Title: Technology, Time, Transposition

Author: Martin Westwood

Abstract: Beginning from the broad proposition that art is a site for contesting temporality this paper considers the relationship between technology and time. Bernard Stiegler's concepts of tertiary retention and epiphylogenesis are used to consider archaeological heritage and its data analysis in technological apparatus. The claim is made that in the process of producing heritage objects situated in a media environment as tertiary retentions, archaeology also (from a *media*-archaeological point-of-view) produces an artifactual matter in the technical support that is open to subsequent data analysis. This process of data extraction and subsequent re-immersion of the tertiary retention's artifactual support into the epiphylogenetic is mapped onto Elie Ayache's interpretation of implied volatility in the Black-Scholes-Merton model for valuing financial derivatives. The paper negotiates these schemas in order to flatten the relation between the topographic site and its mnemo-technic supports making the paradoxical claim that the circulation of the tertiary retention, the derivative, precedes and underwrites the liquidity of the topographic site. In part this paper aims to test the purchase of its own readiness to makes jumps between two registers: the value and interpretation of cultural artifacts, and the value and pricing of financial commodities. This bilateral approach is part of a general project to sketch converging semiotic lines between symbolic and financial economies.

Keywords: Technology, Archaeology, Epiphylogenetics, Tertiary retention, Financial Derivatives, Implied Volatility

Email: m.westwood@csm.arts.ac.uk

That in the future an artwork is perceived differently than in the present or past is both a platitudinous, and a giddy notion. Who was/is/will be addressed? Lou Reed's 1975 'Metal Machine Music', an hour of recorded guitar feedback, is considered by some the most unlistenable record ever made. The 'unlistenable' quality and futurist title suggest 'Metal Machine Music' may require decoding; waiting for a metal machine to decipher, teach an audience how to listen, re-organising auditory capacities to become sensitized to its latent composition. Was it made for the human ear? Instead of metal machines re-wiring human organs, creating new physiognomic channels in which acculturation will occur, in 2002 *Zeitkratzer*, a Berlin ensemble, score the music for orchestra, making the sonic quotes of Beethoven's 'Eroica' that Reed claimed to have placed in the work, available to a more conservative ear and returning it to a principle of continuity. The story of 'Metal Machine Music' suggests parallel worlds of interpretation, unstable aesthetic-organological encounters, physiognomic anachrony, present incomprehensibility and future commensurability. 'Metal Machine Music' suggests waiting for the algorithm, or the Berlin orchestral ensemble, which will compute or with stylistic anachrony make 'Metal Machine Music' available to out-of-time ears. Sometimes forwards, sometimes backwards.

At least since the Renaissance art's primary dialogue has been with time. Aby Warburg's wager was that the survival of the antique in the Renaissance could be considered a matter of building archives and filing data. The Renaissance artist was, in Warburg's own image, filing antique history inside new formations of material and patronage. Sometimes the modern dialogue of art with time has been the explicit anthropological theme of mortality: the still life; at others the conversation shows itself as a romantic dilemma of untimeliness, arriving too early or too late, along with audience incomprehension, indifference or rebukal. Sometimes art became time's representative: avant-garde future, academic past, the return of the repressed. With Situationism the dialogue was manifest as an attempt to shake out of the habitual patterns and narcotic sleep of the consumerist spectacle, a demand to wake into history or assume its end. Sometimes the dialogue sought to erase all temporal deferral in an instantaneous present as with American Formalism. At other times, in the case of Adorno, art negatively guarantees historical progress; a guarantee it is allocated but alone it is unable to honour. Sometimes, as Boris Groys has noted of the 1960s and '70s generation of conceptual artists, the dialogue with time seeks to avoid the formal configurations that would historically situate them, evading the 'now', body-swerving the instrumental exhaustion of the contemporary (Groys 2013, 453). Telematic Art pushed time into a spatial dynamic collapsing time into the techno-politics of a shrunken geography. As soon as science-fiction film looked like a Merchant Ivory costume drama, and Constructivism appeared as a historical quotation, post-modernism had decided that time had either ceased, completed itself or was a knot of simultaneous threads.

Time itself has had multiple articulations: for one the Ancient Greeks wrote of *kairos* as a qualitative time of opportune moments. In contrast are the cyclical time of the seasons or the messianic times of resurrection and apocalypse in which only the one event of redemption or destruction counts; the eternal return of the same; the sequenced time of the medieval annalist's diary of equal units; historical time punctuated unequally by exceptional events; the longue *durée* of

the French Annales School; dialectical thought's synthesizing movement; historical materialism's inevitable progression; biological species' development over millennial timescales and the developmental paradox of evolutionary neoteny; physics' entropic time of dissolution and negentropic time of transforming stored energy; times of myth and legend; and a topological time that Michel Serres analogised to kneading dough (Serres 2015, 68–71).

Such a list could go on. And on.

Technology narratives

There are many technological narratives of time. The futurology of the Technological Singularity predicts a time when computer programs will be better than humans in writing their subsequent generation (Vinge 1993). In the Singularity's narrative computers, not humans, begin to program software that develops through a process known as recursive self-improvement. Through autonomously optimizing their potential such software programmes eventually surpass human cognitive capacity. To some the Singularity is not a comfortable view; a familiar human agent loses its deceptive ability to map and rationalise a world now modeled by an intelligence in excess of the human. For others, more sanguine, the Singularity is seen as a beneficial augmentation of human intelligence. This view, taken to its logical limit, quickly finds reflection in the mirror image of augmentation: redundancy and fragmentation. A fragmentation in which the human world is divided from an outsourced memory and computational calculability leaving the cerebral cortex and cerebral lobes as wallflowers. Situated at the opposing end from the Technological Singularity is the *bulb of percussion*. The two narratives act as chronological bookends for narratives of the technical. An end and a beginning to the expression of the human in technicity. Tool manufacture is found two-and-a-half-million years ago, during the Pleistocene period, but the Holocene period of twelve thousand years ago marks the transformation of the lithosphere by human labour. In paleo-anthropological narratives 'bulb of percussion' is the name lithic analysis gives to the distinctive shape created on lithic flakes from knapping, the chipping away of flakes from flint to produce tools. The bulbous form is produced by a percussive striking action of hard stone against softer stone, distinguishing the bulb's production from natural erosion or geologic movement. The discovery of many bulbous flakes, within vicinity corresponding in scale to the working area of a single human body, allows the credible identification of sites of Stone-Age tool production. The 'bulb' is a surviving material micro-witness to an initial method through which human labour transformed its environment.

In 'Gesture And Speech' the French archaeologist André Leroi-Gourhan, writes of the beginning of the human and the beginning of technology as one and the same, the categories stand and fall together. For the human everything proceeds from adopting the upright stance. Becoming bipedal, releases the hands from their role in locomotion, becoming free to grasp; in turn the mouth is released from its role of grasping or holding becoming free to signify through facial gesture and speech (Leroi-Gourhan 1993).

According to Leroi-Gourhan, the human group assimilates its environment through tools. The appropriation of the geographic environment occurs through a "curtain of objects" forming an "artificial envelope" of technical facts providing protection and conservation for the group ('Milieu Et Techniques' quoted in Stiegler 1998, 57) Central to Leroi-Gourhan's thesis is the interlinking of anthropogenesis and technogenesis, the origin of the human and the origin of the technical occur in

one and the same stroke. He describes "[…] the concept of tools as being a 'secretion' of the anthropoid's body and brain." (Leroi-Gourhan 1993, 91)

For Leroi-Gourhan the human group has a technical tendency. This technical tendency is a movement within an ethnic group's shared history, culture and organisms (the "interior milieu") as it gains purchase upon and appropriates its geographic, climatic and extra-cultural environment (the "exterior milieu"). The pre-historic maker through application of the interior milieu appropriates the exterior milieu into tools, advancing the gradual development of a "technical milieu". This technical milieu has the capacity to newly appropriate features of the external milieu, whether environmental or extra-cultural, previously out of reach (Stiegler 1998).

This narrative of technology beginning with the transformation of the lithic environment develops into a realm of enclosed automation evidencing a progressive control of and eventual autonomy from the external milieu. The prehistoric axe maker was attentive to and directed by material irregularity: the fibrous grain of wood, the strata within flint, in a sensory dialogue with material. Subsequently, the animal became harnessed (the ox ploughed the field), later industrial ecological power (windmills, dams) accelerated the technical tendency. The outsourcing of manual gestures to automated industrial machinery resulted in an amplified power and the irrelevancy of the previous sensitivity to material irregularity.

In the development of industrial and digital technologies engineers manipulate chemical material to dovetail with the capacity of automated machinery. The outsourcing of human labour into automated processes creates an eco system of automated production; an enclosed system of manufacture built upon interrelationships between machines and synthetic material allowing the incorporation, reconfiguration and standardization of both. Technology inaugurates a new external and now autonomous milieu, distinct from geographic environments, in which initially imitative and subsequently synthetic material, such as liquid resin melted and hardened with laser beams, is innovated (Paysant, n.d.); synthetic materials and automated machinery form an autonomous enclosure.

The object presented by the collaborative research project of the European Space Agency (ESA), Foster + Partners architects and Monolite UK (engineers of a robotic building system called D-Shape), is a one-and-a-half-tonne, 3D-printed regolith building block, manufactured for the construction of lunar habitats (Foster + Partners, n.d.). The block is a test print formed through melting and printing regolith simulant (fig. 1). The moon's surface is covered with a blanket of soil, dust and broken rock called lunar regolith. It is from this blanket of lithic dust that the research partners aim to 3D-print lunar bricks. Looking to build the first inhabitable structures on the moon through the technology of 3D-printing, the partners propose that regolith will be vacuumed from the surface of the moon; energy derived from the sun will be focused with mirrors to melt this regolith dust, which will then be extruded through Monolite UK's large-scale architectural 3D printers. This exceptional and not at all outlandish manufacturing proposal is being innovated to avoid the costliness of transporting materials over a 380,000-kilometre journey. Terrestrial building practices organized around enduringly human labour are also, obviously, inappropriate in the hostile lunar terrain, leaving the limited human interaction with robotics as the sole option.

Fig. 1 ‘1.5 tonne regolith building block’. Produced by Monolite UK as a demonstration of 3D printing techniques using lunar soil. Credit: ESA

Unsurprisingly, ESA’s test-brick doesn’t conform to expectations of the technical horizon of advanced robotic processes. The outputs of 3D architectural-scale print technology cannot accommodate or take account of the binder shrinkage occurring when molten material cools, resulting in geometric distortion and the appearance of a distressed and weathered topology. The block appears as an ancient architectural fragment as if dredged from an Etruscan burial chamber and not the science-faction narrative of future progression imaginable

ESA’s test print is both a development in the history of the brick and an embryonic lump born from the most advanced technological innovation and imagination. It proposes a condition in which symbolic form appears short-circuited; a feedback loop of time, automation and contingent imitation. The need for the most basic of housing constructions, in the most challenging planetary circumstances, produces the image of a pre-historic relic. There is little relation between appearance, symbolic form, ambition, chronology and manufacturing know-how in this lunar brick. This engineering project of eco-poietic terraforming inadvertently and negatively re-stages a familiar dialogue for architecture, that of technical construction and symbolic form. It performs this dialogue as a dis-association due to its existence at the outer reaches of imaginable manufacture and in doing so undercuts the cohesion of symbolic form and the expression of a technological horizon. The regolith-simulant brick’s symbolic potential is ideologically distended, a deformation resulting from the radically new distance now involved between interior and exterior milieux. A situation characterised, quite literally, as alienated; symbolic form alienated in the over-reach of the technical milieu. Hypothesising the building block’s unprovable significance backwards as follows: it is as if the first hunter-gatherers chased imaginary bison around caves and practised flint preparation for hundreds of years before venturing on to the prairies.

In a footnote to 1867’s ‘Capital’, Karl Marx is the first to propose that a critical history of technology is yet to be written (Marx 1990, 493–4). Whilst Marx doesn’t directly request an *evolutionary* theory of technology, his references to Darwin’s achievements in natural technology make it implicit. In 1958 Gilbert Simondon posted a delayed response to Marx’s proposition.

Simondon described a process called concretization. Concretisation describes the evolutionary process of technology in which inevitable chemical and physical solutions to mechanical multi-functionality occur (Simondon 1980). Thinking technology as an autonomous time Simondon considers it in a development that is independent of the human, evolving without human invention yet with serendipity, observation and assistance; arrived at through empirical discovery, not the application of scientific principle.

Simondon expresses a technological purism in which technology's development is by and large interfered with by consumerism. The consumer experience casts a cloud over technology, taking it off course like mythology's sirens. The consumer has no interest in how a car works, what kind of engine it has; only journeying from A to B counts. It matters none to the consumer whether it is a steam, turbine or piston engine. It matters even less that in terms of mechanical function a spring engine shares more with a crossbow than any other engine (Simondon 1980, 18). Yet these distinctions are for Simondon exactly what is proper to considering mechanical technology. For Simondon use is a deforming anthropological horizon that disfigures technology's evolution when consumerism is allowed to dictate its terms. Customisation is at the furthest remove from questions of technology and can occur only *because* it is non-essential and only non-essential elements can be customized (Simondon 1980, 22).

In Wolfgang Ernst's essay 'Distory', he describes how technology travels different journeys and time frames than user experience (Ernst 2012, 158–71). Ernst's media archaeology differs from a history of techniques, proposing a subterranean existence where technologies remain vestigial. As Ernst explains it, electro-magnetic radio employed in wireless radio doesn't develop in successive steps towards digital radio; it diversifies in a sideways development, becoming employed in radio-frequency identification (RFID) for tracking goods in supermarkets (Ernst 2012, 165). Electron tubes continue to be employed, but as with Simondon, the journey can't be narrated or accommodated by observing chronological developments in consumer utility or satisfaction, though with Ernst a transversal temporality of technology is proposed.

Tertiary Retentions and Epiphylogenesis

Edmund Husserl's phenomenology was concerned with the perceiving subject's experience of the present as the meeting of *primary* retentions (the remembrance of the previous notes or words in a melody or sentence; the perception of a present that carries forward and transforms its immediate past) and protentions (expectations of that which is about to happen, that a word follows this one, that a ball continues its parabolic flight). The composition of these two aspects of attention makes the perception of an extended present possible, constituting lived temporality for consciousness (Stiegler 2014, 34).

Re-callable experience, subjective memory of a lived past, Husserl named as *secondary* retentions. For Husserl, secondary retentions are imaginary, having no connection to the immediate access that primary retentions establish to lived experience. Bernard Stiegler writes against Husserl on this issue. Stiegler disputes Husserl's isolation of the primary from the secondary retentions. Instead of their isolation, secondary retentions, memory of the non-present past, organize and select primary retentions in the immediate present. Past experience is structured by the imagination, providing the ground upon which the present is selected and filtered by consciousness: a cognitive economy (Stiegler 2014, 52).

For Husserl there is no role for technology in the subject's experience of time. Challenging this oversight Stiegler disrupts the relationship of the Husserlian scheme, introducing the technical and focussing on a fourth form of attention: tertiary retentions. Tertiary retentions are mnemo-technical supports, technical structures that constitute an unlived memory. Tertiary retentions constitute trans-generational memory formulated in books, libraries, digital files, painting, sculpture, monuments; a non-subjectively experienced past. Stiegler writes that the tertiary retention organizes the relations between the primary and secondary retentions. Technical memory organizes and determines the relations between the perception of the lived present and the imagination's filtering of that present. Stiegler's thought is directed to the impossible separation of primary, secondary and tertiary retentions, with the result that technical supports, an inorganic memory inscribed and preserved non-biologically, are writ across both the lived present and the imaginary of the subject both of which become a function of the third form of memory. Tertiary memory is a technical memory support, constituting the primary and secondary retentions, not derivative of them. This insight allows the assertion that subjective access to the present is, in an indivisible part, technological, enabling the phenomenological approach inherited from Husserl to account for an exoskeleton of technology connected to and organising consciousness.

The addition of tertiary retentions to the phenomenological schema of temporality coincides with Stiegler's concern with the programming of life. Looked at as an evolving techno-biology, the process of producing tertiary retentions, gives rise to another terminological extension; that of the two-part relation of genetics and epigenetics, to include yet another term: *epiphylogenesis*. The epiphylogenetic is the third form of species memory, following the cellular genome and the epigenetic experience of individual nervous systems. Epiphylogenetics are inorganic and organized cross-generational memory, "the process of production of […] tertiary retentions" and the "*sedimentary deposit* left by the process of [their] production" (Stiegler 2014, 34–35); the memory supports allowing the human's adoption of a non-lived past.

Whereas animals lose experience stored in the individual nervous system on the death of the individual organism, the epiphylogenetic, allows the transmission of this information across generations. 'Technics And Time 1' (Stiegler 1998) describes a differentiated but shared ground of the genetic and the epigenetic in the epiphylogenetic: the "*sedimentary deposit*" of tertiary retentions; heritage understood as a technical support. Stiegler advances a view in which human life continues through the non-living, sustained in prosthetic artifacts of cultural groups. It is important to note that the tool is not conceived as an aid to the human, rather as its constitution. After the closure of the cerebral cortex, the human is pursued, that is finds its end, in the prosthesis.

Articulating the epiphylogenetic Stiegler, indebted to Leroi Gourhan, uses the term "vector of memory" (Stiegler 2006) to distinguish cultural memory that is not specifically designed as an aid to memory: flint stones, lampshades, parking lots, from techniques specifically employed to store and construct memory: tattoos, writing, monuments, phonography, photography, integrated circuits. The "vector of memory" is the history of a tool's stereotype, something close to a typology: a repetition, duplication and incremental evolution. The ethnic group stores memory in its artifacts; a knapped piece of flint or a commonplace and everyday tool is situated in a vector, an inheritable depository of know-how.

Epiphylogenetic heritage is constant: the pepper pot, garden fence, lampshade, car park or the intangible heritage of making a loaf of bread and other skills or customs. An unfamiliar temporal arrangement occurs when considering everyday heritage as past. The epiphylogenetic experience consists in the world assuming the quality of having already been there before the phenomenological subject's experience. This 'before' meaning 'in front of' and 'in advance of' is a

sedimented past in advance of the 'now' in which it is experienced. If it is always-already ahead of the phenomenological subject this subject experiences it as its possible future; the objective past engenders the condition of adoption preceding experience. Epiphylogenetics allow the adoption of the unlived life of inorganic supports and a relation to time preceding the subject. This adoption is inheritance, heritage, the unlived as the subject's future.

Media

Marx's 1867 request for a history of technology is complicated in the era of media recordings giving little regard for a phenomenological subject whose memory is now organised through electrical and chemical technologies. The electronic patents of Alexander Graham Bell and Thomas Eddison, along with the invention of photography allowed the communicative distances of space and time to be overcome in technologies bearing the sender's imprint: physical inscriptions in wax, and chemical inscriptions in celluloid. A receiver of this information was a reader of an indexical epigraphy inscribed in material as the physical records of actual visual and audible events. A set of operations utilized the passing present as its retrospective evidence. In the era of media technologies the phenomenological experience of the present is not conceivable as primary but, instead, as Louis Kaplan notes, physiology is exposed to the technical effects of "slow motion, playback and delay feed." (Kaplan 1994)

In his 1986 introduction to 'Gramophone, Film, Typewriter', Friedrich Kittler describes the passage of audible language into the discrete units of alphabetic writing. For this process Kittler writes "[…] all data flows […] had to pass through the bottleneck of the signifier" (Kittler 1999, 4). The phrase describes the unitization of the alphabet and the resulting effect of editing unwanted noise, as the audible sounds of speech are translated into the discrete code of writing. A new situation arises in the un-semantic, unbiased recording of analogue media – spit, snivel and background information; the uncomposed, accidental, quotidian and un-grammatised appear as elocution's equal. Analogue records became depositories open for next-generation media analysis: capturing and processing unaccounted information previously considered noise. The hiss, spit and crackle of the past becomes available to novel forensic analysis at each new technological shift. To say the media artifact becomes a resource in time, of time, does not go far enough. The artifact is born as media: together constituting time.

Archaeology studies moments in the epiphylogenetic "vector[s] of memory" by mediating material cultures and artifacts. The application of the physical sciences to archaeology in techniques such as magnetometry, radiocarbon dating, dendrochronology and archaeomagnetic dating alongside cognitive visualization techniques such as photogrammetry and Reflectance Transformation Imaging have expanded the possibilities for the data capture of an artifact. Archaeological remains are in a state of permanent epistemological flux, dependent upon the technology employed. Given that archaeology voraciously reads artifacts through the ever-new technical methods of the physical sciences, a conceptual tipping point occurs in which archaeology no longer effectively employs chronological time; instead the past becomes coordinated through the application of technological media which, according to Ernst, is indifferent to chronological unfolding. Instead the media archaeological view of technology's temporality is a vestigial quality of achronicity, a quality that does not close the door on technological pasts or uninvited continuities. Ernst following Stiegler's emphasis on the sedimentation of history in artifacts as depositories, as

archives, states “the condition for our knowledge of history becomes dependent on the media of its transmission” (Ernst 2012, 42).

Archaeology creates conditions for adopting the past through a succession of technical anamorphisms. A changeable mnemo-technical horizon of tertiary retentive devices squints at an artifact, ushering it into transmission. Under conditions in which adopting the material past arises from the technical possibilities of mediating this material past archaeology’s technologies produce a tertiary retention and a “sedimentary deposit” without antecedent in the epiphylogenetic support. As if the process produces a doubling or split origin.

First, vectors of memory are a material archive of know-how, a technical inheritance, an instant in the tool’s stereotype, arrested and preserved as the materialization of duplication and repetition. This vector of memory is detoured through mnemo-technical apparatus, extracting data from a mute moment in the stereotype of a tool. The vector of memory is re-utilised producing paradata: accidental information, and metadata: structural and descriptive data. Just as the artifact is preserved, so are the records of its information, a process of producing tertiary retentions. A technical montage results, consisting in the superimposition of tertiary memory upon epiphylogenetic memory. Archaeological time, like that of media becomes a transversal temporality of a technically registered retention wrapped in dialogue with vectors of memory. The epiphylogenetic memory is embroiled in the memory of the media of its transmission.

In ‘The Aesthetics Of Ambivalence’ Brooks Landon notes how science-fiction film displays special effects as artifacts. Science fiction affectively presents its technological subject matter by the spectacular display of technological science in special effects, frequently interrupting narrative development. For Landon it is within the imaging capacities employed in science-fiction films, specifically computer-generated imagery, and not in plot or character, that the history of the genre is discernable. Landon prioritises a view of science fiction concentrating on its production techniques to generate a fantastic consciousness of time. Representing fantastical time is marked by contingent materialities of production allowing its representation (Landon 1992, 61-92).

Archaeology mirrors this effect presenting its own history of technological affects running counter to the narrative discourse of history. Artifacts (physically excavated only occasionally) exist as state-of-the-art information modeling. Viewed from a future, archaeology offers a historical costume drama of technology dressing artifacts, a material history of media and affect, with each production of tertiary retentions kaleidoscopically elaborating an artifact. Each technology registering the forceps marks of its process of transmission.

Juno-Moneta and Contingent Claims

Andrew Meadows and Jonathan Williams essay ‘Moneta And The Monuments’ explains the etymology of the Latin *monumentum* as deriving from *monere,* meaning to call to mind. All things meaning to bring to mind an event or person are, in Latin, *monumentums*, whatever their media; poems, buildings, statues, inscriptions, historical accounts. Monuments are tertiary retentions. Meadows and Williams describe how the monument’s cultural operation of hypostasis is not excluded from general circulation. In Ancient and Republican Rome, historic and contemporary images stamped upon coinage staked out claims within collective memory. Images of elite Roman families and their victory in war or prestigious endeavours were the motifs of Roman coins. Coins were small-scale devices for circulating and claiming public memory: mini monuments. (Meadows and Williams 2001)

Meadows and Williams articulate how Roman belief had Moneta as its goddess of memory. In her personification as Juno Moneta the goddess's memorial function was connected with coinage and the Roman mint, located in the Temple of Juno Moneta. The Temple was both the mint and the location of the Roman standards of weight and measurement. Meadows and Williams describe how the Roman goddess Moneta joins together memory, monument and money as the guarantor of both historical memory and, as the issuing authority, the standards by which measurements and coinage can be accurately certified.

"Moneta is a goddess who remembers and certifies the accuracy of the records. Feet measure distance, coins measure *pecunia*, and a consular list measures the past*"* (Meadows and Williams 2001, 37). The records, that is public memory, written and stored within Moneta's walls, the treasurer's temple, are the documents of the cultural group's past serving to heed off, through the advice of that past, future threat. Moneta authorises the symbolic universe as the guarantor of both standards of measurement and monetary value, remembering and certifying, issuing the law of measurement that is the law of valuation guaranteeing both access to time and coinage.

The eighteenth-century fashion for depicting architectural ruins occurred during a period of unprecedented speculation on financial futures in the markets of France and England as Nina Dubin has elaborated in her study of the French painter Hubert Robert (Dubin 2010). An expanding real estate and credit bubble saw its mirror image in catastrophe and swelling debt. In situations of financial speculation the fear that the present has no solid ground, that value, in the form of maturity dates of stocks and bonds, has migrated from present to future tense finds its expression in images of crumbling structures and unstable futures. In presentiment of an ancient cycle of decline the market's volatility is made approachable through images of decay. A society of risk and speculation, of credits with awaiting repayment dates, is aesthetically mirrored in Hubert Robert's images of Parisian architectural volatility (Dubin 2010, 91).

Probability analysis of financial derivatives views their pricing as a function of the stochastic price pattern of an underlying asset; a time-based price-series, allowing the future payoff and the valuation of a derivative to be statistically calculated through data patterning possible states of the world (Ayache 2010). Elie Ayache articulates how the Black-Scholes-Merton model of manufacturing contingent payoffs allows the reverse-engineering of the underlying's volatility value: by reading the price of an option and inverting the BSM model, a trader arrives at the volatility value of the underlying asset (Ayache 2015). This is called *implied volatility* because it is volatility implied by the option price and not arrived at through considering the price series of the underlying.

When the terms *derivative* and *underlying* are displaced and transposed to tertiary retention and archaeology's epiphylogenetic heritage, the calculation of implied volatility gains a peculiar and unexpected aptitude. The epiphylogenetic artifact of archaeology has to have been somehow 'lost' to meaning, value, volatility and therefore being only evaluable through its derivations, through tertiary retentions. The derivative's price is the material measure, translation, exchange, for the semantic volatility/liquidity of the epiphylogenetic asset: only arrived at through implication, through implied volatility; reverse engineered from the contingent claims of tertiary retentions.

When it comes to artifactual remains we might think of the underlying as a piece of flint, a value without a price; of the price as its semantic differentiation as a bulb of percussion; of the price series as "the vector of memory", the history of a tool's stereotype or its typological series; of the valuation process of the contingent payoff as the techno-cognitive economies of tertiary retentions; of the contingent claim as the insertion, not of the information but of the technical support, the

material ground of the tertiary retention, its own sedimentary deposit, (arising from within the valuation process), into the moment of tradability, legibility and its assumption of a price.

The underlying is not evaluated within a temporal process of increased technical complexity, disclosure and completeness (for example, the movement from field drawing to geophysical survey to archaeomagnetic dating). Instead, the underlying follows its writing as a tertiary retention, existing in the wake of the tertiary retention. That tertiary retention is then priced by a further tertiary retention (perhaps written-up as research) and so on; tertiary retentions synchronically extending any given moment of vectoral memory, an extension in which media transposition, not time, figures as the primary mover. The stability or instability of the chain established (a chain to be considered in terms of semantic liquidity/volatility) determines the underlying's price/legibility.

Tertiary retentions are available to second-, third-, fourth-generation analysis: a chain of derivations that establish the valuation model of the underlying. Wolfgang Ernst writes that Thomas Edison's wax phonogram cylinders are now read by optical technologies that calculate visual signals into audible values by a digital technology indifferent to distinctions between the optical and audible, as well as between the semantic and the accidental (Ernst 2012, 66). Unpredictable technical readings are imaginable of contemporary and historic artifacts in the future. Surplus and deferral in the recorded traces of media are revealed by new technologies. New media give rise to new data; the cough, omitted from the written account, is as present as any polemic in an audio recording.

The time series of the underlying, its volatility value, is construed from the price series of the contingent claims. A price series that in technological terms is anachronic: "Media trigger media memory according to nonhistorical laws of their own" (Ernst 2012, 66). Just as Ayache discusses the valuation process of the contingent pay-off being re-immersed in the market as a contingent claim the tertiary retention is re-immersed in the market, not standing on its periphery as a calculative value without translation into price (Ayache 2015, 1–15). A semantic oscillation is produced between the valuation process of the payoff and its re-immersion as a claim. This oscillation is between the mute (untraded) material value (that does not speak any actualized price whatsoever) and its translation as a price, each discourse development leaving a non-discursive artifactual value in its wake.

The Heritage Industry manufactures time, building a stochastic process through the contingent payoffs of tertiary retentions. The site rather than being the underlying asset, is simply a further contingent claim in the series of cognitive pricings. And simultaneously, but at this spectacular point, it is also the remnant-effect of backward looking narratives. The topographic heritage site of epiphylogenesis (whether geographic or artifactual) is but another contingent claim: its actuality becomes modulated. The topographic site is a spectacular husk of a patrimonial process of multiple tranpositions; archaeological processes de-situate and economise data leaving the "vector of memory" persistent now as its own hollowed-out shell. An instrumental remnant from the re-situation of knowledge; a pedagogic tool, a tourist site or the aesthetic construct called ruin.

Afterword

Fig. 2. "Joseph Michael Gandy, 'An imagined view of the Bank of England in ruins', 1830, ©Sir John Soane's Museum, London 2016.

Etymological relationships between memory and money run through the English language. Giving an account, to recount, to make a story count in how you tell it. Telling is what bank tellers and automatic telling machines do when they count money. As Meadows and Williams remind us memory, counting and history are linked.

Joseph Gandy pictured John Soane's monumental rebuilding of the Bank of England in an allegorical gesture of simultaneous past, present and future. The floor plans of his architect-employer Soane are picturesquely modelled in Gandy's 'An imagined view of the Bank of England in ruins' (1830), rendered in the contemporary fashion of antique ruins and proposed as a future yet to come (fig. 2). The bird's-eye viewpoint from which the ruin is surveyed conflates with the projection of a floor plan; an abstracted anticipation of construction mapped onto an imaginary material disintegration. The collapse of the calculation and the calculus. History's vertical monuments to time revisit spatial horizontality. The state's vertical guarantee of measuring both past-time and coinage within Moneta's walls is challenged by the re-emergence of the horizontal plane where the Bank's fortress is constituted as territorially permeable.

It's history painting, not of individuals actions or discourse, but of time sedimented and deposited in the always-already and inclusive of the event disfiguring this always-already. Meta-archaeology as a financial technology and figured as a polysemic temporal imagination. That is finance sedimenting time – archaeology building debts and conditions of adoption, lacking time but existing in transpositions and modulations.

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