for explaining non-wave features of a quantum object, then this is pure speculation and guesswork. It is obviously here where also the experts admit that many aspects of quantum physics are and seem to remain implausible¹⁰.

And, knowing where the Schroedinger equation comes from, one is no longer surprised about the harsh criticism coming from a number of quantum chemists when it comes to the application of the equation to electron orbits in the atomic model. They speak of the “lore” of orbitals, and of the problematic use of “orbital jargon”, or they condemn the use of the orbital model in no uncertain terms as “scandal” and “trash”.¹¹ These critics demand a strict separation of the classical and quantum concepts, and no combination of the two (as was first attempted by Bohr). This demand was made also by Heisenberg. These critical chemists see early so-called quantum chemistry as suffering from such combination of classical and quantum concepts. They have demonstrated their new “uncontaminated” quantum chemistry to yield new important insights into chemical bonding without having to invoke the orbitals-based classical concept of spatially directed covalent bonds between atoms in a molecule. They call the concept of orbital hybridisation introduced for explaining the presumably existing covalent bonds “the single most misleading concept of theoretical chemistry”¹². So much on the mystification of the Schroedinger equation.

Concerning key factor (3) (i.e. the tendency to attribute a finding in physical science to nature rather than to the private conceptual system), we now focus on laws of physics, which have been mystified as laws of nature. The analysis of these laws by philosopher Nancy Cartwright (*How the Laws of Physics lie*, Oxford University Press, 1983) has contribute much to a demystification of these laws.

Cartwright distinguishes between fundamental laws, which she regards as explanatory of nature’s behaviour in the context of a model¹³, and phenomenological laws, which she sees as providing a true description of nature’s behaviour. More specifically, she proposes the phenomenological law to be the closest approach to a description of the behaviour of objects in reality, and the fundamental law to be (merely) an explanation of the behaviour of objects in the model (and, thus, not necessarily also in reality).

¹⁰ Richard Feynman: “I think I can safely say that nobody understands quantum mechanics” (Quoted in T. Hey and P. Walter: *The New Quantum Universe*, Cambridge University Press, 2003). Daniel Greenberger and Anton Zeilinger: “Quantum theory still crazy after all these years”, *Physics World*, Sept. 1995.

¹¹ Jan C. A. Boeyens and J. F. Ogilvie (eds.): *Models, Mysteries and Magic of Molecules*, Springer, Dordrecht, 2008, Preface.

¹² Jan C. A. Boeyens in Jan C. A. Boeyens and J. F. Ogilvie (eds.): *Models, Mysteries and Magic of Molecules*, Springer, Dordrecht, 2008, chap. 20.

¹³ In line with the philosophers’ general preference for speaking of theoretical laws instead of fundamental laws.

Examples of fundamental laws are the universal law of gravitation and Coulomb's law, and examples of phenomenological laws are Fick's laws of diffusion. The distinction between the two types of law derives from a notion of the world as being "full of complex and varied phenomena", each resulting from a multitude of causes, and from the fact that a fundamental law pertains to a single cause under ideal conditions, which are exceptionally rare in nature, but easily realisable in a theoretical model. Hence, Cartwright regards the wide-spread belief as false that fundamental (explanatory) laws of physics state facts of nature. This false notion of truth arises when the model "ties laws directly to reality".

This is not the place to discuss the various implications of Cartwright's classification, except to refer to her statement that, "really powerful explanatory laws of the sort found in theoretical physics do not state the truth", and to another one which emphasises why we, nevertheless, cannot do without fundamental laws, "We could know all the true (i.e. phenomenological) laws of nature and still not know how to explain composite cases".

Further important concepts of physical science falling under key factor (3) include the so-called 'universal constants of nature', the Pauli Principle, and the Uncertainty Principle. The Uncertainty Principle was originally little more than a (fudging) device for separating the wave-property domain of a quantum object from its particle-property domain (Rice and Teller: *The Structure of Matter*, 1949). Also the Pauli Principle can be regarded as a (fudging) device to make model fit observation. And the 'universal constants of nature' are nothing but constants of proportionality in fundamental laws (i.e. constants required to make theoretical prediction fit actual measurement). Constants of proportionality in phenomenological laws (i.e. the true laws of nature) are not (!) elevated to a status above fudge factors.

Finally, a few words on the mystification of mathematics, i.e. on the mystification of mathematics as being more than a special *lingua franca* for describing quantitative instead of qualitative relationships between categories (as in word language). To be more precise, I hold that word languages describe qualitative relationships between (mind-conceived) categories of things, and that number language (mathematics) describes quantitative relationships between categories of things. And, as mentioned before, that name-giving caused the (false) notion that numbers are objects (albeit abstract objects).

Linguist George Lakoff and psychologists Rafael Núñez (*Where Mathematics Comes From*, Basic Books, 2000) even allege that "a great many of the most fundamental mathematical ideas are inherently metaphorical", and that "it appears that mathematics as we know it arises from the nature of our brains and our embodied experience".

An answer to the question of what role mathematics plays not only in man's models of reality, but in reality itself, will certainly have to be sought soon; not only, but also because of the enormous funds flowing into fundamental-particle research under guidance from theoretical physics.

By seeing in mathematics more than a special man-invented language, we may be deluding ourselves into believing mathematics to reveal reality (i.e. the What Is) where our private conceptual system fails. There is certainly a history of physical science in which a mind-conceived 'reality' is mistaken for What Is, and from which conclusions of significant consequence in modern physical science are drawn. For instance, the mind does construct - by analogy and metaphoric conceptualisation - a microcosm of fundamental particles which it conceives so as to comply with - also mind-conceived - mathematical models, while the mind (not necessarily the same mind) also marvels at the "elegance" of a universe (taken as real) which obeys these mind-conceived mathematical models.

So much on mystification for now. We have definitely reached a stage in physical science where plausibility restitution in some areas is called for, as well as a general re-evaluation of physical science from a cognitive perspective.

9. The Parallel-Systems Mind Model¹⁴

As mentioned in the Preface, the initial stimulus for this research came from the plausibility deficits which the author had (and which also colleagues seemed to have) in connection with many “facts of nature” discovered by physical science, which led to the idea to view these “facts” from a cognitive perspective (i.e. by considering the findings of neuroscience, psychology, evolutionary biology, developmental science, anthropology, linguistics, philosophy, and other human sciences). Little did I know at the time that eventually I would have to develop a mind model (the Parallel-Systems Mind Model) to really come to grips with the problem and find out where those “facts of nature” really come from, viz. from a private mind-conceived physical ‘reality’. This private mind-conceived physical ‘reality’ is captured in a private conceptual system, which is the mental representation - i.e. the mind itself - of the biophysical configuration of the neural network that links neurons in the forebrain.

To be more specific, the Parallel-Systems Mind Model is a model of the mind in which the mind is equated to the ensemble of embodied private conceptual subsystems programmed into a person’s forebrain under evolution-favoured constraints by using information from four sources: own experiences, communicated experiences, own imaginations, communicated imaginations, where the key evolution-favoured constraints are

- self-consistency of every private conceptual subsystem, and
- economic use of forebrain-available material and energy resources, for
- primarily the identification of causes.

As mentioned in the Preface and as further elaborated in the following, these private conceptual subsystems are the unavoidable consequence of any individual's development from the foetal stage. They constitute the 'parallel systems' referred to in the term Parallel-Systems Mind Model. In general, these parallel private conceptual subsystems are not mutually compatible (whence they exist in parallel), but one of them becomes dominant at the adult state. As emphasised in the Preface, the latter is referred to as 'the' private conceptual system, but must be understood to be merely the dominant one among two or more. Hence, when 'the private conceptual system' was referred to, it was meant to represent not the mind as a whole, but its dominant part.

The Parallel-Systems Mind Model combines a number of findings from the cognitive sciences with some ideas of the author to form a system of thought which is able to explain the following in particular

- (1) the formation of man’s private conceptual system,
- (2) the inherent (largely hidden) drives, limitations, and strategies behind all thinking,

¹⁴ I would have preferred to call my theory about the mind simply 'mind model' or a 'mind theory', but these terms have become established in psychology for rather different concepts. My choice of Parallel-Systems Mind Model is appropriate in that the parallel systems refer to the private conceptual subsystems which - in my theory - constitute the mind. There is an analogy to systems theory, where systems are combined in parallel to make certain that at least one of them operates under any one of the conceivable conditions facing the system as a whole.

- (3) the rise of physical science from traditional thinking,
- (4) the interaction of the conscious and subconscious levels, and
- (5) the mystification process inherent in both traditional and science-based thinking (which threatens the future development of physical science).

At this stage it will be helpful to re-read Section 1.1 about some axioms and key features of the Parallel-Systems Mind Model, and to recall that all axioms and derived findings rest on the theory of evolution and on the neuro-scientific discovery that the secrets of reasoning are somehow associated with the configuration of the synaptic linkages in the self-programmable forebrain. And furthermore, that the forebrain is coached in its self-programming, and that a holistic (non-Cartesian) view of body and mind is appropriate, as well as a holistic (non-Freudian) view of the conscious and subconscious levels of the mind. For evidence in support of these holistic views, the reader is directed towards the writings of neurophysiologist Antonio. R. Damasio (*Descartes' Error*, Putnam's Sons, 1994; *The Feeling of What Happens*, Vintage, 2000) and of George Lakoff and Mark Johnson (linguist and philosopher respectively; *Philosophy in the Flesh*, Basic Books, 1999).

Against this background, we are now ready to proceed to an explanation of how the 'parallel systems' - i.e. the parallel private conceptual subsystems - arise in the development of the individual from the foetal stage.

At the beginning, the newborn has a forebrain ready to be programmed by means of the gradual interlinking of many billions of neurons. The newborn has a rudimentary set of memories from the womb, but the earthly world appears chaotic. At adulthood, the interlinking has progressed to a stage where the earthly world not only appears ordered, but the adult believes his mind (i.e. his private conceptual system) to have all the recipes for conquering this world. At this stage, the neural network consists of many trillions of synaptic links¹⁵.

To use IT terminology, this neural network represents both hardware and software simultaneously. I.e., the physical growth of the network generates passageways for neural signals, and by so doing in a certain configuration, it also generates a programme for dealing with incoming neural signals. This is but one of the many differences to a hardwired computer (refer to the Appendix for other differences). The implication is that a re-programming necessarily involves a physical re-growing of the network.

The material and energy resources that have to be invested to get to the adult stage are enormous, and can be estimated from the running consumption of an adult brain: The human brain constitutes around 2% of the body mass, receives about 15% of the cardiac output, and accounts for nearly 25% of the oxygen consumed by the body. Most of this consumption is in the forebrain, and is used for the operation of an established self-consistent private conceptual system.

¹⁵ The number of synaptic links between an estimated 10^{11} to 10^{12} neurons in the human brain range from a few per neuron to several hundred thousand per neuron (Heinz R. Pagels: *The Dreams of Reason*, Bantam Books, New York 1989.)

Another important feature of this programming-by-network-growth characteristic of the forebrain is that the synaptic passageways for neural signals are undergoing constant change. They either thicken by frequent use, thus improving the conductance for neural signals, or they “wither” as a result of little or no use. In other words, the neural network and the associated conceptual system are never completely stable. And, the more frequently a chain of reasoning is used, the more likely is its re-use in the near future. I.e. man tends to stick to his/her regular arguments.

Now, how does the private conceptual system progress from the newborn to the adult state?

Certainly via memory, whether conscious or subconscious. If memory is thought of as consisting of individual autonomous elements which can be mentally re-assembled in different ways to create different imagined situations in which man can find himself, then we can compose a starting scenario for the formation of a private conceptual system. This (very simplified) starting scenario is that an observed situation is mentally broken down into autonomous memory elements which the forebrain stores in the form of as many differently configured neural micro-networks.

Initially, the newborn can associate these autonomous memory elements only with the originating situation. As the newborn observes more situations, he/she gathers more autonomous memory elements and learns to organise these into groups of likeness (likeness of appearance as well as likeness of interaction). Autonomous memory elements sharing features of likeness form individual ‘nuclei’ of separate conceptual subsystems. As more autonomous memory elements are gathered, these ‘nuclei’ grow, at different rates; but also new ‘nuclei’ are formed. On growth, the addition of a new autonomous memory element may require a re-interpretation of some or all autonomous memory elements in the ‘nucleus’ for the purpose of maintaining a high level of likeness. Or in other words, any growth of a conceptual subsystems may require a reinterpretation of some or all components for maintaining a high level of self-consistency.

Over time, these ‘nuclei’ grow into ‘islands’ of different sizes. And some of these ‘islands’ may combine into larger ‘islands’ as the growing individual learns how to detect or generate likeness between the autonomous memory elements of different ‘islands’. In other words, some previously separate conceptual subsystems may - as a consequence of learning - be combined into a larger conceptual subsystem, a condition being that the new subsystem be readjusted for self-consistency.

Eventually, the adult emerges with a dominant conceptual subsystem alongside one or more (essentially non-compatible) minor one’s (e.g. a dominant subsystem combining social ‘reality’ and physical ‘reality’, alongside a minor subsystem of a religious nature and another minor subsystem of superstitious nature, say). It is this dominant conceptual subsystem which has been referred to above as the private conceptual system.

As mentioned earlier, the private conceptual system is man's most treasured possession. He/she treats it as such by defending it against all challenges, but also by continuously managing it such that existing conceptual system and new information together form an enlarged conceptual system of highest possible self-consistency. The latter is sensed as plausibility, and lack thereof is sensed as mental stress (or cognitive dissonance). Plausibility is not something which can be imposed by rules, but something which derives from a contradiction-free routing of neural signals through the self-programmed neural network of the forebrain.

In order to improve plausibility, cognitive dissonance can cause (somehow) the neural network to re-programme itself, for instance by re-routing the relevant neural signals. But it can also induce (somehow) the conceptual system to self-improve by the invention of jokers, i.e. imagined entities, like spirits and gods, which can be held responsible for unexplained antics of nature. Where - according to modern science - man lay wrong about the existence of these imagined entities and their influence on nature, the consequences were not survival-threatening to Stone-Age man. But the fact that spirits and gods were and still are being used as jokers emphasises the importance of self-consistency of the private conceptual system. The mind (i.e. the private conceptual system) is primed to "fear" the cognitive dissonance associated with the loss of plausibility.

The Oxford Dictionary defines mind as "ability to be aware of things and to think and reason, originating in the brain". In the Parallel-Systems Mind Model, this definition of mind has been taken to a much more definite stage by equating mind to the private conceptual system. In view of the Theory of Conceptual Subsystems laid out above, mind must actually be equated to the full ensemble of private conceptual subsystems programmed into the forebrain. Hence, whenever, in the following, reference is made to the identity of mind and private conceptual system, then this must be understood to be an identity of mind and this full ensemble of private conceptual subsystems. For a full definition of mind in these terms, the reader is referred to the end of Chapter 10 (Summary and conclusions).

The Oxford-Dictionary-definition of mind puts emphasis on "the ability to be aware of things", i.e. on consciousness. The Parallel-Systems Mind Model puts emphasis on a vision of mind (and, hence, of the private conceptual system) as being an integral part of a continuously interacting and cooperating unity of body and brain, i.e. on a vision of mind as being "embodied". And it also puts emphasis on a view of mind as not being restricted to consciousness, but rather as consisting of conscious and subconscious mind levels which also interact and cooperate at all times. And on a view in which, in a mind consisting of an embodied and highly self-consistent private conceptual system, the overwhelming majority of neural processes proceed subconsciously (for reason that response activation in customary situations of challenge is fastest at the subconscious level).

The type of cooperation between the conscious and subconscious levels envisaged by the Parallel-Systems Mind Model has been described in Chapter 7 ('Free' will and the

conscious and unconscious levels of mind). The intention then was to show that man's thinking and behaviour can be retraced to a previously self-programmed private conceptual system which, while operating largely subconsciously, remains under control of the conscious level. Hence, man remains free to decide within the constraints of his/her private conceptual system.

There is actually not much more that we require to know about the relationship between the conscious and subconscious levels for purposes of this essay. But it may be helpful in future argumentation if this relationship is a little further elaborated here. Within the Parallel-Systems Mind Model the conscious level has a controlling function over the subconscious level not only in a situation as described in Chapter 7 ('Free' will and the conscious and unconscious levels of mind), but also whenever the private conceptual system is to be expanded by the incorporation of new information. This new information can be from external sources, but can also be self-imagined.

The Parallel-Systems Mind Model assumes that information from external sources is "checked" immediately at the conscious level before being accepted into or withheld from the subconscious level, whereas self-imagined information may arise at the subconscious level (e.g. during sleep). The latter is submitted for "checking" at the conscious level only if an implausibility arises within the conceptual system. Then, the conscious level contemplates (or causes the subconscious level to contemplate) possibilities for resolving the implausibility. In other words, the current Parallel-Systems Mind Model assumes the existence of a neural mechanism, involving conscious and subconscious levels, which prevents inconsistent new information to be established at the subconscious level of the mind (i.e. at the subconscious level of the private conceptual system). Let's leave it there, because it is neither possible nor necessary here to speculate on the nature of this interplay between conscious and subconscious levels

The above holistic (non-Cartesian) view of body and mind, and the holistic (non-Freudian) view of the conscious and subconscious levels of the mind derives from the belief in an evolutionary development of life, in which the new builds upon the existing. In consequence, one can expect man to have inherited substantial parts of his brain from his far-off as well as more recent precursors; *inter alia* the pre-programmed interbrain, responsible for what in animals is called instinctive behaviour. It is the pre-programmed "thinking" behind this behaviour which interferes with or even overrules the self-programmed thinking in the forebrain whenever stimuli are strong enough to trigger pre-programmed responses in the interbrain. Then, it becomes difficult to separate behaviour deriving from the self-programmed private conceptual system (i.e. the mind) from behaviour deriving from the dictates of the pre-programmed interbrain.

And finally, the holistic view of body and mind includes also the effect that the environment has on the genetic contribution to man's reasoning and behaviour. That such an effect exists can be derived from the study of bio-chemical mechanisms affecting the genetic control over the life functions (known as Epigenetics, i.e. "over the genes"). The key mechanism consists of a deactivation and reactivation of a gene (an "on-off gene switch", so to speak) by adsorption and desorption of a molecular methyl group. These

gene switches, which are present in the DNA of every body cell, have been shown to react to environmental factors such as experiences (kindness, threats), pollutants, food, and life style, thereby influencing bodily and psychic health. These environmental factors will also switch genes of the DNA in neural cells (neurons). Hence, when I have earlier associated mind with the configuration of synaptic linkages in the forebrain, then this configuration is supposed to include the contributions made by the interlinked neurons themselves. Namely those contributions which derive from the epigenetic modification of the DNA within every neuron, i.e. modifications in response to environmental factors. Since these contributions are highly individual-specific, they contribute in significant measure to the private nature of the private conceptual system.

10. Summary and conclusions

Key findings, key propositions, and key conclusions are schematically summarised in the following:

- Key findings/propositions/conclusions re. a mind-conceived physical ‘reality’ are that
 - each, traditional thinking and physical-science-based thinking, is (after many years of education) enshrined in forebrain-self-programmed private conceptual systems which constitute private physical ‘realities’, or the mind;
 - every private conceptual system corresponds to a specific configuration of the neural network in the forebrain, which continuously grows and modifies in response to new information;
 - this configuration is supposed to include the epigenetic contributions (i.e. contributions due to the environmental-specific bio-chemical on-off switching of genes) made by the interlinked neurons themselves;
 - new information derives from four sources: own experience, communicated experience of others, own imagination, communicated imagination of others;
 - communicated information is the major contributor to learning, because it is pre-interpreted and ready for “installation”;
 - the continuous growth and modification of the forebrain’s neural network necessitates an economy-wise use of forebrain-allocated resources;
 - once established with a reasonable self-consistency (sensed as plausibility), drastic re-programming of the private conceptual system is inhibited by this intrinsic economy-wise use of forebrain-allocated resources;
 - also the incorporation of ill-fitting new information is resisted, becoming manifest by a sense of mental stress (cognitive dissonance);
 - nevertheless, life-long development and modification remain possible, when reward appears to justify investment of resources (by conscious decision).

- Key findings/propositions/conclusions re. the inherent coaching of the mind to develop and think survival-oriented and economy-wise are that
 - the ultimate aim is to develop the mind to “see” order in the apparently chaotic world surrounding the newborn;
 - learning to categorise and to identify causes are primary goals towards this aim;
 - inferring by analogy (via caricaturing of subjects of thought) and metaphoric reasoning and conceptualisation are economy-wise, and hence preferred, because modifiable ready configured neural networks exist;

- this automatically leads to the assumption of a self-similarity of ‘nature’, and hence, to modelling based on (caricatured) analogy and metaphoric reasoning and conceptualisation;
- Key findings/propositions/conclusions re. the embodiment of mind and the function of consciousness are that
 - evolution always builds on the existing in an integrating way; so also the interbrain on the brainstem/body unit, and the forebrain on the combination of the two, all being in continuous cooperative interaction;
 - for the same reason, all levels of the mind (conscious and subconscious) cooperate at all times, but with different tasking;
 - hence, a holistic (non-Cartesian) view of body and mind is appropriate, as well as a holistic (non-Freudian) view of the conscious and subconscious levels of the mind;
 - the subconscious level(s) of the mind is tasked for fastest possible response activation in customary situations of challenge;
 - the conscious level is tasked for a (more time-consuming) controlling function of varied (only partly explored) nature, in particular when new and unexpected challenges arise;
 - the conscious level is (inter alia) thought to be instrumental for the development of a private conceptual system, for resolving implausibilities, and for controlling subconsciously activated responses;
 - in a mind consisting of an embodied, highly self-consistent private conceptual system, the overwhelming majority of neural processes proceed subconsciously.
- Key findings/propositions/conclusions re. the introduction of physical science into traditional cultures are that
 - in view of the foregoing, a traditional-thinking-based private conceptual system cannot simply be substituted by a physical-science-based private conceptual system, nor are single physical-science concepts acceptable to traditional thinkers if these are inconsistent with traditional thinking;
 - hence, a physical-science-based private conceptual system must be developed either side by side with a pre-existent traditional-thinking-based private conceptual system (i.e. collateral learning as per Parallel-Systems Mind Model), or by the conflict-prone enforcing of an early one-sided physical-science-based education.
- Key findings/propositions/conclusions re. causes and consequences of mystification of thinking are that
 - over time, all originally rational thinking becomes plausibility-deficient, then dogmatic, and eventually mystified on account of mainly two factors: (1) that during knowledge transfer by chains of communication essential details of the rationality of the original thinking are lost, (2) new facts emerge that discredit the rationality of the original thinking;

- traditional thinking as well as physical-science-based thinking are subject to this effect;
- in time, cognitive-dissonance-stressed wise men attempt a plausibility restitution of the mystified thinking;
- in Ancient Greece, conditions were singularly favourable for plausibility restitution via development of an alternative, uniquely elaborate, rational conceptualisation of the world which led to physical science;
- meanwhile, modern physical science has reached a stage of mystification where plausibility restitution in some areas is called for.

What is the mind?

The mind is an ensemble of embodied private conceptual subsystems programmed into a person's forebrain under evolution-favoured constraints by using information from four sources: own experiences, communicated experiences, own imaginations, communicated imaginations,

where the key evolution-favoured constraints are

- self-consistency of every private conceptual subsystem, and
- economic use of forebrain-available material and energy resources, for
- primarily the identification of causes.

Appendix: Dissimilarities of forebrain and computer

As stated in the Preface, a correct cognitive perspective of man's reasoning requires the reader to avoid too close an analogy of forebrain and hardwired computer. For instance, reasoning is associated with the configuration of the synaptic linkages between neurons in the forebrain, whence - to use IT terminology - this neural network represents both hardware and software simultaneously. I.e., the physical growth of the network generates passageways for neural signals, and by so doing in a certain configuration, it also generates a programme for dealing with future incoming neural signals. This and other significant differences between 'forebrain and mind' and a 'programmed hardwired computer' are schematically summarised below.

Forebrain and mind	Programmed hardwired computer
Slowly self-generating and continuously self-adjusting combination hardware-and-software, induced by to-be-interpreted sensory information.	Permanent hardware structure. Separate pre-formulated software, rapidly replaceable anytime.
No two forebrains and self-programmed minds are identical.	Identical hardware and software are common.
Individual minds act and interact <u>self-driven and unpredictable</u> at all times. Minds are embodied via interbrain and brainstem, and reasoning is directed by self-interest (survival-oriented and economy-wise).	Individual computers act and interact <u>instruction-driven and predictable</u> at all times.
Forebrains are without central processors.	Computers operate via central processors.
Minds are highly tolerant of forebrain faults: Even multiple neuron failure goes unnoticed.	Computers fail when a single connection fails.
10 exp 15 synapses with 2 on/off states each make for 2 exp (10 exp 15) possible mind states.	Even a terabit-sized (10 exp 12) computer has far fewer possible states than the mind.
Parallel operation in the forebrain compensates for slow neuron response (deciseconds).	Sequential operation is compensated for by fast component response (nanoseconds).
Minds accept only few variables as input.	Any number of variables are acceptable as input.

Two key messages of the foregoing comparison are that (1) the programmed hard-wired computer is totally unsuitable for analogous inferences re. forebrain and mind, and (2) hardwired-computer-based artificial intelligence has the potential of becoming an indispensable logic-based complement of man's mind, but never its substitute.

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