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AMPLIAÇÃO DOS RECURSOS GENÉTICOS DE SERINGUEIRA (*Hevea* spp.) PELA INTRODUÇÃO DE NOVOS CLONES-COPA RESISTENTES AO MAL-DAS-FOLHAS (*Microcyclus ulei*)

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A diversidade genética existente nas populações naturais de *Hevea* spp, na região Amazônica, é reconhecidamente muito grande e de extrema importância para o melhoramento genético da cultura, por concentrar genes de alto interesse agronômico, como aqueles que conferem resistência as principais doenças foliares que tanto afetam a seringueira nas áreas onde as condições climáticas favorecem o estabelecimento e a disseminação de patógenos, a exemplo do sudeste baiano. No entanto, a variabilidade genética envolvida nos clones atualmente disponíveis para o plantio é muito restrita e, este fato, tem sido um dos principais problemas para a expansão da cultura não somente no Estado da Bahia, mas também em outros estados do País onde se cultiva a seringueira. Por essa razão é que a CEPLAC, em cooperação técnica com a Embrapa Amazônia Ocidental (CPAA), introduziu recentemente, em sua coleção de germoplasma, vinte novos clones-copa, visando, assim, ampliar e diversificar a coleção local especialmente em termos de genes de resistência. Esses novos acessos poderão ser empregados nos programas de enxertia de copa e aproveitados no melhoramento genético. Quase sua totalidade resulta de híbridos interespecíficos envolvendo as espécies de *H. pauciflora*, *H. rigidifolia* e *H. guianensis* var. *marginata* e, atualmente, encontram-se em processo de avaliação fenotípica e molecular. O conhecimento da diversidade genética desses acessos, ainda na fase juvenil, permitirá uma seleção preliminar mais criteriosa para fins de enxertia de copa e devida inclusão destes em planos de cruzamentos que objetivam a piramidação de genes para resistência as doenças foliares e desenvolvimento de clones superiores.

Palavras-chave: germoplasma, enxertia de copa, marcador molecular.

Enlargement of the genetic resources of rubber tree (*Hevea* spp.) by the introduction of new crown clones resistant to leaf bright (*Microcyclus ulei*). The existent genetic diversity in the natural populations of Hevea spp, in the Amazonian region, is admittedly very large and of extreme importance to the genetic improvement of the culture, for concentrating genes of high agronomic interest, as those that confer resistance the main foliar diseases that so much affect the rubber trees in the areas where the climatic conditions are favorable to the establishment and dissemination of the pathogen, as in the southeast of Bahia. However, the genetic variability involved in the clones now available for the planting it is very restricted and, this fact, has been one of the main problems for the expansion of the crop not only in the State of Bahia, but also in other states of the Country where the rubber tree is cultivated. For that reason is that CEPLAC, in technical cooperation with The Western Amazon Embrapa (CPAA), introduced recently, in its germplasm collection, twenty new crown clones aiming to enlarge and to diversify the local collection especially in terms of resistance genes. These new accesses can be used in the programs of crown budding and used in the breeding program. Most of these clones derive from inter specific hybrids involving the species of *H. pauciflora*, *H. rigidifolia* and *H. guianensis* var. *marginata* and, now, they are in process of phenotypic and molecular evaluation. The knowledge of the genetic diversity of these accesses, still in the juvenile phase, will allow a more sensible preliminary selection for crown budding or even for inclusion of them in the crossing plans objecting to the pyramiding of genes for resistance to foliate diseases and development of superior clones.

Key words: germplasm, crown budding, molecular markers.

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The Environment of Classification: The Concept of Mutual Exclusivity

It has been suggested that information science is still at the stage of alchemy: if this is so then mutual exclusivity must form its philosopher's stone. Mutual exclusivity appears to be alien to the observable universe: that this is so is displayed through a series of examples. Some of these relate to everyday things like trees, beaches and man himself, whilst others relate to more obscure phenomena like continental drift and black holes. The act of observation is also considered as this has a considerable bearing on the problem.

Nevertheless, mutual exclusivity must form part of man's mental powers and this has found expression in the relatively exclusive series of symbols used in communication. The dangers of exclusive thinking in relation to environmental problems are considered, and this results in a paradox which is probably unresolvable. Finally, it is observed that out-standing genius appears to pay scant regard to existing classifications and is more likely to be involved in an integrated approach to problems.

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Within this, and subsequent papers, classification will be interpreted so as to incorporate all attempts at the imposition of order upon our observations of the universe. Clearly no series of papers could include discussion on all classifications, but no particular approach will be deliberately excluded. Bibliographical classification will be used, in part, to form an entrance to the subject, but it is not intended to limit the exploration to this specialized topic. In an earlier paper (*1*) the emotive word classification, with its connotations of library shelf arrangements, was deliberately avoided by the use of the word structure, sub-divided into *inherent*, *macro-* (or syntax) and *micro-* (or semantic) forms. Apart from noting that a common order, or concensus, is apparent in text-books within a subject area; inherent structure (or order observable within the universe) was largely ignored. In this paper the fundamental bases of classification will be examined: in particular the alien notions of mutual exclusivity and the use of inflexible structures to mirror a dynamic universe will be explored. Consideration of the wider implications of mutually exclusive thinking will not be ignored.

In a brief, didactic note on mutual exclusion Sharp (*2*) criticised Vickery (*3*), Needham (*4*) and others for ventilating the idea that 'facets must, or should be mutually exclusive'. Sharp illustrated his argument by Venn diagrams to show the exclusivity of the classes: *living; dead; male* and *female*. Unfortunately, or perhaps fortunately, publication of this work coincided with a public controversy on these fundamental issues. The introduction of heart transplantation and the disqualification of certain athletes on the basis of 'sex tests' were the causes of the disquiet.

• Primary Categories

Ranganathan (*5*) postulated that there are five mutually exclusive, primary categories into which all knowledge may be directed: Personality, Matter, Energy, Space and Time. Vickery (*6*) subsequently introduced an extended set based upon these, but attention will be focused on the original set.

The distance to stars is measured in light years: a unit combining time with space. Thus, when observing the universe it is impossible to see it as it really is at *present*. Many of the stars observed must have changed and some

may have ceased to exist. Further, because stars vary in their distance from the earth, the night sky presents itself simultaneously at various stages within its history. Nuclear physics has displayed the many links between energy and matter and these are extended still further in the theory of black holes (*7*). Black holes are thought to exist as the ultimate stage in star collapse. They are small, extremely dense bodies with gravitational fields of sufficient strength to act as traps for matter, energy, light and information and to be able to singularize space with time. Thus one theory would seem to be capable of invalidating Ranganathan's concept and seriously endanger the idea of mutual exclusivity.

It may either be argued that black holes are merely theoretical and no more real than unicorns, or that they are so far removed as to be insignificant (if our own star was to behave in this way, all human problems would be resolved without choice). Therefore it is necessary to transfer attention to terrestrial conditions. If a tree is examined it is found that *to be* a tree, as distinct from timber, it is essential for its roots to be in soil and for its branches to have access to air and light. If soil or air or light is removed there can be no tree—only timber: 'tree-ness' is energy dependent and tied to matter. As the combinations of energy and matter are only found under certain conditions (eg not above certain altitudes) trees can only exist in certain places. Further, individual trees are time dependent. Thus 'tree-ness' (the personality of trees) is related to matter, energy, space and time and none of these elements can be excluded from it. Moreover, as all these elements are required it would be futile to attempt to assign especial significance to any one of them, such as time or matter.

• Observations on Observation

Before proceeding further it is necessary to examine some of the physical limitations of observation (visual observation is accentuated, but it is hoped that other techniques will eventually be considered). The most fundamental of these restrictions is that the observer is part of what he 'observes'. This has been forcefully illustrated by Spencer Brown (*8*) in a treatise on the mathematics of distinction: this can be displayed by the following, lengthy extract:

> Let us then consider, for a moment, the world as described by the physicist. It consists of a number of fundamental particles which, if shot through their own space, appear as waves, and are thus of the same laminated structure as pearls or onions, and other wave forms called electromagnetic which it is convenient, by Occam's razor, to consider as travelling through space with a standard velocity. All these appear bound by certain natural laws which indicate the form of their relationship.
>
> Now the physicist, who describes all this, is, in his own account, himself constructed of it. He is, in short, made of a conglomeration of the very particles he describes, no more, no less, bound together and obeying such general laws as he himself has managed to find and record.
>
> Thus we cannot escape the fact that the world we know is constructed in order (and thus in such a way as to be able) to see itself.
>
> This is indeed amazing.
>
> Not so much in view of what it sees, although this may appear fantastic enough, but in respect of the fact that it can see *at all*.

In passing, as partial recompense for the extensive extract, it must be observed that Spencer Brown's work is of inestimable value in formulating bracketed search strategies for computer retrieval. Further, much of the present work is coloured by Spencer Brown's influence, even if only to the extent of making the author open his eyes a little wider.

The observer is also limited in what he can perceive at any one time: thus it is impossible to view a cloud from all angles at once as these are limitless (the six main ones are the four 'sides' the underneath and the upper surface: the interior also exists for observation). As clouds are constantly changing shape and dimensions, it is impossible to see any one cloud state from all possible angles. Although each cloud is unique in form it is possible, with time, to make generalizations about clouds by viewing them from various vantage points. This effect is of slight import when the phenomenum is likely to repeat itself (or virtually so to do), but it does cause difficulties when reporting unique phenomena, like ball lightning (*9*).

The above has introduced another limitation, namely that the world is in a constant state of change. That this should be so is hardly surprising as the world is both constantly turning upon its own axis and rotating around the sun. Further, all matter appears to be subject to the process of ageing. The theory of continental drift (*10*), at first received with scepticism, is a recent extension of the notion of a totally dynamic environment. But even earlier theories of static continental masses had accepted that vertical movement must take place: the new theory adds merely another dimension to the movement. Such movement would appear to be so slow that it might be ignored, but this only serves to illustrate the frailty of the observer. Because the observer is likely to be limited to a life span of approximately 70 years, this does not imply that more lengthy time scales must be ignored. Observing a dynamic system raises many difficulties and these are likely to increase if we attempt to 'freeze' our observations to meet the requirements of classification.

• Scale Effects

The affect of scale, or vantage point is highly significant; this can be illustrated by an example. A beach is appropriate as it forms the indeterminate area between land and ocean and is constantly changing in shape and

dimensions: nevertheless, it is not sufficiently amorphous, to be unrecognisable. Viewed from sufficient height the limits of land and water will appear to be rigidly defined as on a small scale map; from a lesser height the beach will be visible as a strand separating land from sea; from about six feet above the beach, ridges and ripples may be displayed and sand (or mud, pebbles, etc.) should be evident; whilst from six inches or so all that will be seen is grains of sand. With the aid of a microscope, individual grains of sand would begin to display a new world of crystal structures and ultimately a world of fundamental particles should be discovered. If the scale is too large or too small the beach disappears.

A beach may merely act as the junction between land and water, but the word frequently has emotive overtones. It may conjure up the feeling of sand between the toes, of sun-burned backs and hot summer days. These unquantifiable impressions are restricted to those fortunate enough to have experienced them. Thus the observer's own reactions are likely to color his reports even if these are disguised by an impersonal style. 'The reaction was observed' is an utterly illogical statement, unless the observer is describing someone else's observations—a most unlikely event in practice: 'I, or we, observed the reaction' would be far nearer reality.

Although the observer seeks to detatch himself from his observations, this is impossible on a terrestrial plane. Spencer Brown's views (*8*) have been mentioned earlier, but examination at a more superficial level is also required. The observer, like the things he is observing, is constantly changing and employing energy in the process. Thus he is bound to affect the environment which he is attempting to describe. This can be forcefully illustrated by considering the technique of sampling. If a piece of rock is chipped from its natural strata for examination the original rock will age more rapidly due to the fissure produced through sampling. The sample will have a greater surface area exposed to the forces of degradation than the original and by the time that it is examined it may not represent the real nature of the original. Further the force used to extract the sample may have caused fractures which could invalidate tests for strength. In the case of living things the technique of sampling is even more hazardous as death may invalidate the specimen. There is always a danger in sampling that the sample is atypical of the whole: for convenience samples are nearly always taken from the edges of the mass and these may be unrepresentative of conditions at its centre.

• Imperfections in Measurement

In all branches of observation there is the danger of attributing too great a degree of precision to imperfect measurements. 'Water boils at 100°C at sea-level' may appear to be an innocuous statement, but this implies pure water, the exact measurement of 100°C and knowing one's altitude. Clearly tap water is invalid; distilled water is more suitable, but as the distilled water has to be carried through tubing to a container, how can it be guaranteed that all items are *utterly* sterile and non-reactive? Can the accuracy of the thermometer be complete? As sea-level varies from place to place quite significantly, and there are tidal effects, what is sea-level? How can the exact registration of 100°C be ensured? Thus 'water boils at 100°C at sea-level' is merely an approximation, albeit a fairly accurate approximation and may be compared with 'the flight to London leaves at 10.35'. Unless the 'plane is high-jacked it is probable that London will be reached eventually and it is possible that the 'plane will leave around half-past ten, but nobody would pretend that airlines operate within scientific claims of accuracy. Science may work to finer limits than airlines, but the limits remain. If limits did not exist then number would be finite.

• Symbolism

It has thus been shown that mutual exclusivity does not appear to exist in the real universe: even if it did we would not have the ability to measure it exactly. Thus it must exist as part of man's mental processes and this has found expression in symbolism: phonemes, alphabets and numerals. Apart from the aural phonemes most symbols are restricted to two-dimensional planes. There are a few exceptions and these are mainly connected with religious symbolism: the Cross, the Crescent and the Star (Judaism, Communism). Molecular model-building and relief maps also attempt to escape from two dimensions, but discussion will be limited to words (the approximate counterparts of phonemes), but not until two-dimensional symbolism has been more thoroughly explored.

It would be difficult to dispute that alphabets and numerals are exclusive within themselves, except to note that O is common to both and has to be changed to Ø for computer use. Before the arrival of computers this duality rarely appeared to cause confusion: 'O that 0 after the 1 is a 0 not an O' appears rather artificial! Many typewriters can produce acceptable copy when the lower case L serves as 1 and l. If sets of symbols did not possess mutual exclusivity between their members discourse would be impossible. In English it is possible to communicate on a verbal plane with 26 letters and ten numbers. As the letters are employed on a very uneven basis it would probably be possible to reduce the set (KW in place of Q for instance), if this were to serve any vital function. In practice all 36 symbols can be replaced by binary notation, but this would be difficult to employ manually. Fenn (*11*) has observed that 'Mere mathematicians must accept that symbols will have to be used ambiguously sometimes, and hope that the reader will use his intelligence to place the appropriate meaning on them, at the appropriate time.'

The sets of symbols used as words are frequently not mutually exclusive. This can be hardly expected when words are used as tags to describe a universe which fails to clearly display exclusivity. Sometimes one word can carry several unrelated meanings (homonymy): seal (the aquatic mammal) and seal (the mark of approval), but more typically one word can possess several related meanings. This is because it is easier to express a novel idea in terms of existing vocabulary than to clothe new ideas in new words. In general short words which employ the commonest letters display the greatest shifts in meaning. Longer words, or words containing odd letters like Zs, tend to be less abused.

Homonymy and shift in meaning may appear to be major problems when words are considered in isolation, but within context they rarely cause problems. Even an artificial statement like 'The seal, bearing a leaping seal, was affixed to the document' is unlikely to cause difficulties in comprehension. If this was not so discourse would be impossible. Similarly the related problem of synonymy is to be expected within a world where it is impossible to make distinctions except in terms of shades. Ullmann (*12*) considered that absolute synonymy was a luxury which language could ill-afford.

• Classification: Shades of Formality

Although the power of language cannot be too greatly stressed, it is its alleged short-comings which lie at the basis of most formal classifications. The species of classification must now be loosely classified into degrees of formality. Firstly, there is what might be termed subconscious classification: this is closely related to words. It has been identified as hyponymy by Lyons (*13*) but has been criticised by Karen Sparck Jones (*14*) as lying outside the sphere of linguistics. Some words seem to fall into a natural generic order: thus it is possible to state that trucks are vehicles, but the converse (vehicles are trucks) is nonsensical. The difficulty with this relationship is in deciding whether:

i. it is the function of words as such
ii. it repeats a mental process
iii. it mirrors some essential order

It is probably a mixture of all, but it is significant that when a child first learns to speak it tends to use the more generic words before attempting to specify in detail. Thus a baby uses the words dog and flower long before it can cite individual species and in fact will recognize several breeds under the generic head. Another significant feature is that some words seem to form obvious groups, but no head word can be found to accommodate them.

Although the importance of the hyponymous relationship in words should not be under-estimated it must be emphasized that it does *not* offer an avenue towards mutual exclusivity. It is possible to state (*15*) that: potatoes, carrots, cabbages and tomatoes are vegetables, but it is also possible to refer to: strawberries, raspberries and tomatoes as fruits. Further it is possible to recognize that: hamlets, villages, towns, cities and connurbations are all settlements, but it is impossible to quantify the size of each unit precisely. It may be tempting to state that cities must have a population of at least 500 000 but if city A fails to reach this mark by 5000 at a later census does it lose its city status and become a town? What is a population of 500 000? It is merely a census record and must fluctuate greatly with season and time of day. If population density is taken as the sole criterion of city-ness, then many city centers cease to be cities every night and during weekends.

Verbal imprecisions have led to the foundation of more formal classifications for certain purposes, predominantly within the sciences, but also to some extent within areas of artistic criticism. The more precise of these possess their own symbolism and aim at a high degree of mutual exclusivity. A somewhat less precise group lacks its own symbolism, but nevertheless aims at a high degree of mutual exclusivity and usually notates its classes with proper, Greek, or Latin names, or derivatives of these. Lastly classifications may be generated to meet less exacting conditions, but may be identified by the deliberate use of jargon or more rarely symbolism.

The periodic table within chemistry offers an excellent example of a completely mutually exclusive *classification*, accompanied by exclusive symbolism. Within chemistry, H always represents hydrogen: O is always oxygen. The fact that neither hydrogen nor oxygen is likely to be *completely* isolated from its environment is almost immaterial except to note that it represents a goal rather than a reality. Thus water is only more or less H_2O: sometimes more; sometimes considerably less. Further, the notation is arbitrary and fails to correspond with English in many places; eg Sn for tin, Fe for iron, and there has been a failure to exploit the alphabet; thus two of the commonest elements under terrestrial conditions (aluminium and silicon) possess two letter notations, whereas rarer elements sometimes possess single letters (eg V=vanadium).

The requirements of meteorology have led to several classifications, some of which have been revised to achieve greater clarity. Symbols for mapping have been established for factors like wind speed and direction, falling snow, thunderstorms and rain. As they are used internationally and in many media they do not require illustration, but it must be stressed that they are used to describe current conditions as well as predictions. Naturally the symbols are used exclusively, but the conditions which they represent are *never* static. Continuous plottings of wind velocity look like a grotesque mountain range. Temperature is constantly fluctuating. The distinctions between rain, snow, ice, hail, soft hail and sleet are extremely difficult to define. How many flashes of lightning make a thunderstorm? When does a shower become a 'longer period of rain'?

At a less formal level clouds have been classified into a number of broad groupings based on height and form. The works used are readily identifiable being based on Latin: cumulonimbus, stratus, cirrus, etc. The difficulties in observing clouds have been noted earlier: this does not invalidate classification, but it does negate notions of mutual exclusivity in recording. The classification in terms of notation (the use of derivatives from a dead language) is highly exclusive. Similar classifications are found in the relatively exclusive taxonomies of the biosciences (notated in Latin) and in the several time-based classifications of geology. The latter tend to be notated with derivatives from proper names (precambrian, devonian, alpine, etc.) and these are less exclusive than the Latin derivatives used in many other natural sciences. Thus alpine may apply to flowers, ski-slopes and holidays as well as to earth movements. In practical applications, that is within context, the problem evaporates. Proper name derivatives are also used to identify some of the chemical elements: Strontium (the name of a Scottish village) and Americium for instance.

At an intermediate stage between hyponymy and scientific taxonomies lie the quasi-formal classifications created to serve empirical tasks. Sometimes these may be accompanied by notation. Frequently they may be created to serve the requirements of one work: a book or an article for instance. The use of notation is usually confined to standards and more typically this group can be characterized by its loose-ness.

• Notation

Notation has been receiving considerable attention. Sometimes an error is made in failing to appreciate the distinction between classification and notation. Some notationary systems are only incidentally related to classification, whilst many classifications, indeed almost certainly the majority, apply words in place of formalized notation. This is to be expected as words and notation overlap in function. Notations, which are only incidentally classifications require further examination: these include telephone numbers, postal codes, account numbers, and automobile registration codes. All of these are intended to be 100 per cent mutually exclusive for obvious reasons: they should be, but some errors may occur. The symbolism and exclusivity take precedence over classification, but elements of it may be observable. Thus place is usually recognizable and sometimes time as well. Glasgow telephone numbers are prefaced by 041 for all telephone calls made from outside the Glasgow area within Great Britain. If it is accepted that Glaswegians do not need to know their location when making their own local calls, then it can be stated that 041 represents Glasgow in the same way that 414 35 represents it in the Dewey decimal classification. Similarly YS is one of the letter combinations allocated to the same Scottish city for registering automobiles. Unfortunately these empirically derived codes seldom correspond and the British Post Office is guilty of operating two separate systems (telephone and postal*): as will be shown, this is as a result of mutually exclusive thinking.

In the above it has been shown that classifications are numerous and a vital component in logical thought: indeed it is difficult to discuss classification, or anything else, without constructing classifications. But the destruction, re-structuring and postulation of new classifications is an equally important part of scientific endeavour, and in part is needed merely to keep pace with changes within the universe. Zwicky (*16*) in his studies on morphological analysis, appears to favour the terms negation and construction for this process, but negation is too 'strong' in its overtones: classifications may be rendered obsolete, but they cannot be annihilated. Moreover, it seems that some of the greatest advances in thinking have been achieved by paying scant respect to existing theory: these are sometimes termed intuitive leaps.

The intuitive process is at the core of the problem. Man is an exclusive species—if he were not, he could communicate with lower orders of primates and he is the only species who explores for the sake of exploration. Whether thought is a Divine gift or an intricate chemical process need not concern us here, but the essentially exclusive nature of individual thinking must be stressed. All our 'objective' observations, immediately become subjective assessments and a science can only achieve a degree of objectivity through concensus. What is seen, is seen by individuals through their own eyes. With few exceptions, classifications are created by individuals. All intuitive leaps are made by individuals: no amount of group effort by lesser genius will produce the results attainable by one Newton, Einstein or Leonardo da Vinci.

• Mutual Exclusivity and the Environment

Environmental studies would appear to form the antithesis of rigorous mutual exclusivity. The true environmentalist tries, as far as humanly possible, to see the world as a whole. Thus he may be saddened, but not surprised to find DDT in the fat of peguins at the South Pole. Whereas the original applicators of the DDT could only see the advantages wrought from using DDT in terms of 'pests' on their own few acres. The construction of tall chimneys to rid the local environment of smoke is an example of mutually exclusive thinking on a national scale: the pollution eventually comes to earth somewhere else. Our misuse of the oceans and places of great scenic value are yet further examples of confined thinking. Everyone likes to have a 'convenient' urban freeway or airport as long as it is not built in his own back-yard. Mutual exclusivity within the environment

* Zip Codes.

is thus a contradiction, but even the environmentalist must be aware of his own enemy: recent bans on the use of DDT might help to save a few rare bird species in the developed countries, but a total ban in its use could have a catastrophic effect on tropical agriculture and health. Finally it may be noted that scientists tend to assess materials on the basis of their 'good' qualities (high tensile strength, for instance) and fail to explore their 'bad' properties. Thus a material prone to swelling in solvents will probably be assessed along the lines of 'poor resistance to solvents', but this quality may be capable of exploitation in other forms, as in caulks for instance (*17*).

On at least two occasions Batten (*18*) has stated that only God can classify. Throughout the history of man, the greatest evils have arisen when man has forgotten his own human frailty. The current interest in the environment has only emerged because the environment (and man in a *component* within it) is being assaulted on a greater scale than ever before. This evil has grown through man's false assumption that he is able to control everything that he sees and achieve a positive good in the end. Mutually exclusive thinking (which can be summarised in its most extreme form as 'I will get into the lifeboat first') is part of this evil. Man cannot isolate himself from his environment except on a religious plane and survive: in this respect his limitations are as great as that of the tree discussed earlier. He is dependent on energy from the sun, is limited within space (the effort in terms of energy in getting to the moon was enormous), and cannot survive without matter.

Mutually exclusive thinking beyond certain ill-defined, probably undefinable, limits is capable of great harm. Yet, provided that the notion of integrity is not ignored, the concept (and it is merely that) lies at the basis of all communication. Without the *idea* of exclusive conceivable truths, there can be no chemistry, no physics, no theology, no musical appreciation and no environmental studies.

• Mutual Exclusivity and Information Science

The concept has become the philosopher's stone (*19*) for many classifiers (some were mentioned in the introduction) and even endangers the integrity of information science: Brookes (*20*) has criticised information scientists for attempting to delineate the boundaries between information science and librarianship instead of postulating fundamental theory (whether these theories are ultimately rejected is immaterial).

In relation to information retrieval, other than 'traditional' bibliographical classification, the notion has found its greatest expression within the 'limited vocabulary school' of Boyd (*21*), Snel (*22*) and Moss (*23*). Boyd, Snel and several others deprecated the use of the words *term* or *descriptor* to designate their closely defined vocabularies and preferred the word *concept*. These limited vocabularies, together with the supposedly exclusive faceted classifications, failed to be as efficient as 'natural language' in the Cranfield tests (*24*) and this has been confirmed in subsequent tests by Michael Keen (*25*). It is almost certain that instead of resolving the problem, generic substitution (vocabulary limitation) makes the quest for exclusivity more difficult (*1*).

The quest for mutual exclusivity may be compared with Brillouin's dictate (*26*) that 'an infinite amount of information is unobtainable.' If, as it appears, that mutual exclusivity is only attainable on a *virtually exclusive* mental level then classifications (as empirical tools) can only attempt to be exclusive as in Sharp's (*2*) empirical demonstration about life and death. Classification is a difficult enough exercise without postulating unattainable limitations.

In subsequent papers it is hoped to display some of the techniques which have been applied in non-bibliographical classifications in an endeavor to discover common practice. This quest will not be hindered by searching for mutual exclusivity, but will rather try to trace unifying factors (thus morphological analysis is normally considered only as a forecasting technique, whereas it is in fact a form of classification).

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