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`Now' as the `actual occasion' to forge left and right cerebral exactness

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What is `now'? Now is more precisely defined by Alfred North Whitehead, OM (1861–1947) as an actual occasion that gives rise to a fact and is then gone. There are no facts in the past for all history is myth for the past is always a matter of interpretation. There are no facts in the future for they have yet no actual occasion. The Universe itself may be defined as just one big NOW— but an extremely complicated notion for as Einstein explained simultaneity nowhere exists between any of its parts.

We can dig up artefacts from the past but their existence is now. We may have memories of the past but these memories only exist presently. Every entity in the World has a fleeting (covariant) capacity to act on and a (contravariant) perception to receive from its immediate surroundings. That is a local `now' in both time and space giving rise to the synchronicity of the actual occasion where all the separate *loci* of each entity meet. These local `nows' all compose to form the big NOW. Curiously Whitehead's view of time as no more than the non-linear ordering of the World is really more in tune with Einstein's intuitive notion of space-time-mass than his (Einstein's) own solution of curving the absolute space of Newton. It also accords with Whitehead's understanding of quantum mechanics.

Whitehead uses the technical term of `concrescence' to describe this process of formation and composition. It is the process that brings into existence *matter* or *value* in Whiteheadian analysis. Matter is inexplicable in the standard Yang-Mills model of mainstream particle physics without a hypothesis of the existence of the Higgs-Boson and its subsequent controversial observation to fill the gap. It should be noted that that is bottom up and does not satisfy true topos theory which has no initial object. The Higgs-Boson like the inverse square law of Newton's theory of gravity is a mathematical creature born out of Euclidean space which Whitehead rejected after the intense study of logic in his early years. However a very good example of topos process can be found in the role of `now' in the forging of neurological paths in the brain.

To date it is only the emergence of category theory and the topos that enables the life sciences to escape the clutches of Euclidean space. It was Robert Rosen (1934–1998) who first proposed the use of category theory as a formal approach to the study of *life* itself but beware for mainstream is still running on a legacy version of category theory inherited with the failings of a Euclidean

space founded in set theory. So the `topos' of current literature is merely a reductionist model and only a shadow of the true topos that has no (so-called) `natural number' object and therefore free of the constraints of Euclidean space. Although he did not live to see it developed, true topos theory is a full and faithful formal representation of Whitehead's cosmology. It is also the appropriate `space' to support quantum processes on which surely the living brain relies. It should be noted that the current mainstream version of quantum mechanics is a hysteron proteron construction of Whitehead's thinking. The structure of a true topos is determined by all the potential relationships within it. All possible connections are *a priori* available. Whitehead uses the term `non-separable' to describe this feature. That applies to the cosmos as a whole where relationships arise from the laws of physics. The same applies to any sub-cosmos within it such as the living brain where the relationships may be described as neural paths.

The existence and prime importance of limits and co-limits as universal was not really recognised until the 1970's and not explicitly recognised by Whitehead although implicit in some of his writings. They need to be appreciated as operating at the level of metaphysics as recommended by Whitehead and therefore difficult to handle without category theory. Unlike physics which is never exact but only approximate, metaphysics can be precise for it potentially contains everything contrary to scientific models which are always reductionist. Co-limits are co-exact in that they are identifiable individually while remaining non-separable: a characteristic not easily representable in set theory, if at all.

Exactness arises from the unique relationships of adjointness. Thus for medical practice it is the difference between determining the proper remedy for the specific characteristics of a patient in personal medicine by contrast with relying on the results of statistical inferences from a wider population. At first sight this would seem even more critical for psychiatry and mental illness than in general medicine. However it is a much wider overarching problem for science as a whole. Whitehead's later work is a broadside attack on the confidence that science places on number.

Statistical models only hold at first order and their application to higher order phenomena should always be treated with great caution. This includes the use of measurement as pursued by physicists with almost religious fervour as contrasted with their scepticism for `anecdotal evidence'. Measurement is a projection on to Euclidean space. For higher order phenomena anecdotal evidence may be the only evidence because it is *evidence of now* and the only statement of fact ever available. For every `now' is unique in exactness. Reproducibility in scientific method is not repeatability. The Universe never repeats itself exactly. Whitehead does not include among his fallacies the false confidence in number but in reality it is allied to his fallacy of misplaced concreteness.

With the benefit of hindsight it is not surprising that category theory and the cerebral hemispheres follow equivalent relationships although historically their theories developed quite independent of one another. Left means rational; right means emotive. Left and right categories in a topos are related by a unique pullback f^* functor: left and right cerebral hemispheres are connected

by a nerve tract in the central cortex of the brain termed the *corpus callosum.* By the adjoint functor theorem the pullback functor can connect dynamically every relevant object in the left hand category with every relevant object in the right hand category and *vice versa.* However that *vice versa* is no mere simple `equal and opposite reaction' in the limited sense of Newton's third law. Rather each relationship takes account of every relevant relationship between every other object in the category. This is the fundamental structure of intuitionistic logic as introduced by Brouwer and developed formally by his student Heyting.

The key feature is relevant immediacy, the `now' determined by the adjointness of theory and by the physics in the real world that give rise to the actual occasion which in formal terms is a *monad* as an object in a topos.

This is a recursive instance where the method becomes the subject for there is evidence that learning and applying category theory requires the use of both cerebral hemispheres of the brain and the spotlight is on communication between the two hemispheres. Another area requiring such extensive co-communication is music and it is reported that professional musicians are found to have an enlarged *corpus callosum.* Musical performance turns out as fine example to illustrate the operation of lateralisation in the brain. One hemisphere controls the operation of the other at a lower level but different functions control different operations while maintaining coherence as a whole. This coherent process is coordinated with the outside world as an actual occasion. In an orchestra there is a higher level of coherence in the one actual occasion of the whole. The conductor of the orchestra may be imagined as a personification of the actual occasion semiotically exhibited by the tap of the baton.

Take the first violinist. The left hand physically produces the pitch through intonation and the right hand physically performs articulation through bowing. On account of the cross level control the intonation on the violin is handled by the right-hand side of the brain and the articulation is handled by the left-hand side of the brain. Keeping rhythm is an example of an activity requiring the co-ordination of both hands in playing the instrument and delivering the musical performance is achieved by the coordination of both sides of the brain— an actual occasion.

The front portion of the human *corpus callosum*, has been reported to be significantly larger in musicians than in non-musicians and musical training has been shown to increase plasticity of the *corpus callosum* during a sensitive period of time in development. The implications are an increased bimanual coordination, differences in brain structure, and amplification of plasticity in motor and auditory faculties which would serve to aid in future musical training. Thus detailed studies of magnetic resonance in children who practised regularly for at least 2.5 hours a week between the ages of 6 and 9 were found to have a *corpus callosum* larger by about 25% relative to the overall size of their brain.

Learning to play a musical instrument by practicing is a process action with perception by the senses of the surrounding circumstances and therefore an

ordered sequence of `nows' or actual occasions able to train and hence enhance the communication between the exactness and co-exactness of the brain. While Whitehead rails against the bifurcation *of* nature this is shown to be distinguishable from bifurcation within nature.