SHIFT REGISTER プロジェクト「シフト レジス

地球観測配列ワークショップ (EOAW) EARTH

OBSERVATORY ARRAY WORKSHOP

Higure 15-17 cas

116-0013

東京都荒川区西日暮里3-17-15

2017/04/29-30

Even if we ourselves didn't actually make it, the fact that I can understand what it is, automatically means that I'm responsible for it.

Timothy Morton 2014

人類は地球 に刻まれ、それ自体はある意味で刻され

Augustin Berq

In history as in nature, decay is the laboratory of life. Karl Marx

Introduction

SHIFT REGISTER プロジェクト「シフト レジスタ (http://shiftregister.info/) is a set of div

readings, objects and actions, collectively manifested in a series of **EARTH OBSERVATOI**

ShR_ プロジェクト「シフト レジスタ
地球観測配列ワークショップ
EARTH OBSERVATORY ARRAY
WORKSHOP
(EOAW)

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READER

Table of Content

INTRODUCTION

SHIFT REGISTER プロジェクト「シフトレジスタ (http://shiftregister.info/) is a set of diverse readings, objects and actions, collectively manifested in a series of **EARTH OBSERVATORY ARRAYs (EOA)**
地球観測配列ワ.

of EARTH OBSERVATORY ARRAYS (EOA) .

Located all over the world, each EOA is composed through workshop formats, field sites, textual resources, and the active construction of an EOA. Each workshop is locally resonant with the physical environment where each EOA is installed, and each EOA remains distinct to any other. Thus EOA's are designed to perform as part of a network of 'subaltern' observation stations that generate aesthetic knowledge that escapes formal instrumentation and analysis such that each attempts to elude indexical and colonial epistemologies – for example, 'samples' are not gathered in centralised labs or institutions, but relations are set up and played out, in situ, extemporised and disaggregated. Each EOA provides a mediation and meditation on climate, atmospheric, cosmological and/or geophysical science, using parasitic techniques for gathering an uneven, localised, inconsistent impression of the earth.

EOAs are based across four levels of observation: the cosmological, the atmospheric, the earth sciences and the imaginary, maintaining influences from industrial aesthetics and the sciences of observation and recording, land art, alchemical apparatus and the symbolic machinery of the contemporary esoteric. Materials used in their construction are based on localised necessity and draw on a repertoire of common industrial materials such as concrete, stone, mineral ores, copper,

glass, plastics, and in combination with vernacular expressions of environment and organic life.

EOA's are ephemeral and transient constructions that attempt to insinuate other ways of knowing by being inserted at the confluence points of lines drawn between sites of ancient and contemporary knowledge generation and transmission, both regional and global. Networks of these sites, and their 'lines of intersection', are compared and collapsed during each workshop, composing localised maps of infrastructures, sacred, ancient and imagined resonances. By charting these sites and understanding better their relations, EARTH OBSERVATORY ARRAYs will asymptotically compose a global chart of the coincidental, non-coincidental, conspiratorial and infrastructural energies of ancient sites, modern (Global Information System) GIS techniques and industrial-scale earth-experimentation.

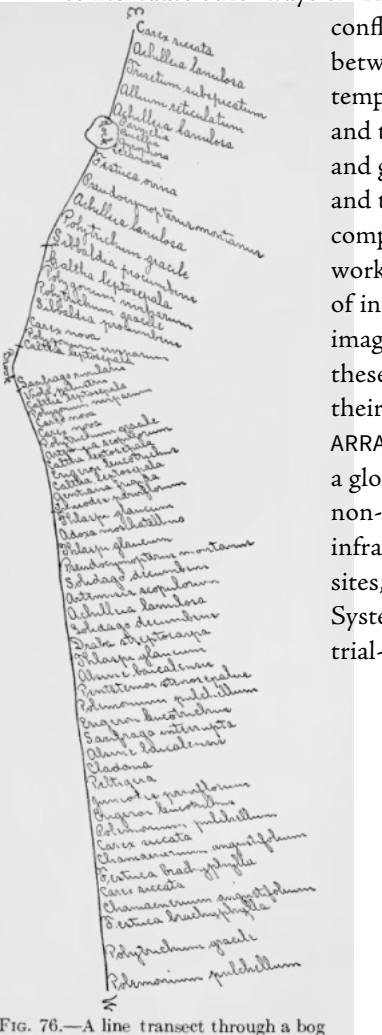
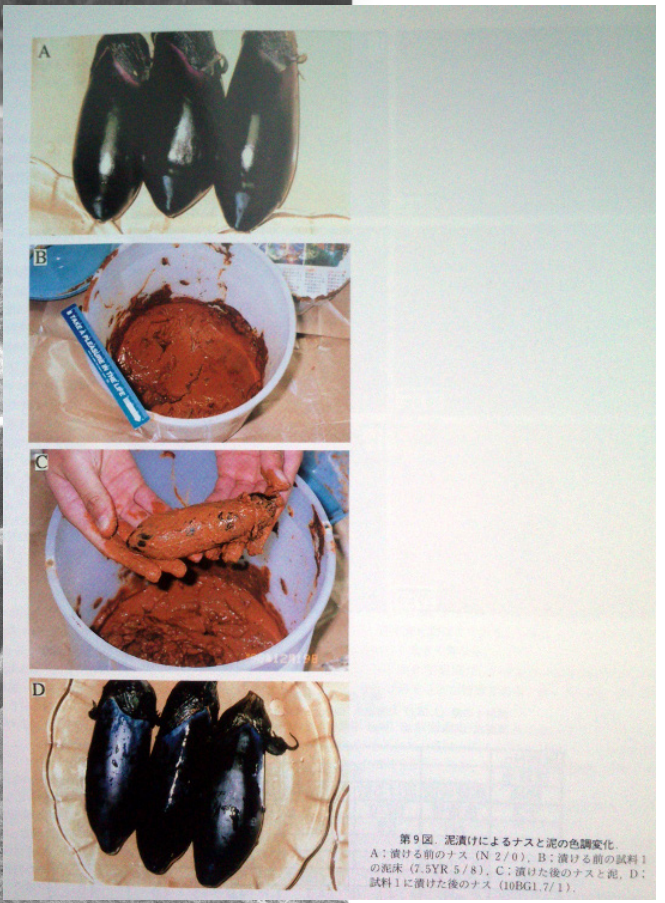
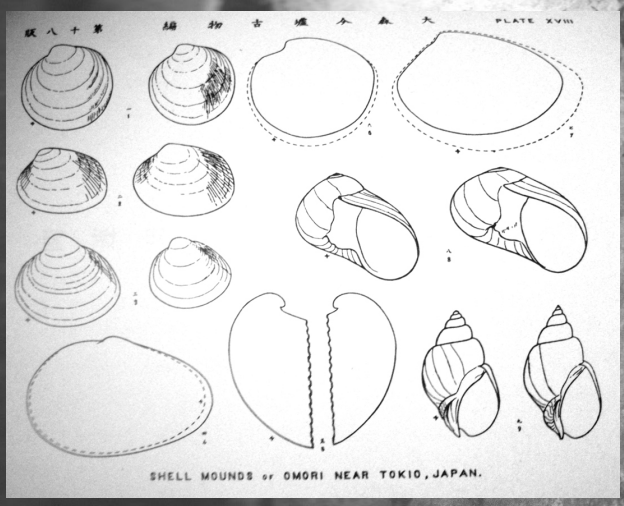


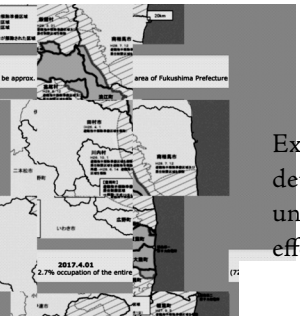
FIG. 76.—A line transect through a bog formation which has invaded a forest along a brook. The ecotones between the two formations are shown at *e*.



第9図．泥漬けによるナスと泥の色調変化．
A：漬ける前のナス（N 2/0），B：漬ける前の試料1の泥床（7.5YR 5/8），C：漬けた後のナスと泥，D：試料1に漬けた後のナス（10BG1.7/1）．


第十八版 大森介墟古物貝 PLATE XVIII
SHELL MOUNDS or OMORI NEAR TOKIO, JAPAN.

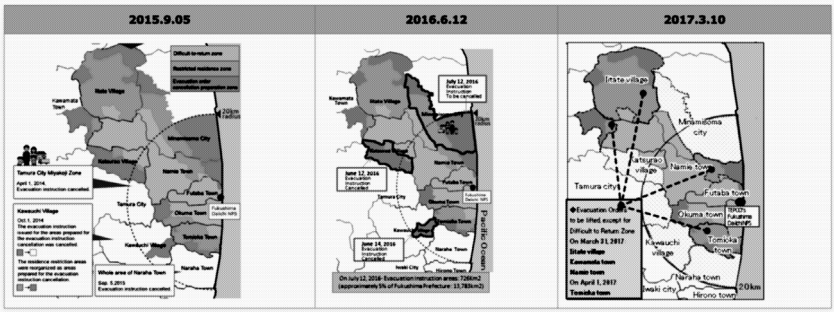
DECAY



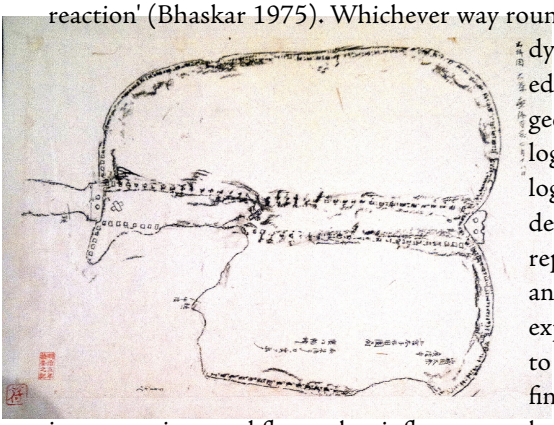
Explanations of the earth require data detailing the zones observed including under what constraints was observation effected; the life that operates within those constraints; and the interactions among those lifeforms and between them and the environment of the constrained zone.

In attempting to register ecologies on the earth, observations typically attempt to delimit zones by registering shifts in communities prefigured to be sensitive to any suggested environmental change.

However, ecological thinking is scale dependent, with its containment zones and zone edges irrepressibly rescaled to present functional contrasts to what lies on either side in order to reveal or hide. The significance of each of any observed shifts might differ between zone environments such that lifeforms and their interactions may account for much of the shifts registered in one zone, while other factors may limit activity in less-favourable environments. All zones and their edges get ratified by aggregating procedures that, by default, articulate something of the configuration of their own operating system.



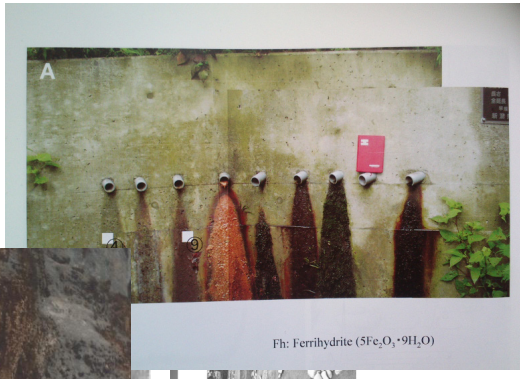
The paradox is that while edges may be defined at one scale of representation but remain implicit or invisible on another, nonetheless explaining something in terms of its larger bits doesn't render those smaller bits any less real, any more than, inversely, 'zinc and sulphuric acid cease to react in a certain way when we explain their reaction in terms of the atomic reaction' (Bhaskar 1975). Whichever way round they are, the dynamics of these edges, while doggedly epistemological and ontological, are heavily dependent on representational and regulatory* expenditures used to detail many finer-grained inter-reactions and fluxes that influence earth and its (impossible) observation.



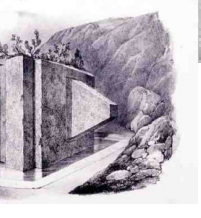
Finer-scale boundaries are minutely observable in atomosphere-to-earth and earth-to-earth reactions and reductions, for example, in the proximal zonings between atmosphere and stone and between stone and earth and biotic growth. These atmosphere and stone and earth and biotic zonings have dramatically different material environments, biotic/abiotic distributions and rates of transfer, and decay. Strongly heterogeneous as defined by such distinct material compositions and dynamics (atmosphere–stone and stone–biota), they can be considered as counter-factual patches, sores, malignancies within any larger zoning. They act on each other in various forms of penetration in and through each other and through which flows of materials and energy between air, stone, earth

and plant are modulated. They are nonlinear, chaotic and have 'memory-effects', with absent (past) configurations influential on present and future determinations. Thus in this iteration of the SHIFT REGISTER project we will foreground how things decay both as a modulating and disruptive force in our epistemic zoning of earth and ourselves, and as one with which to register other than 'objectifying' procedural responses to earthly process.

* against the backdrop of a leaking Fukushima, 300grams of pitchblende (uraninite) remains quarantined at Tokyo airport.

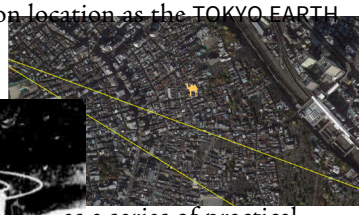


Fh: Ferrihydrite ($5Fe_2O_3 \cdot 9H_2O$)

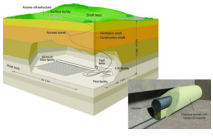


DECAY ACTIONS

We will design and build forms across two environmental registers, earth and stone, to respond and materialise environmental and radioactive forms of decay. These elements will be collaboratively designed and constructed by workshop participants and incorporated on location as the TOKYO EARTH OBSERVATORY ARRAY.



The workshop will present as a series of practical exercises around which to discuss decay cycles (anthropogenic, earthly). We will then construct the TOKYO EOA from the products of these exercises and 'activate' it on location during a 2nd day field trip. The location for installing the EOA will be determined by plotting those 'lines of intersection' generated from processing confluences of site geo-locations - including those vectorized from Jomon shell middens, NTT data centres, nuclear sites and Median Tectonic Line shrine sites – and then finally determined in their bisection by two GPS tracks from 'leaked' radioactive w.a.s.t.e material sent from Fukushima to the workshop.



The schedule is proposed to include

Saturday April 29th, 11:00-19:00

Introduction to Shift Register, and theme of Decay

Discussion of material and nuclear decay

Safety and techniques

The Tokyo Earth Observatory Array (EOA)

Constructing decay registers: radiation

Constructing decay registers: stone

Sunday April 30th 11:00-18:00

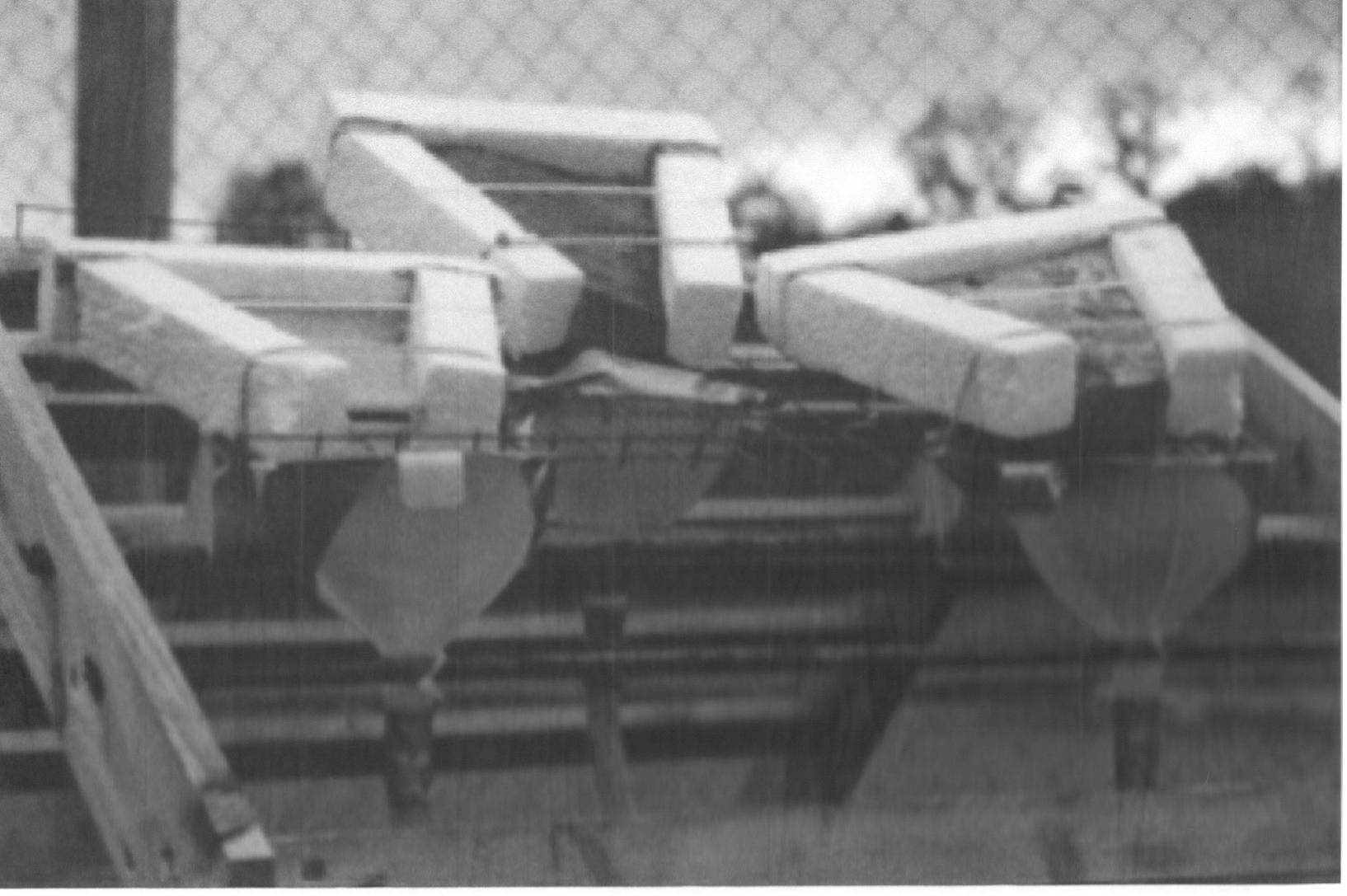
Divination of EOA location

Field trip for combined installation
and burial of EOA elements

Workshop discussion

19:00-22:00

Performance evening on the theme of 'decay'.



TOKYO
EARTH OBSERVATORY ARRAY
ELEMENT SITES

MAP REFERENCES

*000

NAME | APPROX GEO-LOCATION | LATITUDE | LONGITUDE | NOTES

Median Tectonic Line (MTL) shrines 神社
(cf. https://www.jnto.go.jp/)

Kashima Jingu: 35.968351,140.631266
Katori Jingu: 35.8861, 140.5287
Meiji Jingu: 35.6749895,139.6993756
Suwa Taisha: 35.998198,138.119431
Toyokawa Inari Shrine: 34.824584,137.392056
Ise Jingu Shrine: 34.455517, 136.725583
Tenkawa Dai-Benzaiten Shrine: 34.223349,135.841677
Koyasan Kimugumoji Temple: 34.2143494,135.5838795
Ishizuchi shrine: 33.889417,133.155576
Aso shrine: 32.947984,131.117739
Yamamoto shrine: 32.2419569,130.801025

Nuclear plants in Japan 原子力発電所
(source Wikimedia GeoHacks)

Fugen 35.754444, 136.016389 decommissioned
Fukushima I 37.421389, 141.0325 reactors 1-4 damaged, to be decommissioned
Fukushima II 37.319444, 141.021111 shutdown
Genkei 33.515556, 129.837222 suspended
Hamaoka 34.623611, 138.1425 suspended
Higashidōri 41.188056, 141.390278 suspended
Ikata 33.490833, 132.311389 operational
Kashiwazaki-Kariwa 37.428333, 138.601667 suspended
Mihama 35.7025, 135.963333 suspended
Monju 35.740278, 135.988056 suspended
Ōi, Fukui 35.540556, 135.651944 suspended
Ōma 41.509722, 140.910278 in construction
Onagawa 38.401111, 141.499722 shutdown
Sendai 31.833611, 130.189722 operational
Shika 37.061111, 136.726389 suspended
Shimane 35.538333, 132.999167 suspended
Takahama 35.522222, 135.504722 suspended

中央構造線と神社・仏閣・霊場

伊勢神宮や**諏訪大社**は書くまでもないでしょう。また、四国には多くの霊場がありますね。

鹿島神宮は日本全国に約600社ある鹿島神社の総本社である。地震の守り神としても有名である。

香取神宮は鹿島神宮と同じく国家鎮護・武門の守護神として古くからの歴史を誇っています。

豊川稲荷は神社ではなく、寺院であり円福山豊川閣妙厳寺と称する。日本三大稲荷の1つとされる

丹生大師は正式には神宮寺だが通称丹生大師と呼ばれる弘法大師ゆかりの寺。女性にも開放されていたことから「女人高野」とも言われる。

吉野山は人々の厳粛な祈りの場として保たれた霊場で、熊野三山」、「高野山」とあわせ、「紀伊山地の霊場と参詣道」として平成16年7月、世界遺産に登録された。

高野山は平安時代の弘仁10年(819年)頃より弘法大師空海が修行の場として開いた高野山真言宗、ひいては日本仏教における聖地であり総本山金剛峯寺がある。

石槌山は修験者の山で、今でも7月1日は女人禁制である。

阿蘇神社は健磐龍命(タケイワタツノミコト)＝阿蘇大明神を祭っています。諏訪氏と阿蘇氏は先祖が同じです。

釈迦院は標高980mの釈迦院岳山頂に位置し西の高野山といわれている霊場である。

Tōkai 36.466389, 140.606667 suspended

Tomari 43.036111, 140.5125 under repair

Tsuruga 35.672778, 136.077222 suspended

Selected Jomon shell middens 貝塚
(see map below for major midden sites)

Higashimyo, Kyushu 33.293611, 130.309444

Awazu, Shiga 34.9852609,135.899116518

Mazukari, Aichi 34.7342831,136.871651215

Torihama, Fukui 35.5538232,135.897103216

Kitagawa, Kanaga 35.548104611512514, 139.60366233638456

Yanaka Tennoji, Tokyo 35.7254752,139.773358718

Uguisudani, Ueno, Tokyo 35.719448,139.77897316

Kusaka, Bunkyo, Tokyo 35.7302396, 139.757458719

Nakazato, Kita-ku, Tokyo 35.7448177, 139.7505528

Omori, Tokyo 35.593245,139.73029

Omori, Tokyo (false Morse/NTT data) 35.5902396,139.72746617

Kasori, Chiba 35.6245653,140.158672

Choshichiyachi, Hachinohe City 40.57197899018729,141.45871674603268

Sakiyama, Iwate 39.674631, 141.961447

Takonora, Iwate 39.03557,141.740144

Satohama, Miyagi 38.337731, 141.147483

Tagoyana, Amori 40.852774000000004, 140.34965499999998

Futatsumori, Amori 40.76312100000001, 141.22152299999993

Kitakogane, Hokkaido 42.401911000000005, 140.91064499999993

Irie–Takasago, Hokkaido 42.549097000000025, 140.77297199999998

NTT data centres Tokyo

Omori, Tokyo 35.5902396,139.72746617

Data Centre 1 Chiyoda-ku 35.686087,139.7657215,17

Data Centre 2 & 4 Koto-ku, 35.6566438,139.786232615

Data Centre 3 Chuo-ku 35.6870115,139.759238315

Data Centre 5 Bunkyo-ku 5.7305798,139.7423291

Data Centre 6 Kita-ku

Plot data:
NTT

35.5902396,139.72746617

35.686087,139.7657215,17

35.6566438,139.786232615

35.6870115,139.759238315

35.7305798,139.7423291

貝塚

33.293611, 130.309444

34.7342831,136.871651215

34.9852609,135.899116518

35.5538232,135.897103216

35.548104611512514, 139.60366233638456
35.7254752,139.773358718
35.7302396, 139.757458719
35.719448,139.77897316
35.5902396,139.72746617
35.593245,139.73029
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35.7448177,139.7505528
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39.674631, 141.961447
39.03557,141.740144
40.852774000000004, 140.34965499999998
40.57197899018729,141.45871674603268
40.76312100000001, 141.22152299999993
42.401911000000005, 140.91064499999993
42.549097000000025, 140.77297199999998

神社
35.968351,140.631266
35.8861, 140.5287
35.6749895,139.6993756
35.998198,138.119431
34.824584,137.392056
34.455517, 136.725583
34.223349,135.841677
34.2143494,135.5838795
33.889417,133.155576
32.947984,131.117739
32.2419569,130.801025

原子力発電所
34.623611, 138.1425
41.188056, 141.390278
33.490833, 132.311389
37.428333, 138.601667
35.7025, 135.963333
35.740278, 135.988056
35.540556, 135.651944
41.509722, 140.910278
38.401111, 141.499722
31.833611, 130.189722
37.061111, 136.726389
35.538333, 132.999167
35.522222, 135.504722
36.466389, 140.606667
43.036111, 140.5125
35.672778, 136.077222

EARTH OBSERVATORY ARRAY ELEMENT SITES

NUMBER.

REFERENCE DESCRIPTION.

NAME.

APPROX GEO-LOCATION.

REF:

LATITUDE | LONGITUDE.

MAP

GENERAL NOTES

SOURCES.

REFERENCES.

SELECTED READINGS

1_ ECOLOGIES OF THOUGHT

BASE MATERIALISM AND GNOSTICISM **Georges Bataille Visions Of Excess, Selected Writings 1927-1939, 45-52**

In Bataille's base materialism, unlike functionalist versions of materialism, matter is not reconstituted as underwriting any 'laws' for an idealised science. Instead, gnosticism's base materialism is seen as producing a surfeit of protean and fetid burrowing around that ultimately undermines all idealistic 'mastery' of matter by whatever -ism.

SEED CONCEPT **Hiro Hirai 2015**

Short paper that traces the development and investment in the concept of 'seeds' as giving rise to all forms of matter in nature. Diffused by Platonists and developed by physician philosophers including Paracelsus - who'se 'internal alchemists' ultimately shape all life - the seed concept was finally reinterpreted in a corpuscular perspective, culminating in the notion of 'molecule' as the 'seeds of things'.

A CLASSIFICATION OF ECOLOGICAL BOUNDARIES **David L Strayer et al. 2003**

An articulation of the epistemic problems faced by ecologists in trying to define boundaries for use across a diverse range of situations. Its argued that boundaries are best thought of as 2- or 3-dimensional features which can nest finer boundaries as being transitional. One issue is that in observing boundaries there is the assumption of an importance to an ecological variable that might prove less important at the scale used to examine the entities themselves.

ON ENVIRONMENTALITY: GEO-POWER AND ECO-KNOWLEDGE IN THE DISCOURSES OF CONTEMPORARY ENVIRONMENTALISM **Timothy W. Luke, 1995**

Classic text in which Luke suggests that the increasing number of references to the 'environment' from the 1970s onward corresponds to the growing number of technologies that provide global measurement. In a recent descriptive essay on the theme, Program Earth• Environmental Sensing Technology and the Making of a Computational Planet 2016, Jennifer Gabrys examines the future condition of both the earth and humans under such 'environing'.

FURTHER READINGS

BEING UP FOR GRABS: A SPECULATIVE ANARCHAEOLOGY **Hilan Bensusan, 2016**

Bensusan offers a metaphysics of contingency through which to think about necessity and to ultimately comes to terms with the planetary real. He examines three complementary 'tonalities' - fragments, where their reconfiguration presents no single necessity; doubt, where the absence of sufficient reason leads to non-determinismic thought; and rhythm, where events are related through timing not necessity – to present the case for a world based not on sheer contingency but one that is always turning on a plurality of non-eliminable interstices.

A NON PHILOSOPHICAL THEORY OF NATURE **Anthony Paul Smith, 2013**

Smith sees thinking (philosophical, scientific, ecological) as a process that always takes place in a real ecosystem and, as such, cannot claim any objective or transcendental position (and so remain outside of both Bruno Latour's political- and Timothy Morton's immanent- retirements of 'nature'). In re-cuperating nature Smith sets about reconciling thought with nature by understanding nature as being perverse, 'this is to say it outruns thought' and that, as thought requires energy, thoughts too live, decay and die on our 'refractory planet'.

13

Base Materialism and Gnosticism

If one thinks of a particular object, it is easy to distinguish matter from form, and an analogous distinction can be made with regard to organic beings, with form taking on the value of the unity of being and of its individual existence. But if things as a whole are taken into account, transposed distinctions of this kind become arbitrary and even unintelligible. Two verbal entities are thus formed, explicable only through their constructive value in the social order: an abstract God (or simply the idea), and abstract matter; the chief guard and the prison walls. The variants of this metaphysical scaffolding are of no more interest than are the different styles of architecture. People become excited trying to know if the prison came from the guard or if the guard came from the prison; even though this agitation has had a primordial historical importance, today it risks provoking a delayed astonishment, if only because of the disproportion between the consequences of the debate and its radical insignificance.

It is nevertheless very remarkable that the only kind of materialism that up to now in its development has escaped systematic abstraction, namely dialectical materialism, had as its starting point, at least as much as ontological materialism, absolute idealism in its Hegelian form. (There is no need to go back on this method: materialism, whatever its scope in the positive order, necessarily is above all the obstinate negation of idealism, which amounts to saying, finally, of the very basis of *all* philosophy.) Now Hegelianism, no less than the classical philosophy of Hegel's period, apparently proceeded from very ancient metaphysical conceptions, conceptions developed by, among others, the Gnostics, in an epoch when metaphysics could still be associated with the most monstrous *dualistic* and therefore strangely abased cosmogonies.[1]

I admit that I have, in respect to mystical philosophies, only an unambiguous interest, analogous in practice to that of an uninfatuated psychiatrist toward his patients; it seems to me rather pointless to put one's

The text is from *Visions of Excess: selected writings, 1927–1939*, ed. Allan Stoekl, tr. Allan Stoekl with Carl R. Lovitt and Donald M. Leslie, Jr (University of Minnesota Press, Minneapolis, MN, 1985), pp. 45–8. 'Le bas matérialisme et la gnose' was published in *Documents*, second year, 1 (1930). See *OC*, I, pp. 220–6.

trust in tendencies that, without meeting resistance, lead to the most pitiful dishonesty and bankruptcy. But it is difficult today to remain indifferent even to partly falsified solutions brought, at the beginning of the Christian era, to problems that do not appear noticeably different from our own (which are those of a society whose original principles have become, in a very precise sense, the *dead letter* of a society that must put itself in question and overturn itself in order to rediscover motives of force and violent agitation). Thus the adoration of an ass-headed god (the ass being the most hideously comic animal, and at the same time the most humanly virile) seems to me capable of taking on even today a crucial value: the severed ass's head of the acephalic personification of the sun undoubtedly represents, even if imperfectly, one of materialism's most virulent manifestations.

I will leave it to Henry-Charles Puech to explain here, in future articles,[2] the development of such myths, so suspect in this period, hideous as chancres and carrying the germs of a bizarre but mortal subversion of the ideal and of the order expressed today be the words 'classical antiquity'. Yet I think it would be neither vain nor impossible to simplify things extremely, first of all, and indicate the meaning that must be given to the mythological and philosophical disorders which at that time affected the representation of the world. Gnosticism, in fact, before and after the preachings of Christianity, and in an almost bestial way, no matter what were its metaphysical developments, introduced a most impure fermentation into Graeco-Roman ideology, borrowed from everywhere, from the Egyptian tradition, from Persian dualism, from eastern Jewish heterodoxy, elements that conformed the least to the established intellectual order; it added its own dreams, heedlessly expressing a few monstrous obsessions; it was not revolted, in its religious practices, by the basest (and thus most upsetting) forms of Greek or Chaldeo-Assyrian magic and astrology; and at the same time it utilized, but perhaps more exactly it compromised, newborn Christian theology and Hellenistic metaphysics.

It is not surprising that the protean character of this agitation has given rise to contradictory interpretations. It has even been possible to represent Gnosticism as a strongly Hellenized intellectual form of a primitive Christianity too popular and indifferent to metaphysical developments, a kind of superior Christianity elaborated by philosophers who had broken with Hellenistic speculation, and rejected by the uncultivated Christian masses.[3] Thus the principal protagonists of Gnosticism – Basilides, Valentinus, Bardesanes, Marcion – appeared to be great religious humanists and, from the point of view of traditional Protestantism, great Christians. Their bad name and the more or less suspect character of their theories were supposedly explained by the fact that they were only

known through the polemics of the church fathers, their violent enemies and obligatory slanderers.

The writings of the Gnostic theologians were systematically destroyed by the orthodox Christians (with few exceptions, nothing remains today of a considerable literature). Only the stones on which they engraved the figures of a provocative and especially indecent Pantheon permit one to comment at length on something other than diatribes: but they precisely confirm the bad opinion of the heresiologists. The most consistent modern exegesis admits, moreover, that the abstract forms of Gnostic entities evolved out of very crude myths, which correspond to the crudity of the images represented on the stones.[4] It establishes above all that Neoplatonism or Christianity must not be sought as the origin of Gnosticism, whose real foundation is Zoroastrian dualism.[5] A sometimes disfigured dualism, doubtless following Christian or philosophical influences, but a profound dualism and, at least in its specific development, not emasculated by an adaptation to social necessities, as in the case of the Iranian religion (on this subject, it is essential to observe that Gnosticism, and to the same degree Manicheanism, which in a way derived from it, never served any social organizations, never assumed the role of state religion).

In practice, it is possible to see as a *leitmotiv* of Gnosticism the conception of matter as an *active* principle having its own eternal autonomous existence as darkness (which would not be simply the absence of light, but the monstrous *archontes* revealed by this absence), and as evil (which would not be the absence of good, but a creative action). This conception was perfectly incompatible with the very principle of the profoundly monistic Hellenistic spirit, whose dominant tendency saw matter and evil as degradations of superior principles. Attributing the creation of the earth, where our repugnant and derisory agitation takes place, to a horrible and *perfectly illegitimate* principle evidently implies, from the point of view of the Greek intellectual construction, a nauseating, inadmissible pessimism, the exact opposite of what had to be established at all costs and made universally manifest. In fact the opposed existence of an excellent divinity, worthy of the absolute confidence of the human spirit, matters little if the baneful and odious divinity of this dualism is under no circumstances reducible to it, without any possibility of hope. It is true that even within Gnosticism things were not always so clear-cut. The fairly widespread doctrine of *emanation* (according to which the ignoble creator god, in other words the *cursed god* – sometimes associated with Jehovah of the Bible – emanated from the Supreme God) responded to a need for a palliative. But if we confine ourselves to the specific meaning of Gnosticism, indicated both by heresiological controversies and by carvings on stones, the despotic and bestial obsession with outlawed and evil forces seems irrefutable, as much in its metaphysical speculation as in its mythological nightmare.

It is difficult to believe that on the whole Gnosticism does not manifest above all a sinister love of darkness, a monstrous taste for obscene and lawless *archontes*, for the head of the solar ass (whose comic and desperate braying would be the signal for a shameless revolt against idealism in power). The existence of a sect of *licentious Gnostics* and of certain sexual rites fulfils this obscure demand for a baseness that would not be reducible, which would be owed the most indecent respect: black magic has continued this tradition to the present day.

It is true that the supreme object of the spiritual activity of the Manicheans, as of the Gnostics, was constantly the good and perfection: that was the way in which their conceptions in themselves had a pessimistic meaning. But it is more or less useless to take these appearances into account, and only the troubled concession to evil can in the end determine the meaning of these aspirations. If today we overtly abandon the idealistic point of view, as the Gnostics and Manicheans implicitly abandoned it, the attitude of those who see in their own lives an effect of the creative action of evil appears even radically optimistic. It is possible in all freedom to be a plaything of evil if evil itself does not have to answer before God. Having had recourse to *archontes*, it does not appear that one has deeply desired the submission of things that belong to a higher authority, to an authority the *archontes* stun with an eternal bestiality.

Thus it appears – all things considered – that Gnosticism, in its psychological process, is not so different from present-day materialism, I mean a materialism not implying an ontology, not implying that matter is the thing-in-itself. For it is a question above all of not submitting oneself, and with oneself one's reason, to whatever is more elevated, to whatever can give a borrowed authority to the being that I am, and to the reason that arms this being. This being and its reason can in fact only submit to what is lower, to what can never serve in any case to ape a given authority. Also I submit entirely to what must be called matter, since *that* exists outside of myself and the idea, and I do not admit that my reason becomes the limit of what I have said, for if I proceeded in that way matter limited by my reason would soon take on the value of a superior principle (which this *servile* reason would be only too happy to establish above itself, in order to speak like an authorized functionary). Base matter is external and foreign to ideal human aspirations, and it refuses to allow itself to be reduced to the great ontological machines resulting from these aspirations. But the psychological process brought to light by Gnosticism had the same impact: it was a question of disconcerting the human spirit and idealism before something base, to the extent that one recognized the helplessness of superior principles.

The interest of this juxtaposition is augmented by the fact that the specific reactions of Gnosticism led to the representation of forms radically contrary to the ancient academic style, to the representation of forms in which it is possible to see the image of this base matter that alone, by its incongruity and by an overwhelming lack of respect, permits the intellect to escape from the constraints of idealism. In the same way today certain plastic representations are the expression of an intransigent materialism, of a recourse to everything that compromises the powers that be in matters of form, ridiculing the traditional entities, naively rivalling stupefying scarecrows. This is no less important than general analytic interpretation, in the sense that only forms specific and meaningful to the same degree as language can give concrete and immediately perceptible expression to the psychological developments determined through analysis.

Notes

1 Since the Hegelian doctrine is above all an extraordinary and very perfect system of reduction, it is evident that it is only in a reduced and emasculated state that one finds there the *base elements* that are essential in Gnosticism.

However, in Hegel the role of these elements in thought remains one of destruction, just as destruction is given as necessary for the constitution of thought. This is why, when dialectical materialism was substituted for Hegelian idealism (through a complete overthrow of values, giving matter the role that thought had had), matter was no longer an abstraction but a source of contradiction; moreover, it was no longer a question of the providential character of contradiction, which became simply one of the properties of the development of material facts.

2 [See H.-C. Puech's 'Le Dieu Besa et la magie hellénistique', in *Documents*, 7 (1930), pp. 415–25. TR.]

3 This interpretation has been developed in France by Eugène de Faye (cf. *Introduction à l'étude du gnosticisme* (Paris, 1903), taken from *Revue de l'histoire des religions*, vols 45 and 46, and *Gnostiques et gnosticisme. Etude critique des documents du gnosticisme chrétien aux IIe et IIIe siècles* (Paris, 1913), in *Bibliothèque de l'Ecole des Hautes Etudes, Sciences religieuses*, vol. 27).

4 Wilhelm Bousset, *Hauptprobleme der Gnosis* (Göttingen, 1907).

5 Ibid., ch. 3, 'Der Dualismus der Gnosis'.

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Seed Concept

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Abstract

In Renaissance and early modern "chymistry" (alchemy/chemistry) and biomedical sciences, ideas derived from "seeds" (*semina*) were frequently used: "seeds of things" (*semina rerum*), "seeds of reasons" (*semina rationum*), "seminal reasons" (*rationes seminales*), "seminary" (*seminarium*), and "seminal principle" (*principium seminale*). These notions can be grouped together under the name of the "concept of seeds." Widely diffused under the authority of the "Platonists," this concept aimed to explain the formation and organization of natural bodies and even the origin of their forms in matter. It first took shape in the cosmological metaphysics of Marsilio Ficino (1433–1499) and then was developed by physician philosophers such as Jean Fernel (1497–1558), Paracelsus (1593/1594–1541), and Petrus Severinus (1540/1542–1602) during the sixteenth century. It was finally reinterpreted in a corpuscular perspective, culminating in the notion of "molecule" (*molecula*) as the "seeds of things" (*semina rerum*) by French atomist Pierre Gassendi (1592–1655). The concept of seeds can be regarded as a missing link in the chain which bridged between the medieval scholastic doctrine of substantial forms and the mechanistic corpuscular theories of the late seventeenth and eighteenth centuries. Closely connected to Renaissance chymical philosophy, it played a significant role in the rise of early modern science.

Synonyms

Concept of seeds; *Semina*; Seminal principle; Seminal reason; Seminal reason principle

Innovative and Original Aspects

In his philosophical works, Marsilio Ficino adopted various terms derived from the seed so as to designate the formative cause in the sensible world: "seeds of reasons" (*semina rationum*), "seminal reasons" (*rationes seminales*), "seminary" (*seminarium*), and "seminary reason of the world" (*ratio seminaria mundi*).

Following Neoplatonists such as Plotinus and Proclus, Ficino elaborated the theory of hypostatical substances in his interpretation of Plato's works (Allen 1982). According to the version developed in his *Commentary* on Plato's *Symposium* (written before 1482), the divine "mind" (*mens*) derives from the good, which is the preeminent being of God, in the concentric metaphysical universe. It is followed by the "soul" (*anima*) of the universe, then "nature" (*natura*), and finally "matter" (*materia*). Nature is an intermediate hierarchy between the soul and matter. Ficino attributes "divine species" (*species divinae*) to each of these five hypostases: "ideas" (*ideae*) to the mind, "reasons" (*rationes*) to the soul, "seeds" (*semina*) to nature, and "forms" (*formae*) to matter. Ideas turn around God and connect Him with the mind. Reasons gravitate around the mind and communicate it with the World-Soul. Seeds revolve around the soul and link it to nature. Finally forms turn around nature and make the bridge between nature and

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matter. Forms in matter are the ultimate vestiges of the divine species, all of which are incorporeal and spiritual. Thus seeds share the same source with superior species (ideas and reasons) and inferior species (forms). Beauty, regarded as the ray emanating from God, embellishes the divine mind with ideas, fills the soul with reasons, impregnates nature with seeds, and dresses matter with forms (Ficino 1956).

Ficino further identified nature with the "power of generation" (*potentia generandi*). He also qualified as "seminary" or "seedbed" (*seminarium*) the vivifying power, which is diffused in the whole world. Comparing the emanation of these hypostases with the sun's rays, Ficino connected nature with "heat" (*calor*), which is responsible for the generation of bodies. Generation is linked to a biological notion of fertility. This fecundity is introduced into nature through the invisible ray of the World-Soul, which conveys the spiritual seeds. Ficino thus incorporated the concept of seeds as the integral part of his metaphysical universe. For him, these invisible and spiritual seeds are the vestiges of forms, which were introduced in formless matter so as to generate diverse beings in the sensible world (Ficino 1956).

In his masterpiece, *Platonic Theology* (*Theologia Platonica*) (Florence 1482), Ficino even went further by combining the Thomistic doctrine of substantial forms to his concept of seeds. According to him, nature encloses the invisible and spiritual seeds, endowed with the power to extract the substantial forms of the elements from the depth of matter. These seeds are superior to the elemental forms, and under their control, the elemental qualities bring about properties such as colors in natural things. Ficino's seeds were, therefore, able to make Aristotelian physics subordinate to Platonic metaphysics and are not identical with the seminal reason principles of the ancients (Stoics, Neoplatonists, and Augustine) (Ficino 2001; Hirai 2002).

Jean Fernel of Paris was the first academic physician to introduce Ficino's teachings into the foundation of learned medicine. In his major philosophical dialogue, *On the Hidden Causes of Things* (*De abditis rerum causis*) (Paris 1548), calling upon the belief in the "ancient theology" (*prisca theologia*), Fernel established the basis of his natural and medical philosophy through the harmonization of ancients such as Plato and Aristotle. In doing so, he adopted Ficino's concept of seeds. According to Fernel, the seeds of the forms of natural things were sown by God at the moment of the creation of the world. Now these seeds fall from heaven, being carried by the World-Spirit diffused everywhere in the universe. Fernel connected Ficino's theory of the universal spirit with the Biblical idea of the spirit (breath) sent from God's mouth as is seen in Psalm 32 (33). Fernel thus tried to place his concept of seeds in a Christian perspective (Fernel 2005).

Parallel to Fernel, Paracelsus also contributed much to the elaboration of the concept of seeds. Although he might initially have been inspired by the ideas of Ficino, he radically Christianized its contents. According to him, God sowed the archetypal word "fiat" as the primordial seed of the universe in the creation of the world. This divine seed enclosed within itself the seeds of the four elements (Paracelsus 1922-1933, XIII: 9, 12–13). Paracelsus did not see the elements as the material causes of natural bodies but as their cosmological receptacles, called "mothers" (*müter*). These matrices contain all natural beings under the form of particular seeds and foster them until their maturation as "fruits" (*früchte*) (Paracelsus III: 32–33). Thus all creatures are born from their own spiritual seeds. Each being in nature lives its biological time and grows toward its definite end according to the "predestination" (*praedestinatio*) which was determined by God. At the time of "harvest," natural things are consumed by human beings as food or medicine (Paracelsus III: 34–35).

In Paracelsus, universal nature is depicted as the divine Sower's enormous bag, which contains the spiritual seeds of all natural beings mixed together. Each seed encloses the three principles (salt, sulfur, and mercury). These are not the natural substances bearing these names but the symbolical denominations based on their functions. They should not be understood as the material causes from an Aristotelian perspective. These three principles in the spiritual seed determine the development (life) of each individual through the intervention of administrator "workers," conceived in the guise of internal

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alchemists. Paracelsus referred to them as "vulcanus" when they are in nature and as "archeus" when inside the human body (Paracelsus III: 35 and XI: 187–88).

Under the influence of Ficino, Fernel, and Paracelsus, Petrus Severinus established his unique system, which can be qualified as the "philosophy of seeds." Indeed the concept of seeds occupied the central place of his natural and medical philosophy. In his masterpiece, *The Idea of Philosophical Medicine* (*Idea Medicinae Philosophicae*), he built a synthesis upon the *prisca theologia* belief so as to defend the teachings of Paracelsus. Among his immediate forerunners besides Paracelsus, he owed much to Fernel although he tried to eclipse the Frenchman's name by that of Paracelsus (Severinus 1571; Shackelford 2004; Hirai 2005).

Severinus's theory of the four elements largely depends on that of Paracelsus. They are not conceived as the material causes of natural bodies but as the cosmological receptacles of all creatures. According to Severinus, God implanted future fruits under the form of invisible and spiritual seeds in these matrices. The elements foster these seeds in their bosom so as to produce their fruits and nourish them. This process is programed according to a determined delay for each individual. The spiritual seeds assure the presence of life's vestige everywhere in the world and guarantee the continuity of natural species. They are the source of all kinds of action in nature since they provide all the properties of sensible things. In Severinus's favorite expression, everything in nature is regulated by the seeds' tide-like ebb and flow.

Severinus placed the "principles of the bodies" (*principia corporum*) in the invisible and spiritual seeds. Identified with Paracelsus's salt, sulfur, and mercury, these principles are subordinated to the seeds' incorporeal components: "reasons" (*rationes*), "knowledge" (*scientia*), and "gifts" (*dona*). These components regulate the flows of the seeds in the world to produce corporeal bodies in the process of generation with the help of inner instrumental agents. Severinus called these agents the "mechanical spirits" (*spiritus mechanici*), the invisible and spiritual workers or craftsmen conceived upon the model of Paracelsus's archeus. They produce individuals thanks to the *scientia* given to the seeds. According to Severinus, the spirits deprived of *scientia* are merely sterile vapors, while the mechanical spirits endowed with *scientia* are fertile and productive. If they have the *scientia* of the heart, they construct the heart; if they possess the *scientia* of the brain, they build the brain (Severinus 1571; Hirai 2005).

Severinus's work was venerated by many physician philosophers of the turn of the century and exerted a considerable impact on the matter theories of the next generations. His fervent followers included Joseph du Chesne (1546–1609), Oswald Croll (ca. 1560–1608), and Jan Baptista van Helmont (1579–1644). Especially under the influence of du Chesne, the concept of seeds became widespread in the early seventeenth century to explain the generation of living beings (animals and plants) and the formation of nonliving things (stones, minerals, and metals) (Hirai 2005; 2010). Heavily influenced by Severinus in his youth, van Helmont long struggled to establish his own system of the seminal principle. Pierre Gassendi also considerably relied on Severinus's theory for his concept of molecules, identified with the "seeds of things" (*semina rerum*) (Hirai 2003). These figures, whose perspectives seem to diverge, shared the same source for their own concepts of seeds and their respective matter theories. Other prominent figures such as Francis Bacon (1561–1626) came to know this concept developed in the steam of chymical philosophy. Although Daniel Sennert (1572–1637) himself preferred forms and souls to spiritual seeds, Severinus's ideas led him to develop the notion of the "seminal principle" (*principium seminale*), to which the young Robert Boyle (1627–1691) and others were to pay considerable attention in the late seventeenth century (Clericuzio 1990; Anstey 2002; Hirai 2011). Thus the concept of seeds bears witness to the lively impacts exerted by chymical philosophy on the emergence of new matter theories during the scientific revolution.

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A Classification of Ecological Boundaries

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Ecologists use the term boundary *to refer to a wide range of real and conceptual structures. Because imprecise terminology may impede the search for general patterns and theories about ecological boundaries, we present a classification of the attributes of ecological boundaries to aid in communication and theory development. Ecological boundaries may differ in their origin and maintenance, their spatial structure, their function, and their temporal dynamics. A classification system based on these attributes should help ecologists determine whether boundaries are truly comparable. This system can be applied when comparing empirical studies, comparing theories, and testing theoretical predictions against empirical results.*

Keywords: boundaries, edges, ecotones, landscape ecology, patches

Studies of boundaries are an important and rapidly evolving part of contemporary ecology (e.g., Fagan et al. 1999, Turner et al. 2001, other articles in this issue of *BioScience).* It is clear from reading the ecological literature that ecologists attach a range of meanings to the term *boundary,* presumably to accommodate the systems and questions they are studying. In view of the rich diversity of kinds of boundaries, both in real landscapes and in conceptual models, it is probably counterproductive to insist that all ecologists agree on a single rigid definition of a boundary. However, if ecologists are to use *boundary* to mean different things on different occasions, it is important to specify the concept of boundary that is being used (Cadenasso et al. 2003). Generalizations and theories about boundaries may apply only to a subset of boundaries with particular attributes, and different study designs may be best suited to different conceptualizations of boundaries. Imprecise terminology will impede the search for general patterns and theories about ecological boundaries.

We have developed a classification of boundary attributes to aid communication and theory development. Our intent is twofold: (1) to expose the wide but sometimes subtle differences among concepts of ecological boundaries currently in use; and (2) to list some of the attributes of boundaries that should be considered when designing a field study, modeling boundaries, or comparing different field studies or models of boundaries to one another.

A classification

Ecological boundaries can be classified in many ways. We have tried to build a classification system that is simple and practical and that includes most of the boundary characteristics that ecologists care about. We consider four main classes of boundary traits: (1) origin and maintenance, (2) spatial structure, (3) function, and (4) temporal dynamics (see box). These characteristics cover the range of boundary attributes that ecologists have considered. We recognize that many of these attributes are related to one another and may interact in ecological boundaries, but we have artificially isolated them to make the classification clear and complete. We deliberately chose to illustrate this classification with a wide variety of examples to emphasize that concepts about ecological boundaries can be extended beyond the studies of vertebrates and vascular plants that have historically dominated the field.

Origin and maintenance of boundaries. Boundaries can arise in various ways. We first distinguish between what we call investigative boundaries and tangible boundaries. Did the boundary originate in a scientist's mind or in nature? For many ecologists, boundaries are human constructs: lines on a map drawn by a scientist that may or may not correspond with any obvious physical discontinuities in nature. In fact, the arbitrary placement of boundaries for the convenience of a scientific study is a central tool of ecology (Likens 1992, Adler 1998) and other sciences. Political boundaries are often used by ecologists as investigative boundaries. Other ecologists think of boundaries as tangible structures that can be identified in nature. Both investigative and tangible boundaries are widely used by contemporary ecologists, and both are useful. It is necessary, however, to be clear when using the term *boundary* to indicate whether an investigative or a tangible

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Box 1. Attributes of ecological boundaries

How did the boundary originate, and how is it maintained?
- Investigative or tangible
- Causal or consequential
- Contemporary or relict
- Endogenous or exogenous origin
- Endogenous or exogenous controls (maintenance or suppression)

What is the spatial structure of the boundary?
- Grain size
- Extent
- Thickness and dimensionality
- Geometry of adjacency
- Interactive or noninteractive
- Abruptness, steepness
- Patch contrast
- Integrity (perforated versus unbroken)
- Geometric shape and tortuosity
- Number of attributes (single or multiple)
- Offsets or congruencies of multiple attributes

What are the functions of the boundary?
- Transformation
- Transmission
- Absorption
- Amplification
- Reflection
- Neutral

How does the boundary change over time?
- Changes in any structural or functional properties
- Mobility (stationary, directional, oscillating, or random)
- Age and history

boundary is meant. In practice, most boundaries that ecologists study are a mixture of investigative and tangible boundaries, involving the imposition of human order onto some real natural structure (Cadenasso et al. 2003). Rarely do ecologists draw investigative boundaries that are independent of real structure, and practical constraints often force at least some degree of arbitrariness onto boundary definition.

Once we restrict our attention to tangible boundaries, we can ask how the boundary arose. Boundaries may arise because of discontinuities between patches (a consequential boundary, such as a forest–field boundary), or they may cause discontinuities between patches (a causal boundary, such as a fence that encloses a herd of cattle). Existing boundaries may have arisen from forces still in operation (contemporary boundaries) or from forces no longer operating at that site (relict boundaries). For example, the boundary between adjacent wind-driven Langmuir cells (elongate, spinning spirals of water) in a lake or ocean is a contemporary boundary, because the structure lasts only as long as the winds persist, whereas the boundary between glaciated and unglaciated terrain is a relict boundary. Many boundaries are difficult to classify as contemporary or relict because their structure arose from a mixture of current and past forces.

It may be useful to subdivide boundary origins further, depending on the purpose of the study. For instance, we might distinguish between natural and anthropogenic boundaries, which may have very different spatial structures (Turner et al. 2001) and functions. More generally, we could classify boundaries as having exogenous or endogenous origins, arising, respectively, from processes outside or inside the system of patches and boundaries being studied. Boundaries between new lava flows and older vegetation (Aplet and Vitousek 1994) are of exogenous origin. In contrast, a forest edge maintained by the joint effects of succession and seed predation (Sork 1983) would have endogenous origins, as would grazing halos around coral reefs (Ogden et al. 1973), which depend on the foraging distances of algivorous fish or invertebrates that shelter within the reef. Of course, many boundaries arise as a result of a combination of exogenous and endogenous factors. Ephemeral patches of zooplankton can arise from the interaction between wind-driven Langmuir circulation and the behavior of zooplankton (George and Edwards 1973).

Likewise, exogenous or endogenous forces may tend to maintain or destroy a boundary through time. As an example of exogenous forces that strengthen or weaken boundaries, plankton may be concentrated into patches by ocean gyres or dispersed by winds or currents. A boundary between two vegetation types that is reinforced by the grazing preferences of herbivores (Farnsworth and Anderson 2001) is an example of an endogenously maintained boundary.

Several problems prevent the unambiguous classification of boundaries as exogenous or endogenous. First, *exogenous* and *endogenous* are defined with respect to the study system, and different investigators may define the study system differently; therefore, the same process may be regarded as exogenous by one investigator and endogenous by another. Second, many boundaries originate and are maintained not by exogenous or endogenous forces alone but by an interaction between exogenous and endogenous forces (e.g., zooplankton patches). Finally, control of boundary structure and function may shift between exogenous and endogenous forces over time (as in the case of an exogenous, wind-created forest gap whose boundary is later maintained or destroyed by endogenous biological interactions). Nevertheless, a general distinction between exogenous and endogenous origin and maintenance may be useful for generating hypotheses and comparisons.

Spatial structure. We tried to capture the enormous range in spatial structure of ecological boundaries by recognizing 11 attributes (see box). This list is not exhaustive, nor are the characteristics listed independent of one another, but these 11 attributes do provide a reasonably complete description of the spatial structure of boundaries.

As is the case with many features in landscape ecology (Turner et al. 2001), boundaries may be defined or studied using different grain sizes (figure 1a, 1b, 1c; Fagan et al. 2003). As different grain sizes are used, the same physical structure may appear to be very different or may not appear at all. Many of the boundary attributes that we discuss below, such as length, tortuosity, and sharpness, depend on grain size. Consequently, comparisons of these scale-dependent properties across studies must be made cautiously, as must comparisons of field data (which have a grain size) with models (which may have a different grain size or may be continuous and therefore have an infinitely small grain). At a minimum, scientists must choose their grain size deliberately and specify it in their publications (Cadenasso et al. 2003).

The second scale attribute commonly considered by landscape ecologists is extent (Turner et al. 2001), the absolute physical size of a structure (figure 1d, 1e). Although the term *landscape boundary* may bring to mind a structure hundreds of meters to tens of kilometers long, separating patches of hectares to square kilometers, ecological boundaries range enormously in physical extent. Ecologists have studied small boundaries, such as microbial biofilms, soil crusts, leaf boundary layers, and rhizospheres, whose extent is measured in micrometers to centimeters (Belnap and Lange 2001, Belnap et al. 2003). At the other end of the spectrum, boundaries such as forest edges (Turner et al. 1994), the boundaries of biomes (Allen and Breshears 1998), and oceanographic fronts may be kilometers thick and hundreds of kilometers long. The extent of a boundary is especially relevant when the boundary interacts with a process that has its own characteristic physical scale (e.g., molecular diffusion, the home range of an animal, the dispersal shadow of a plant).

Boundaries may be construed as having thickness (and therefore having the same dimensionality as the patches they separate) or as being infinitesimally thin (and therefore having one less dimension than the patches) (figure 1f, 1g). That is, when considering two-dimensional patches on a map, are the boundaries thought of as zones between the patches or as infinitesimally thin lines around the patches? It is important for ecologists to think carefully about which boundary dimensionality is more appropriate to their research and to be clear about what boundary dimensionality is being used in their study, as different study designs, models, and theories may be applied to boundaries of different dimensions. To some extent, the choice of boundary dimensionality may be set by the abruptness, grain size, and extent of the boundary, as well as by the mind-set of the investigator, the requirements of experimental design, and mathematical tractability. Both conceptions of boundary dimensionality are widely used in empirical and theoretical studies in ecology.

The detailed geometry of adjacent patches can result in several kinds of boundaries (figure 1h, 1i, 1j, 1k). In the simplest

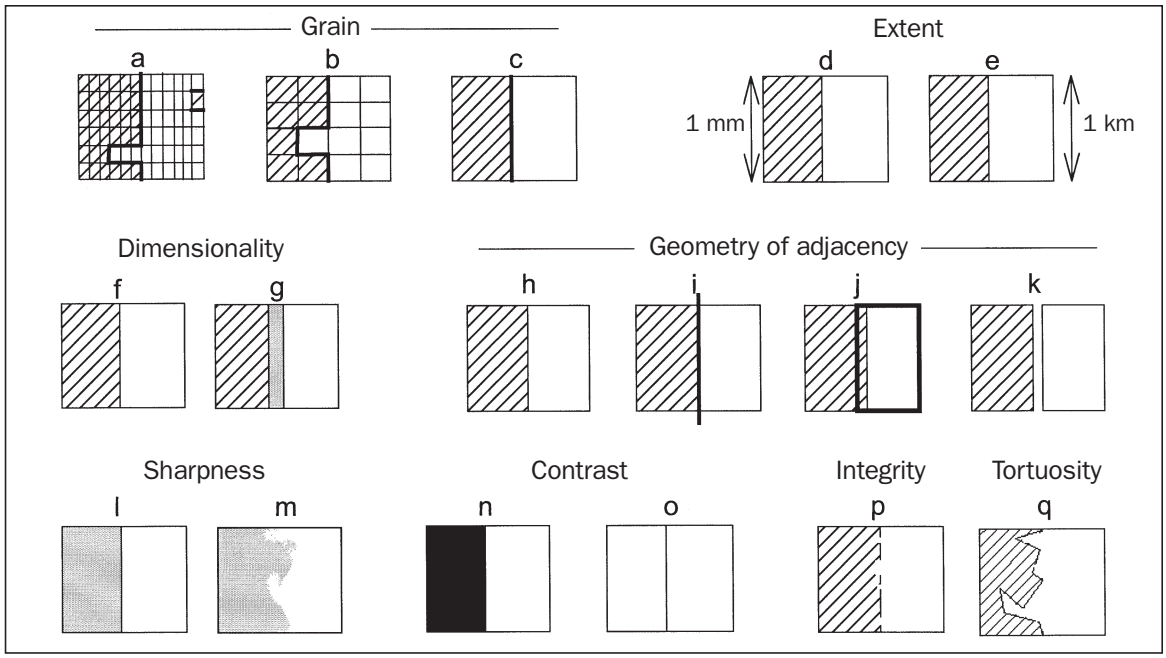

Figure 1. Some attributes of boundary spatial structure. (a) A boundary (heavy line) defined using a fine grain size; (b) the same boundary defined using a medium grain size; (c) the same boundary defined using a coarse grain size; (d) a boundary of small extent; (e) a boundary of large extent; (f) an infinitesimally thin boundary; (g) a boundary with finite thickness (the gray area is the boundary zone, which belongs to neither of the adjacent patches); (h) a boundary between two adjoining patches; (i) a boundary formed by a distinct structure (heavy line) between two patches; (j) a boundary between two overlapping patches; (k) a boundary between two disjunct patches; (l) a sharp boundary; (m) a gradual boundary; (n) a boundary between two highly contrasting patches; (o) a boundary between two slightly contrasting patches; (p) a perforated boundary; and (q) a convoluted boundary.

case, two neighboring patches physically adjoin one another (figure 1h). Adjacent patches may be separated by a third, distinct structure (figure 1i), as when a fence, road, or stream separates patches. Patches may overlap (figure 1j; e.g., home ranges of animals) or not quite meet along the boundary (figure 1k; e.g., a forest and a cornfield separated by a road that is itself not considered to be part of the system under study). The detailed geometry along the boundary between two patches will have important consequences for natural processes and for the design and interpretation of models and field studies.

Conditions in the boundary may be a simple average of conditions in the patches on either side (figure 2a), or they may reflect interactions that occur along the boundary (figures 2b, 2c). We refer to these as interactive and noninteractive boundaries (Lidicker [1999] called them ecotonal and matrix edges, respectively). Many kinds of mechanisms can create interactive boundaries; indeed, much of the literature on the positive and negative effects of boundaries has been focused on identifying, quantifying, and managing these interactions (Phillips 1999, Zheng and Chen 2000, Woodward et al. 2001). For instance, spillover predation (Holt 1985, Oksanen 1990, Cantrell et al. 2001) of wide-ranging predators sustained in rich patches can intensify prey depression in nearby, unproductive patches. Large populations of Antarctic krill occur just inside the boundary between sea ice and open water, probably because they can find both rich phytoplankton food and refuge from air-breathing predators along this boundary (Brierley et al. 2002). Many biogeochemical reactions (especially redox reactions) take place in boundaries, resulting in the accumulation or depletion of materials in boundaries (Phillips 1999). Boundary interactions may occur regardless of the geometry of adjacency; that is, interactions such as spillover predation do not always require that interacting patches be physically adjacent.

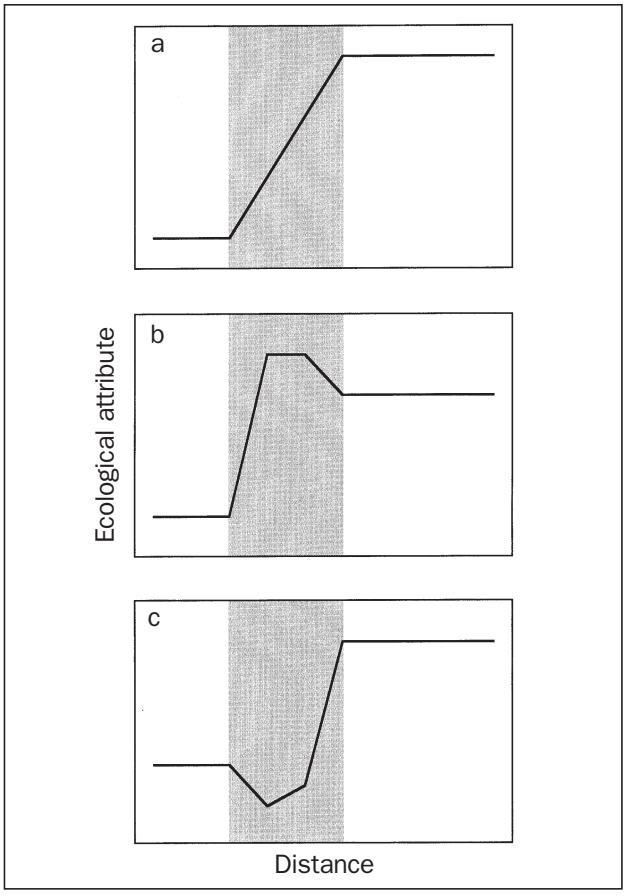

Figure 2. (a) A noninteractive boundary (or matrix boundary, in the sense of Lidicker [1999]); and (b, c) two examples of interactive boundaries (or ecotonal boundaries, in the sense of Duelli et al. [1990] and Lidicker [1999]). The gray area is the boundary, which is conceived as having finite thickness.

Some people think of boundaries as necessarily being step functions (figure 1l), and some ecological boundaries do fit this model (e.g., the air–water interface or a barbed-wire fence enclosing a grazed pasture). On the other hand, especially if boundaries are thought of as having thickness, the change in ecological conditions across a boundary may be gradual (figure 1m; see also Cadenasso et al. 1997, Bowersox and Brown 2001, Cadenasso et al. 2003, Fagan et al. 2003). The boundary separating a forest from an aging old field and the change from a riffle to a pool in a stream are familiar examples of gradual boundaries. Further, the perception of a boundary as abrupt or gradual will depend on the grain size at which the boundary is being measured or modeled; a boundary that appears abrupt at a coarse grain size may appear gradual at a fine grain size.

The change in ecological conditions across a boundary may be large or small (figure 1n, 1o), depending on the process being studied and the goals of the study. In fact, it is the magnitude of this cross-boundary difference that determines whether the researcher recognizes the existence of the boundary in the first place (Fortin et al. 2000, Fagan et al. 2003). Thus, a specified spatial change in ecological conditions may be perceived as a boundary by one researcher but not by another. Many mechanisms that regulate the exchange of materials, energy, and organisms across boundaries depend on the contrast between neighboring patches, so these contrasts often influence boundary function (Cadenasso et al. 2003). Examples include the gas exchange rate across the air–water interface, which depends on the difference in gas partial pressures between air and water (Cole and Caraco 1998); the movement of animals from one patch to another (Wiens et al. 1985, Holmquist 1998); and the transfer of water and other cloudborne substances, which probably depends on the contrast in vegetational structure across boundaries (Weathers et al. 2000, 2001).

Boundaries may be unbroken (figure 1f) or perforated by conduits (figure 1p). The permeability of a boundary may be determined in large part by the existence and properties (size, spatial arrangement) of such conduits. Thus, Weller and colleagues (1998) suggested that gaps in a riparian buffer would severely reduce the buffer's ability to retain nutrients. Other examples of gaps and conduits through boundaries

include ventilated animal burrows that increase biogeochemical transformations across the sediment–water interface (Reise 1985) and water lily stems, which are actively ventilated by the plant and which transfer gases across two boundaries (sediment and water and water and air) in lakes (Dacey and Klug 1979). Again, the perception of the integrity of a boundary may depend on the grain size at which it is measured or modeled.

The shape of the boundary, seen from above, may help to determine its properties. Boundaries may be simple (figure 1f) or convoluted (figure 1q). The degree of convolution (tortuosity) may be measured by an index such as the ratio of the actual distance along the boundary to the straight-line distance between the ends of the boundary. As Mandelbrot (1977) noted, however, this ratio may depend strongly on the grain size at which the boundary is being measured. Thus, to compare the tortuosity of different boundaries, the measurements must be made at comparable grain sizes or must be subjected to a fractal analysis in which measurements of each boundary are made across a range of grain sizes. Highly convoluted boundaries allow more exchange across boundaries, whether they are formed by villi in intestines, by complex soil crusts (Belnap et al. 2003), or by meanders and anastomosing channels in a river floodplain. Further, the shape of a boundary may determine its temporal dynamics; Hardt and Forman (1989) noted that succession (and therefore boundary movement and softening) was much faster along concave parts of a forest boundary, where the field protruded into the forest, than along convex parts where the forest protruded into the field.

In the discussion above, we have assumed that boundaries are defined by a single ecological property (e.g., vegetation type). Many real ecological boundaries are defined by a change in several more or less congruent ecological properties: A forest–field edge, for example, could be defined by vegetation height, vegetation species, animal species, wind resistance, or light penetration. Similarly, many ecological factors covary along vertical gradients in lakes, across shorelines, or along elevational zones on mountains. Thus, we can distinguish between single and multiple boundaries. Probably few ecological boundaries are purely single in structure.

In cases where multiple ecological properties jointly define a boundary, these properties may be spatially congruent with one another, or they may be offset. Thus, Cadenasso and colleagues (1997) and Cadenasso and Pickett (2000) found that physical factors such as temperature and humidity, as well as herbivore activity, were significantly offset from the position of a forest–field edge and from one another. Offsets along boundaries may have important ecological consequences. For instance, photosynthetically active radiation penetrates farther into desert crusts than ultraviolet radiation; desert algae take advantage of this offset by living in the narrow zone where photosynthetically active radiation is high enough to support photosynthesis but ultraviolet radiation is low enough to be tolerable (Belnap et al. 2003).

Boundary function. Boundaries may themselves affect ecological phenomena (figure 3; Belnap et al. 2003). Many cases exist in which boundaries transform materials. For instance, many materials are transformed at oxic–anoxic boundaries in groundwaters or where groundwaters discharge into surface waters (Chapelle 1993, Phillips 1999). Thus, ammonia may be transformed into nitrate by oxidation at a groundwater–surface water boundary. Similarly, soil crusts transform nitrogen gas and carbon dioxide to ammonia and organic carbon, respectively (Belnap et al. 2003).

Ecological boundaries are commonly differentially transmissive or permeable; that is, they may allow only some fraction of materials, energy, or organisms to pass. Thus, wind speed falls as it moves from an open field into a forest (Geiger 1965), and many animals are reluctant to cross boundaries (Wiens et al. 1985, Duelli et al. 1990, Fagan et al. 1999, Lidicker 1999). As an extreme case of impermeability, many ecological boundaries are absorptive: For example, most of the mechanical energy contained in waves is absorbed in the surf-zone boundary that separates land and water. This absorption of energy concentrates materials along the shore and has profound consequences for the ecology of the beach zone (McLachlan and Erasmus 1983, Polis and Hurd 1995, 1996).

If transmission exceeds 100%, the boundary has amplified the ecological phenomenon. Amplification by ecological boundaries is probably rare. A possible example is when groundwater rich in carbon dioxide passes from carbonate-poor rock (e.g., sandstone) to carbonate-rich rock (e.g., limestone). As the water crosses the boundary, the carbon dioxide aggressively dissolves calcium carbonate from the rock, increasing the content of dissolved inorganic carbon (DIC) in the water. Thus, the DIC vector is amplified by crossing the boundary.

In many cases, boundaries are reflective: Organisms or materials that approach the boundary are returned to the patch from which they originated (highly reflective boundaries are sometimes called hard boundaries; Lidicker 1999, Ries and Debinski 2001). From the viewpoint of a fish, the shoreline (or, in some cases, even the 20-centimeter depth contour) is a reflective boundary (Power 1984, 1987, Power et al. 1989). Like transmissive boundaries, reflective boundaries may attenuate or amplify an ecological phenomenon and therefore might be said to have an albedo. (Fish approaching a shoreline where the water is receding may be stranded and killed in shoreline pools; in this case, the shoreline both absorbs and reflects fish.)

Finally, the boundary itself may have no effect on the phenomenon under study (a neutral boundary).

Temporal dynamics. Maps or diagrams of boundaries represent snapshots of boundary structure at a given moment; a single map or diagram may give the impression that boundaries do not change over time. In fact, many ecological boundaries are dynamic (Fagan et al. 2003). We ask two basic questions about temporal dynamics of boundaries: (1) Are the

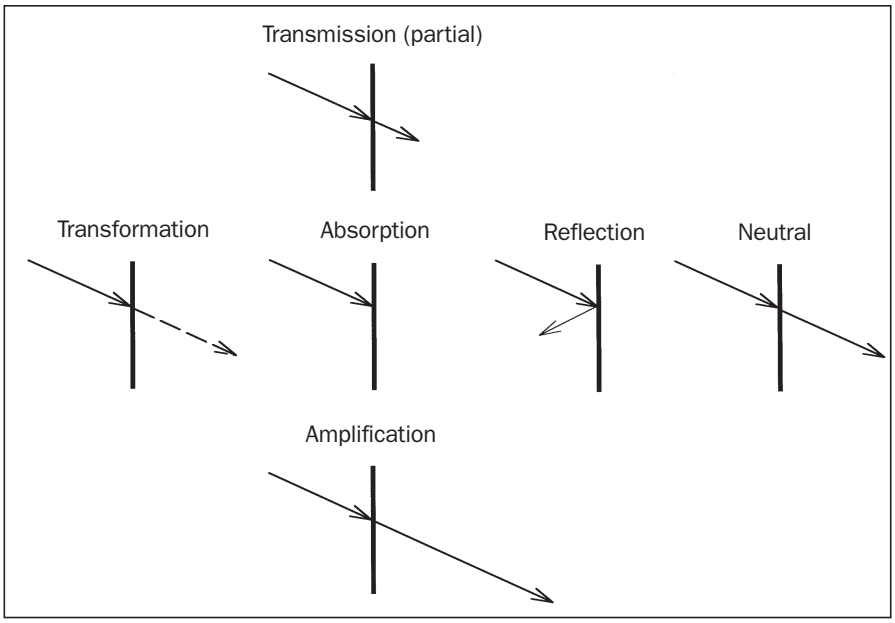

Figure 3. Possible activities of ecological boundaries. The heavy vertical line is the boundary, and the thin arrows are fluxes across, into, or out of boundaries. The length of the arrow indicates the size of the flux.

position, structure, and function of the boundary stable over time? and (2) What is the age and history of the boundary?

Both the properties and the position of a boundary may change over time. Several spatial properties may change: Boundaries may become sharper or more diffuse; conduits may appear or disappear. For instance, vegetational growth along the boundaries of tropical forest patches may make the boundaries less permeable over time and isolate the interior of the forest from the surrounding matrix (edge sealing; Williams-Linera 1990). The position of a boundary in the landscape may be stationary over time, or it may move. Movement may be directional (a forest expanding into a neighboring field, a growing root tip; Belnap et al. 2003), oscillating (a salt front in an estuary moving with tides or with regular seasonal changes in freshwater flow from the watershed), or irregular (a climatically determined boundary between biomes moving in response to a fluctuating climate). Further, a change in the location or properties of a boundary may be predictable or unpredictable.

The age and history of a boundary may also be important. Some boundaries are ephemeral (films around bubbles), while others are ancient (continental margins, boundaries between biogeographic provinces or geologic formations). Because the effects of a boundary may be cumulative, the age and history of a boundary may determine its functional properties and the local ecological conditions around the boundary. The edge sealing described for tropical forest edges may take years to develop (Williams-Linera 1990). Biogeochemical reactions occurring in boundaries may result in the progressive buildup or depletion of materials along the boundary as it ages. Phillips (1999) noted that oxidation of iron seeping from the groundwater through the sides of valleys can cause the progressive formation of ferricretes (a layer of hardened iron oxides) along anoxic–oxic boundaries. The amount of ferricrete that is formed depends in part on the age of the boundary. Thus, both the function and the structure of a boundary may depend on its age and history.

Conclusions

Ecologists use the term *boundary* (or *edge)* to refer to a wide range of conceptual and tangible structures. Different ecologists may use *boundary* to mean structures that are two-dimensional or three-dimensional; mental or physical; microscopic to regional in size; step functions or gradients; reflective, absorptive, or permeable; and so on. As long as usage is so varied, it is important for ecologists to specify the type of boundary they are investigating. Our intent in presenting a classification of ecological boundaries is to expose this wide range in usage to critical examination, not to encourage literal, formal classification of ecological boundaries.

Different kinds of boundaries may have very different structural and functional characteristics. Consequently, different kinds of boundaries are as different as apples and oranges, and careless confounding of different boundary types may lead to unfruitful study designs, tests of theories, and comparisons across studies. Ecologists who wish to compare empirical studies of boundaries to predictions of theories, empirical studies to one another, or theories to one another need to be careful that the boundaries defined in these studies are truly comparable. For instance, theories that model boundaries as two-dimensional are best tested with field studies whose design uses a two-dimensional, rather than three-dimensional, approach to boundary definition. Likewise, phenomena such as diffusion, boundary layers, and laminar flow, which may be essential to measure or model in studies of small boundaries, may be dispensed with in studies of large boundaries. Comparisons of many structural characteristics of boundaries (e.g., tortuosity, integrity) must be made using comparable grain sizes. Transport across perforated boundaries may be much higher than predicted by models of unperforated boundaries. These and many other examples show that careful specification of boundary traits can improve understanding of the structure and function of ecological boundaries.

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On Environmentality: Geo-Power and Eco-Knowledge in the Discourses of Contemporary Environmentalism

Timothy W. Luke

This study examines how discourses of nature, ecology, or the environment, as disciplinary articulations of "eco-knowledge," might be reinterpreted as efforts to generate systems of "geo-power" over, but also within and through, Nature for the governance of modern economies and societies. The thinking of Michel Foucault, particularly his notions of sexuality and bio-power as mediations for discursively formed discipline, provides a basis for this reinterpretation, because many of the terms associated with "the environment" are perplexing until one puts them under a genealogical lens. These dynamics have been at play for nearly a hundred and thirty years—or at least since self-consciously ecological discourses were formulated by George Marsh (1885) or Ernst Haeckel (1866) in the nineteenth century—but their operations are particularly apparent today.

While many examples of such tendencies might be mobilized here, this examination of geo-power systems as a mediation of

environmentality will center upon only one—the work of the Worldwatch Institute. The continuous attempt to reinvent the forces of Nature in the economic exploitation of advanced technologies, linking structures in Nature to the rational management of its energies as geo-power, is an ongoing supplement to the disciplinary construction of various modes of bio-power in promoting the growth of human populations (Foucault, *History of Sexuality* I 140–41). Directed at generating geo-power from the more rational insertion of natural and artificial bodies into the machinery of production, discourses of environmentality can be seen fabricating disciplinary environments where power/knowledge operate as ensembles of geo-power and eco-knowledge.

In and of itself, Nature arguably is meaningless until humans assign meanings to it by interpreting some of its many signs as meaningful (Bramwell, Eckersley). The outcomes of this activity, however, are inescapably indeterminate. Because different human beings will observe its patterns, choosing to accentuate some while deciding at the same time to ignore others, Nature's meanings always will be multiple and unfixed. Only these interpretive acts can construct contestable textual fields, which can then be read on various levels of expression for their many manifest or latent meanings. Before technologies turn its matter and energy into products, Nature already is transformed discursively into "natural resources." And, once it is rendered intelligible through these discursive processes, it can be used to legitimize almost anything. Therefore, this analysis will look into the discursive uses and conceptual definitions of some common theoretical notions, like "the environment," "environmentalism," and "environmentalist," to reconsider how many contemporary environmentalists are giving a new look to "the environment," as a concept, by transforming its identity in the practices of "environmentality." Finally, as these preliminary navigational bearings indicate, doubts are raised here about the apparently benign intentions of environmental actions, given the disciplinary propensities of the practices embedded in this new regime of environmentality.

For more concrete evidence to justify such caution, this study of geo-power and eco-knowledge will look at the work of the Worldwatch Institute. Established in 1974 amidst the economic and political panic sparked by the OPEC oil crisis of 1973, the

Worldwatch Institute might be dismissed as just another nest of D.C. policy wonks, turning out position papers on water scarcity, reforestation, windmill economics, and overpopulation. This image of the Worldwatchers is accurate, but incomplete. And, given this incompleteness, worldwatching ought not to be quickly ignored or easily dismissed. Such activities can be the essence of power/knowledge formation, because much of what policy wonks do basically boils down to defining, creating, and enforcing discursive regimes of disciplinary truth. Consequently, this analysis carefully re-reads one recent Worldwatch Institute publication, *Saving the Planet: How to Shape an Environmentally Sustainable Society* (1991) by Lester Brown, Christopher Flavin, and Sandra Postel, to illustrate how the eco-knowledge generated by the Worldwatch Institute might be seen as a mediation of environmentality in a new regime of geo-power.

1. Eco-Diction: Making Nature Speak as "Environment"

Many individuals who are intent upon turning the world into "a better place to live" often turn today to "the environment" in order to make their improvements. Believing that they must do anything and everything to protect "the environment," they transform this undertaking into a moral crusade. Their struggles, however, are often hobbled by a fundamental lack of clarity about what "the environment" actually *is*. This lack of certainty or centeredness in the meaning of environments is intriguing, because so many contemporary ecological discourses articulate their visions of moral value, political organization, and social control by stressing the salience of solving "environmental problems" for contemporary society.

"Environment," "environmentalism," and "environmentalist" are words used and accepted so broadly now that it is difficult to remember how recently they came into such wide currency. Before 1965, their use in ordinary discussions actually was quite rare in most policy discourses. More suggestive terms, like "Nature," "conservation," or "ecology," typically were deployed in making references about the characteristics of the environmental. Now, a generation later, in the 1990s, Nature in these discourses occasionally

will speak as "Nature," but increasingly its presence is marked as "the environment." This twist is interesting inasmuch as the various meanings of Nature, while remaining fully contestable, are somewhat clearer than a generation ago. At the same time, the meanings of the "environment," which are essentially uncontested, remain very unclear. Documenting this shift in usage is not an exact practice, but to start, one might look briefly through newspaper indices or expert discourses to develop a sense of the shift.

In 1960, or the year Rachel Carson's *New Yorker* essays on how pesticides were despoiling wildlife first drew broad public attention, there is only one story in *The New York Index* about environmental science, and it ties the topic to "astronautics." Five years earlier, in 1955, the word is not even registered in the index, but by 1965 there are four entries about "the environment," one of them about a speech by President Johnson on the need for greater efforts at conservation and beautification in preserving the environment. By 1970, there are almost two and a half entire pages of citations. And, more importantly, the concept remains a significant feature in the index during every year after 1970: one and two-thirds pages in 1975, one and a third in 1980, two pages in 1985, and three and a third in 1990. Even though increasing attention is being allotted in *The New York Times* to concerns that are broadly labeled as "environmental" or "environmentalistic," what "the environment" means to the press is much less clear. It encompasses Nature, conservation, and ecology as well as pollution, deforestation, and contamination.

Despite all of the talk about its central importance, "the environment" constantly escapes exacting definition, even in expert "environmentalist" discourses (Worster). For almost any given ecological writer, the significance of the environment and environmentalism is now apparently assumed to be so obvious that precise definitions are superfluous. ReVelle and ReVelle in their text *The Environment: Issues and Choices for Society* (1988), for example, name their book after the environment, but they fail to include any definition of what it means in their book's glossary or analysis. Buchholz in *Principles of Environmental Management: The Greening of Business* (1993) does not define the environment as a vital concept in ecology, even though he recounts standard dictionary definitions, presenting it as the surroundings that are natural organisms'

ecological settings (29–30). When the environment is defined by experts, it basically encompasses everything. Nebel, for example, in his *Environmental Science: The Way the World Works* (1990) follows this fashion by identifying the environment as "the combination of all things and factors external to the individual or population of organisms in question" (576). Given such nonexistent, derivative, or vague understandings of the environment, it becomes more interesting as to how and why "Nature," "the biosphere," or all "ecological systems" easily can circulate as conceptual equivalents in rough-and-ready exchange as a loose understanding of what "the environment" might mean.

Interestingly, this tendency also marks the work of explicitly political analyses of the environment (Paehlke). Even Barry Commoner, whose political thinking on environmental problems from the 1960s through the 1990s has won wide respect, takes this analytical path. Commoner does not directly confront the concept of the environment; instead, he divides Nature into "two worlds: the natural ecosphere, the thin skin of air, water, and soil and the plants and animals that live in it, and the man-made technosphere," which now has become

> sufficiently large and intense to alter the natural processes that govern the ecosphere. And in turn, the altered ecosphere threatens to flood our great cities, dry up our bountiful farms, contaminate our food and water, and poison our bodies—catastrophically diminishing our ability to provide for basic human needs. (*Making Peace* 7)

Ultimately, Commoner depicts these two worlds as being "at war." As humans in the technosphere disrupt the ecosphere, the ecosphere responds with equally or more disruptive secondary effects in the technosphere. In some sense, the environment is "Nature" for Commoner, but it is also "Society," or, more accurately, Nature-as-transformed-by-Society. The prospect of something like "geo-power," in turn, is foreshadowed by expert intellectual interventions typified by his critiques. In fact, geo-power might be seen as the means of productively fusing the technosphere with the biosphere through the right codes of eco-knowledge. He stresses this interpretation in *The Closing Circle* (1971) when he claims "the envi-

ronment is, so to speak, the house created on the earth *by* living things, *for* living things" (32). This representation of the environment as life's house, however, does little more than reduce it to a biophysical housing of all living things—or, again, the setting that surrounds organisms. Hence, environmentalism becomes the practice of running this house created by living things for living things more rationally or justly.

This curious absence of clear definition can be tracked back beyond Commoner to Carson's original call for greater environmental awareness. *Silent Spring,* as it appeared in *The New Yorker* in 1960, and as a book in 1962, largely directed its analysis at "the web of life" rather than "the environment." Still, in reexamining how unregulated application of chemical pesticides adversely affected biotic communities in the world's overlapping and interconnecting food chains, Carson constructed a provisional reading of "the environment." That is, some substances from the technosphere (chemical pesticides) were invented to kill something in the biosphere (animal pests). While their application was intended to control only those animals that ate crops, carried disease, and infested dwellings, their impact was much broader. Pesticides soon spread through everything in the ecosphere—both human technosphere and nonhuman biosphere—returning from the "out there" of natural environments back into plant, animal, and human bodies situated at the "in here" of artificial environments with unintended, unanticipated, and unwanted effects. By using zoological, toxicological, epidemiological, and ecological insights, Carson generated a new sense of how "the environment" might be seen. However, she never based her analysis directly upon a formalized notion of "the environment" or "environmental damage."

Of course, any concept, like "the environment," "environmentalism," or "environmentalist," can be deployed as indistinctly as all of these patterns of use indicate. In noting how the words are used, one sees what we might ordinarily expect: namely, that they tend to mean various things to many people in several different contexts. Another approach to the problem would be to develop a provisional genealogy of the term's early origins to reveal other more embedded understandings of "the environment" that could be more suggestive than the sense of "environment" which

encompasses *all* surroundings, *every* factor that affects organisms, the *totality* of circumstances, or the *sum* complex of conditions. A return to the semantic origins of environment, then, might illuminate some of these ambiguities and clarify how environmentalistic concepts actually work in the present.

2. On Environing

The separation of organisms from their environments is the primary epistemological divide cutting through reality in the rhetorics of ecology. This discursive turn goes back to Haeckel's initial 1866 identification of ecology as the science that investigates all of the relations of an organism to its organic and inorganic environments. Nonetheless, there are differences among ecologists over what these "environments" might be. Because the expanse of the organic and inorganic environment is so broad, it often is defined in terms delimiting what it *is* by looking at what it *is not*. In other words, it is the organism, or biotic community, or local ecosystem that ecologists place at the center of their systems of study, while the environment is reduced to everything outside of the subject of analysis. With these maneuvers, environments are often transformed rhetorically into silences, backgrounds, or settings. In this manner, they also are studied and understood not directly as such, but more indirectly in terms of the objective relations and effects they register upon the subjects of study they surround.

Even so, this inversion of *one* thing, like an organism or society, into *everything*, or the environment, might disclose the nature of the environment only in relation to this one thing. After all, environmental analysis must reduce "everything" to measures of "anything" available for measurement (like temperature levels, gas concentrations, molecular dispersions, resource variations, or growth rates) to track variations in "something" (like an organism's, a biome's, or a river's responses to these factors). But is it "the environment" that is being understood here, or is its identity being evaded in reducing it to a subset of practicable measurements? Does this vision of "environment" really capture the actual quality or true quantity of all human beings' interrelations with all of the terrains, waters, climates, soils, architectures, technologies,

societies, economies, cultures, or states surrounding them? In its most expansive applications, then, the environment becomes a strong but sloppy force: it is anything out there, everything around us, something affecting us, nothing within us, but also a thing upon which we act. Despite its formal definitions, however, the environment is not, in fact, everything. Many environmental discourses look instead at *particular* sites or at *peculiar* forces. The discursive variations and conceptual confrontations of the "environment" really begin to explode when different voices accentuate this or that set of things in forming their environmental analysis. On the one side, they may privilege forces in the ecosphere, or, on the other side, they might stress concerns from the technosphere. But in either case, each rhetoric which operates as an agency protecting "the environment" struggles to site "the environmental" as a somewhere affected by or coming from everything.

Perhaps the early origins of "the environment" as a concept—its historical emergence and original applications—might prove more helpful. In its original sense, which is borrowed by English from Old French, an environment is an action resulting from, or the state of being produced by a verb: "to environ." And environing as a verb is, in fact, a type of strategic action. To environ is to encircle, encompass, envelop, or enclose. It is the physical activity of surrounding, circumscribing, or ringing around something. Its uses even suggest stationing guards around, thronging with hostile intent, or standing watch over some person or place. To environ a site or a subject is to beset, beleaguer, or besiege that place or person.

An environment, as either the means of such activity or the product of these actions, now might be read in a more suggestive manner. It is the encirclement, circumscription, or beleaguerment of places and persons in a strategic disciplinary policing of space. An environmental act, in turn, is already a disciplining move, aimed at constructing some expanse of space—a locale, a biome, a planet as biospherical space, or, on the other hand, some city, any region, the global economy in technospherical territory—in a discursive envelope. Within these enclosures, environmental expertise can arm environmentalists who stand watch over these surroundings, guarding the rings that include or exclude forces, agents, and ideas.

If one thinks about it, this original use of "the environment" is an accurate account of what is, in fact, happening in many environmental practices today. Environmentalized places become sites of supervision, where environmentalists see from above and from without through the enveloping designs of administratively delimited systems. Encircled by enclosures of alarm, environments can be disassembled, recombined, and subjected to the disciplinary designs of expert management. Enveloped in these interpretive frames, environments can be redirected to fulfill the ends of other economic scripts, managerial directives, and administrative writs. Environing, then, engenders "environmentality," which embeds instrumental rationalities in the policing of ecological spaces.

3. Environmentality and Governmentality

These reflections on "the environment" reframe its meanings in terms of the practices of power, allowing us to turn to Michel Foucault for additional insight. The bio-power formation described by Foucault was not historically closely focused upon the role of Nature in the equations of biopolitics (Foucault, *History of Sexuality* I 138–42). For Foucault, the whole point of the controlled tactics of inserting human bodies into the machineries of industrial and agricultural production as part and parcel of strategically adjusting the growth of human populations to the development of industrial capitalism was to bring "life and its mechanisms into the realm of explicit calculations," making the disciplines of knowledge and discourses of power into many agencies as part of the "transformation of human life" (143). Once this threshold of bio-power was crossed, human economics, politics, and technologies continually placed all human beings' existence into question.

Foucault notes that these industrial transformations implicitly raised ecological issues as they disrupted and redistributed the understandings provided by the classical episteme of defining human interactions with Nature. Living became "environmentalized," as humans related to their history and biological life in new ways from within growing artificial cities and mechanical modes of production, which positioned this new form of human being "at the same time outside history, in its biological environment, and inside

human historicity, penetrated by the latter's techniques of knowledge and power" (143). Here we can begin to locate the emergence of "the environment" as a nexus for knowledge formation and as a cluster of power tactics. As human beings began to consciously wager their life as a species on the outcomes of these biopolitical strategies and technological systems, it became clear that they also were wagering the lives of other (or all) species as well. While Foucault regards this shift as one of many lacunae in his analysis, it is clear there is much more going on here than he realizes. Once human power/knowledge formations become the foundation of industrial society's economic development, they also become the basis for the physical survival of all terrestrial life forms. Here, ecological analysis emerges as a productive power formation that reinvests human bodies—their means of health, modes of subsistence, and styles of habitation integrating the whole space of existence—with bio-historical significance by framing them within their various bio-physical environments filled with various animal and plant bodies.

Foucault can be read as dividing the environment into two separate, but interpenetrating spheres of action: the biological and the historical. For most of human history, the biological dimension, or forces of Nature working in the forms of disease and famine, dominated human existence with the ever-present menace of death. Developments in agricultural technologies as well as in hygiene and health techniques, however, gradually provided some relief from starvation and plague by the end of the eighteenth century. As a result, the historical dimension began to grow in importance as "the development of the different fields of knowledge concerned with life in general, the improvement of agricultural techniques, and the observations and measures relative to man's life and survival" averted some of the imminent risks of death (142). In other words, "the historical" starts to envelop, circumscribe, and surround "the biological." Hence, environmentalized settings emerged "in the space of movement thus conquered, and broadening and organizing that space, methods of power and knowledge assumed responsibility for the life processes and undertook to control and modify them" (142). While he does not explicitly define these spaces, methods, and knowledges as such as being "environmental," it appears that such maneuvers were cru-

cial to the emergence of environmentalization. As biological existence was refracted through economic, political, and technological existence, "the facts of life" passed into fields of control for eco-knowledge and spheres of intervention for geo-power.

Environments then emerged with bio-power as part and parcel of the regulation of life via biopolitics, and, for nearly a century, ecology apparently remained another ancillary correlate of bio-power, inhabiting discourses about species extinction, resource conservation, and overpopulation. Until the productive regime of biopolitics became fully globalized (because Nature itself is not entirely encircled), ecology was a fairly minor voice in the disciplinary chorus organizing development and growth. Things changed, however, once the extensive expansionist strategies of development and growth employed in the eighteenth and nineteenth centuries collapsed around 1914, promoting conservationist ethics in Europe and North America that fretted over conserving resources for resource-driven intensive modes of production. And, as new mediations of development and growth were constructed after 1945, the geo-power/eco-knowledge nexus of environmentalization came to comfortably supplement the high technology, capital intensive development strategies that have since been implemented.

Thus, the environment, if one follows Foucault's line of reasoning (105–06), must not be understood as the naturally given sphere of ecological processes which human powers try to keep under control, nor should it be viewed as a mysterious domain of obscure terrestrial events which human knowledge works to explain. Instead, it emerges as a historical artifact that is openly constructed, not an occluded reality that is difficult to comprehend. In this great network, the simulation of spaces, the intensification of resources, the incitement of discoveries, the formation of special knowledges, the strengthening of controls, and the provocation of resistances can all be linked to one another.

The immanent designs of Nature, when and where they are "discovered" in environments, closely parallel the arts of government. One might ask if the two are not inseparable in geo-power/eco-knowledge systems. As Foucault sees the arts of government, they essentially are concerned with how to introduce economy into the political practices of the state. Government becomes in the

eighteenth century the designation of a "level of reality, a field of intervention, through a series of complex processes" in which "government is the right disposition of things" ("Governmentality" 93). Governmentality applies techniques of instrumental rationality to the arts of everyday management. It evolves as an elaborate social formation, or "a triangle, sovereignty-discipline-government, which has as its primary target the population and as its essential mechanism the apparatuses of security" (102).

Most significantly, Foucault sees rulers and authorities mobilizing governmentality to bring about "the emergence of population as a datum, as a field of intervention and as an objective of governmental techniques" (102) so that now "the population is the object that government must take into account in all its observations and *savoir,* in order to be able to govern effectively in a rational and conscious manner" (100). The networks of continuous, multiple, and complex interaction between populations (their increase, longevity, health), territory (its expanse, resources, control), and wealth (its creation, productivity, distribution) are sites of governmentalizing rationality to manage the productive interaction of these forces.

Foucault invites social theorists not to reduce all ensembles of modernizing development to the "statalization" of society wherein "the state" becomes an expansive set of managerial functions, discharging its effects in the development of productive forces, the reproduction of relations of production, or the organization of ideological superstructures. Instead he argues in favor of investigating the "governmentalization" of the economy and society whereby individuals and groups are enmeshed within the tactics and strategies of a complex form of power whose institutions, procedures, analyses, and techniques loosely manage mass populations and their surroundings in a highly politicized symbolic and material economy (103). Because governmental techniques are the central focus of political struggle and contestation, the interactions of populations with their natural surroundings in highly politicized economies compel states constantly to redefine what is within their competence throughout the modernizing process. To survive after the 1960s in a world marked by decolonization, global industrialization, and nuclear military confrontation, it is not enough for states merely to maintain legal jurisdiction over their allegedly

sovereign territories. As ecological limits to growth are either discovered or defined, states are forced to guarantee their populations' fecundity and productivity in the total setting of the global political economy by becoming "environmental protection agencies."

Governmental discourses methodically mobilize particular assumptions, codes, and procedures in enforcing specific understandings about the economy and society. As a result, they generate "truths" or "knowledges" that also constitute forms of power with significant reserves of legitimacy and effectiveness. Inasmuch as they classify, organize, and vet larger understandings of reality, such discourses can authorize or invalidate the possibilities for constructing particular institutions, practices, or concepts in society at large. They simultaneously frame the emergence of collective subjectivities (nations as dynamic populations) and collections of subjects (individuals) as units in such nations. Individual subjects as well as collective subjects can be reevaluated as "the element in which are articulated the effects of a certain type of power and the reference of a certain type of knowledge, the machinery by which the power relations give rise to a possible corpus of knowledge, and knowledge extends and reinforces the effects of this power" (Foucault, *Discipline and Punish* 29). Therefore, an environmentalizing regime must advance eco-knowledges to activate its command over geo-power as well as to re-operationalize many of its notions of governmentality as environmentality. Like governmentality, the disciplinary articulations of environmentality must center upon establishing and enforcing "the right disposition of things."

4. Green Governmentality as Resource Managerialism

The script of environmentality embedded in new notions like "the environment" is rarely made articulate in scientific and technical discourses. Yet, there are politics in these scripts. The advocates of deep ecology and social ecology dimly perceive this in their frustrations with "reform environmentalism," which weaves its logics of geo-power in and out of the resource managerialism that has defined the mainstream of contemporary environmental protec-

tion thinking and traditional natural resource conservationism (Luke, "Green Consumerism"). Resource managerialism can be read as the eco-knowledge of modern governmentality. While voices in favor of conservation can be found in Europe early in the nineteenth century, the real establishment of this stance comes in the United States with the Second Industrial Revolution from the 1880s through the 1920s and the closing of the Western Frontier in the 1890s (Noble). Whether one looks at John Muir's preservationist programs or Gifford Pinchot's conservationist codes, an awareness of modern industry's power to deplete natural resources, and hence the need for systems of conservation, is well established by the early 1900s (Nash, *Wilderness*). President Theodore Roosevelt, for example, organized the Governor's Conference in 1907 to address this concern, inviting the participants to recognize that the natural endowments upon which "the welfare of this nation rests are becoming depleted, and in not a few cases, are already exhausted" (Jarrett 51).

Over the past nine decades, the fundamental premises of resource managerialism have not changed significantly. In fact, this code of eco-knowledge has only become more formalized in bureaucratic applications and legal interpretations. Paralleling the managerial logic of the Second Industrial Revolution, which empowered technical experts on the shop floor and professional managers in the main office, resource managerialism imposes corporate administrative frameworks upon Nature in order to supply the economy and provision society through centralized state guidance. These frameworks assume that the national economy, like the interacting capitalist firm and household, must avoid both overproduction (excessive resource use coupled with inadequate demand) and underproduction (inefficient resource use in the face of excessive demand) on the supply side as well as overconsumption (excessive resource exploitation with excessive demand) and underconsumption (inefficient resource exploitation coupled with inadequate demand) on the demand side.

To even construct the managerial problem in this fashion, Nature must be reduced—through the encirclement of space and matter by national as well as global economies—to a cybernetic system of biophysical systems that can be dismantled, redesigned, and assembled anew to produce "resources" efficiently and in ade-

quate amounts when and where needed in the modern marketplace. In turn, Nature's energies, materials, and sites are redefined by the eco-knowledges of resource managerialism as the source of "goods" for sizable numbers of some people, even though greater material and immaterial "bads" also might be inflicted upon even larger numbers of other people who do not reside in or benefit from the advanced national economies that basically monopolize the use of world resources at a comparative handful of highly developed regional and municipal sites. Many of these eco-knowledge assumptions and geo-power commitments can be seen at work in the discourses of the Worldwatch Institute as it develops its own unique vision of environmentality for a global resource managerialism.

5. New Power/Knowledge

The Worldwatch Institute provides a curious instantiation of how regimes of environmentality might be seen at work in the processes of developing a geo-power/eco-knowledge formation. Taking the world as one ecological site, the Worldwatch Institute aptly typifies a green power/knowledge center in the play of current-day environmental politics. Seeing the path of untrammeled industrial development as the cause of environmental crises, a recent Worldwatch Institute book by Brown, Flavin, and Postel attributes the prevailing popular faith in material growth to "a narrow economic view of the world" (21). Any sense of constraint on further growth is cast by economics "in terms of inadequate demand growth rather than limits imposed by the earth's resources" (22). Ecologists, however, study the allegedly complex changing relationships of organisms with their environments, and, for them, "growth is confined by the parameters of the biosphere" (22). For Brown, Flavin, and Postel, economists ironically regard ecologists' concerns as "a minor subdiscipline of economics—to be 'internalized' in economic models and dealt with at the margins of economic planning," while "to an ecologist, the economy is a narrow subset of the global ecosystem" (23). To end this schism, the Worldwatch Institute pushes for melding ecology with economics to infuse environmental studies with economic instrumental ratio-

nality and defuse economics with ecological systems reasoning. Once this is done, the roots of economic growth no longer can be divorced from "the natural systems and resources from which they ultimately derive," and any economic process that "undermines the global ecosystem cannot continue indefinitely" (23).

With this rhetorical maneuver, the Worldwatch Institute articulates its vision of geo-power/eco-knowledge as the instrumental rationality of resource managerialism working on a global scale. Nature, now reinterpreted as a cybernetic system of biophysical systems, reappears among nation-states in those "four biological systems—forests, grasslands, fisheries, and croplands—which supply all of our food and much of the raw materials for industry, with the notable exceptions of fossil fuels and minerals" (Brown, Flavin, and Postel 73). As a result, the performance of these systems might be monitored in analytical spreadsheets written in bioeconomic terms, and then judged in equations balancing increased human population and highly constrained base ecosystem outputs. When looking at these four systems, one must recognize that Nature is merely a system of energy-conversion systems:

> Each of these systems is fueled by photosynthesis, the process by which plants use solar energy to combine water and carbon dioxide to form carbohydrates. Indeed, this process for converting solar energy into biochemical energy supports all life on earth, including the 5.4 billion members of our species. Unless we manage these basic biological systems more intelligently than we now are, the earth will never meet the basic needs of 8 billion people.
>
> Photosynthesis is the common currency of biological systems, the yardstick by which their output can be aggregated and changes in their productivity measured. Although the estimated 41 percent of photosynthetic activity that takes place in the oceans supplies us with seafood, it is the 59 percent occurring on land that supports the world economy. And it is the loss of terrestrial photosynthesis as a result of environmental degradation that is undermining many national economies. (73–74)

Photosynthetic energy generation and accumulation, then, is to become the accounting standard for submitting such geo-power to environmentalizing discipline. It imposes upper limits on eco-

nomic expansion; the earth is only so large. The 41 percent that is aquatic and marine as well as the 59 percent that is terrestrial are actually decreasing in magnitude and efficiency due to "environmental degradation." Partly localized within many national territories and partly globalized as transboundary pollution, the system of systems needs global management—a powerful, all-knowing world watch—to mind its environmental resources.

Such requirements arise from the convergence of dangerous trends identified by such bioeconomic accounting:

> 40 percent of the earth's annual net primary production on land now goes directly to meet human needs or is indirectly used or destroyed by human activity—leaving 60 percent for the millions of other land-based species with which humans share the planet. While it took all of human history to reach this point, the share could double to 80 percent by 2030 if current rates of population growth continue; rising per capita consumption could shorten the doubling time considerably. Along the way, with people usurping an ever larger share of the earth's life-sustaining energy, natural systems will unravel faster. (74)

To avoid this collapse, human beings must stop increasing their numbers so rapidly, halt increasingly resource-intensive modes of production, and limit increasing levels of material consumption. All of these ends require a measure of surveillance and degree of steering beyond the modern nation-state, but perhaps *not* beyond some postmodern worldwatch engaged in the disciplinary tasks of equilibrating the "net primary production" of solar energy fixed by photosynthesis in the four systems. Natural resources in the total solar economy of food stocks, fisheries, forest preserves, and grass lands are rhetorically ripped from Nature only to be returned as environmental resources, enveloped in accounting procedures and encircled by managerial programs. Worldwatching presumes to know all of this, and in knowing it, to have mastered all of its economic/ecological implications through authoritative technical analysis. By questioning the old truth regime of mere economic growth, a new regime of truth for attaining sophisticated ecological economy stands ready to reintegrate human production and consumption in the four biological systems.

The Worldwatch Institute writers here are engaged in a

struggle "for truth" in economic and environmental discourse. By simultaneously framing economics with the bad rap of growth fetishism and twinning ecology with the high purpose of documenting environmental interconnectedness, the Worldwatchers are striving to transform fields of knowledge as bands of power. Inasmuch as today's decentered networks of power operate through relations of truth "linked in a circular relation with systems of power which produce and sustain it, and to effects of power it induces and which extend it" (Foucault, *History of Sexuality* I 144), these discursive alterations are the requisite moves for prevailing in a disciplinary struggle for discursive authority. By shifting the authorizing legitimacy of truth claims used in policy analysis away from *economic* terms to *ecological* terms (as they are cast in these thermodynamic allusions), the Worldwatch Institute's experts are working to reframe the power/knowledge systems of advanced capitalist societies.

6. The Environment as Disciplinary Space

No longer Nature nor even ecosystem, the world under this kind of watch is truly becoming "an environment," ringed by many eco-knowledge centers dedicated to the rational eco-management of its geo-powers. Being "an environmentalist" quickly becomes a power expression of the eco-knowledge formations of environmentality in which the geo-powers of the global ecosystem can be mobilized through the disciplinary codes of green operational planning. The health of global populations as well as the survival of the planet itself allegedly necessitate that a bioeconomic spreadsheet be draped over Nature, generating an elaborate set of accounts for a terrestrial eco-economy of global reach and scope. Hovering over the world in a scientifically centered surveillance machine built out of the disciplinary grids of efficiency and waste, health and disease, poverty and wealth as well as employment and unemployment discourses, Brown, Flavin, and Postel declare "the once separate issues of environment and development are now inextricably linked" (25). Indeed, they are in the discourses of Worldwatch Institute as its organizational expertise surveys Nature-in-crisis by auditing levels of topsoil depletion, air pollu-

tion, acid rain, global warming, ozone destruction, water pollution, forest reduction, and species extinction.

Environmentality, then, would govern by restructuring today's ecologically unsound society through elaborate managerial designs to realize tomorrow's environmentally sustainable economy. The shape of an environmental economy would emerge from a reengineered economy of environmentalizing shapes vetted by worldwatching codes. The individual human subject of today, and all of his or her unsustainable practices, would be reshaped through this environmentality, redirected by practices, discourses, and ensembles of administration that more efficiently synchronize the bio-powers of populations with the geo-powers of environments. Traditional codes defining human identity and difference would be reframed by systems of environmentality in new equations for making comprehensive global sustainability calculations as the bio-power of populations merges with the ecopower of environments. To police global carrying capacity, in turn, this environmentalizing logic bids each human subject to assume the much less capacious carriage of disciplinary frugality instead of affluent suburban consumerism. All of the world will come under watch, and the global watch will police its human charges to dispose of their things and arrange their ends—in reengineered spaces using new energies at new jobs and leisures—around these environing agendas.

Sustainability, however, cuts both ways. On the one hand, it can articulate a rationale for preserving Nature's biotic diversity in order to maintain the sustainability of the biosphere. But, on the other hand, it also can represent an effort to reinforce the prevailing order of capitalistic development by transforming sustainability into an economic project. To the degree that modern subjectivity is a two-sided power/knowledge relation, scientific-professional declarations about sustainability essentially describe a new mode of environmentalized subjectivity. In becoming enmeshed in a worldwatched environ, the individual subject of a sustainable society could become simultaneously "subject to someone else by control and dependence," where environmentalizing global and local state agencies enforce their codes of sustainability, and police a self-directed ecological subject "tied to his own identity by a conscience or self-knowledge" (Foucault, "Afterword" 12). In both manifesta-

tions, the truth regime of ecological sustainability draws up criteria for what sort of "selfness" will be privileged with political identity and social self-knowledge.

Sustainability, like sexuality, becomes a discourse about exerting power over life. How power might "invest life through and through" (Foucault, *History of Sexuality* I 139) becomes a new challenge, once biopolitical relations are established as environmentalized systems. Moreover, sustainability more or less presumes that some level of material and cultural existence has been attained that is indeed worth sustaining. This formation, then, constitutes "a new distribution of pleasures, discourses, truths, and powers; it has to be seen as the self-affirmation of one class rather than the enslavement of another: a defense, a protection, a strengthening, and an exaltation . . . as a means of social control and political subjugation" (123).

The global bio-accounting systems of the Worldwatch Institute conceptually and practically exemplify the project of environmentality with their rhetorics of scientific surveillance. How Nature should be governed is not a purely administrative question turning upon the technicalities of scientific "know-how." Rather, it is essentially and inescapably political. The discourses of Worldwatching that rhetorically construct Nature also assign powers to new global governors and governments, who are granted writs of authority and made centers of organization in the Worldwatchers' environmentalized specifications of managerial "who-can" and political "how-to."

7. Instituting a Worldwatch: The Eco-Panopticon

Not surprisingly, then, the various power/knowledge systems of instituting a Worldwatch environmentality appear to be a practical materialization of panoptic power. The Worldwatch Institute continually couches its narratives in visual terms, alluding to its mission as outlining "an ecologically defined vision" of "how an environmentally sustainable society would look" in a new "vision of a global economy." As Foucault claims, "whenever one is dealing with a multiplicity of individuals on whom a particular form of behavior must be imposed, the panoptic schema may be used"

(*Discipline and Punish* 205) because it enables a knowing center to reorganize the disposition of things and redirect the convenient ends of individuals in environmentalized spaces. As organisms operating in the energy exchanges of photosynthesis, human beings can become environed on all sides by the cybernetic system of biophysical systems composing Nature.

Worldwatching, in turn, refixes the moral specification of human roles and responsibilities in the enclosed spaces and segmented places of ecosystemic niches. And, in generating this knowledge of environmental impact by applying such powers of ecological observation, the institutions of Worldwatch operate as a green panopticon, enclosing Nature in rings of centered normalizing super-vision where an eco-knowledge system identifies Nature as "the environment." The notational calculus of bioeconomic accounting not only can, but in fact must reequilibrate individuals and species, energy and matter, inefficiencies and inequities in an integrated panel of globalized observation. The supervisory gaze of normalizing control, embedded in the Worldwatch Institute's panoptic practices, adduces "the environmental," or enclosed, segmented spaces, "observed at every point, in which the individuals are inserted in a fixed place, in which the slightest movements are supervised, in which all events are recorded, in which an uninterrupted work of writing links the centre and periphery, in which power is exercised without division, according to a continuous hierarchical figure, in which each individual is constantly located, examined, and distributed among the living beings, the sick and the dead" (Foucault, *Discipline and Punish* 197). To save the planet, it becomes necessary to environmentalize it, enveloping its system of systems in new disciplinary discourses to regulate population growth, economic development, and resource exploitation on a global scale with continual managerial intervention.

Many contemporary environmental movements, particularly those inspired by the Worldwatch Institute's analyses, push governmentality to a global rather than a national level of control. The biosphere, atmosphere, and ecosphere are all reintegrated into the truth regime of political economy to serve more ecological ends, but they are also made to run along new economic tracks above and beyond the territorial spaces created by nation-states. By touting the necessity of recalibrating society's logics of governmentality

in new spatial registers at the local and global level, the geo-power politics of environmentality aim to rewrite the geographies of national stratified space with new mappings of bioregional economies knitted into global ecologies—complete with environmentalized zones of "dying forests," "regional desertification," "endangered bays," or "depleted farmland."

If Foucault's representation of governmentality accounts for the practices of power mobilized by centered national sovereigns in the era of capitalist modernization and national state-building after 1648, the Worldwatch Institute's approach to environmentality perhaps foreshadows the practices of power being adduced by multicentric alliances of transnational capital or loose coalitions of highly fragmented local sovereignties, following the collapse of the old Cold War competitions in the early 1990s. New spatial domains are being created in the world today, on the one hand, by pollution, nuclear contamination, and widespread rapid deforestation, and, on the other, by telecommunications, jet transportation, and cheap accessible computerization. Nation-states are not answering effectively the challenges posed within their borders by these new spaces. But a variety of new organizations in the contemporary environmental movement (Luke, "Ecological Politics"), like the Worldwatch Institute, Earth First!, The World Wildlife Federation, or Greenpeace, at least are addressing, if not answering, how these spaces are developing, what impact they have in today's political economy, and who should act to respond to the challenge. In the bargain, they also are interposing their own environmentalizing conceptual maps, technical disciplines, and organizational orders on these spaces as they urge local citizen's groups or global supranational agencies to move beyond the constraints imposed by national sovereignty to construct new sustainable spaces for human habitation.

The cybernetic system of biophysical systems, once known as Nature, has now been reduced to "the environment," so that it might be remapped to police the provinces of photosynthesis and bind the borders of bioeconomics which these spaces constitute. Logics of sovereignty, imposing military-administrative jurisdiction over bits and pieces of these global systems in irrationally drawn territories through governmentality, must be supplanted by larger logics of environmentality. As Fredric Jameson notes, if

these changes can be understood as the historical expression of what is regarded as "postmodern," then this postmodernity must be confronted "since the modernization process is complete and Nature is gone for good" (ix). That is, where the times of modernity end, the spaces of environmentality perhaps begin.

Of course, it is possible to define the environment in codes that are not entirely wound up within the power/knowledge regime of technoscience, like those of the Worldwatch Institute. In their own ways, the discourses of many Earth First! activists, some ecofeminist writers, and a few deep ecology thinkers are working to develop understandings of Nature that stand outside of the bioeconomic accounting standards used by so many mainstream environmental organizations and quite a few radical ecology groups (see Fox; Devall and Sessions; and Nash, *Wilderness*). These alternative discursive frameworks, however, tend to exclude such voices from any effective participation in policy-making (Luke, "Dreams of Deep Ecology"). And, even when some token access might be granted to the members of these movements for registering some policy-related input, their discursive understandings are either pardoned as metaphysical excess or translated into latent policy-relevant prescriptions. Otherwise, the dominant regime of power/knowledge expects its critics, even fairly effective ones like those in the Worldwatch Institute, to accept the technoscientific codes of bureaucratic address which drive environmentality.

In many ways, these contemporary maneuvers to construct an eco-panopticon which re-envisions Nature by environmentalizing its workings as a system of systems can be traced back to the power/knowledge provided in a photographic image (captured initially by the Apollo 8 astronauts) of the Earth in space as it was seen from a NASA spacecraft traveling to the Moon. From its popularization in the 1960s to its banalization in the 1990s, many have put the image to pernicious uses. The dust jacket of another world-watching manifesto, *Earth in the Balance: Ecology and the Human Spirit* (1992) by Vice President Al Gore, continues this practice with its iconic presentation of a composite photograph of a cloudless earth reduced to crystalline perfection by digital photography. Inside the book, Gore walks down many of the Worldwatch Institute's paths in touting the merits of an "eco-nomics" to underpin his visions for a Global Marshall Plan to save "the environment"

with carefully targeted Strategic Environmental Initiatives operated by post–Cold War Washington bureaucracies. Framing the planet in computer-controlled photography serves as his rhetorical pretext for saving the planet through the operations of the green power/knowledge of Gore's "eco-nomic" environmentality.

The pretense of human agency actually engaging in some sort of worldwatch becomes a credible possibility, technologically and administratively, only with this image. Technological power is now so great that even Nature can be reduced to an eco-panoptic snapshot. Armed with the first photos of the earth in space, many people began rethinking their foundational images of the planet in the late 1960s. As the Earth was enveloped for the first time in photography, bringing it under control, into focus, and within reach for ordinary human beings, mythologies changed. For some, the image conveyed the precious fragility of a tiny planet in the immense cosmos. For others, it provided a compelling representation of the world's biggest managerial challenge—generating geo-power via eco-knowledge. Humanity's role must become one of watching over or policing all of the natural systems at work in the skies, oceans, and continents depicted by such photographs as encircled manageable space. Once one can watch the world in eco-panoptic videotapes and photographs, the worldwatching project begins, turning photographic images into political practices and ideological ideals aimed at environing Nature by disciplining its spaces.

Note

A preliminary version of this paper was prepared for the annual meeting of the Society for Human Ecology, April 22–23, 1994, at Michigan State University in East Lansing, Michigan, and some passages of it appear in *Telos* 97 (1993) and *Capitalism Nature Socialism* 18 (1994).

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DECAY AND ITS DISCONTENTS

DON'T FOLLOW THE WIND IN THE NUCLEAR CULTURE SOURCE BOOK **Noi Sarawagi, 2016**

Taking up Smithson's game of non-site, with its never-ending shuffle between decay and disillusion, Noi Sawaragi's essay - commissioned as part of the exhibition 'Don't Follow the Wind' in which 12 artists produced works never to be seen on site in the Fukushima exclusion zone with their documentation on display in a Tokyo Non-Visitor Center - tackles the 'here' (non-site) and 'elsewhere' (sites) of both art and radioactive decay as read against a 'befouled' Fukushima. JP EN

ON THE EXHIBITION 'TANESASHI DECONTAMINATION BY SHUJI AKAGI + KIO KURODA **Noi Sarawagi, 2017**

Noi Sawaragi takes on the theme of the temporary containment of radioactive waste material to suggest that 'if this "temporary temporariness" retreats without end, then ultimately our own bodies will probably end up having to be the final storage facility'. JP EN

ENTROPY MADE VISIBLE **Robert Smithson interviewed by Alison Sky, 1973**

Highlighting 'fluvial entropy', where everything geologic is

gradually being worn down, Smithson quickly pencils in a dark ecology where any attendant distraction of those apparitional and 'irreconcilable situations' keep us busy aesthetically enough to distance us from the face of the irreversible violence of 'earth's heat-death'.

KARST TERRAINS: ENVIRONMENTAL CHANGES AND HUMAN IMPACTS **Robert Inkpen and Stephen Trudghill 1993**

An early representative paper of thinking around stone decay that reviews work on the effects of acid rain (SO2) on building stones to then explore the potential effects it might have on karst formations. Concludes that dissolution (also known as 'karren sculpting') and loss to such limestone formations is dependent on the buffering of any soil overlays. This is a precursor to some interesting but perhaps over-directed work - given that stone decay is nonlinear and highly stochastic - produced around using stone as one element in monitoring changes in physical systems.

FURTHER READINGS

ATOMIC LIGHT (SHADOW OPTICS) **Akira Mizuta Lippit 2005**

Following the early twentieth century's synchronous restructuring of vision in x-ray, cinema and dreaming in a double bind of invisibility and revelation, Lippit's book flickers over

these different orderings until the moment of their exponential and violent re-enactment in the bombings of Hiroshima and Nagasaki which turned them "in the instant of a flash, into massive cameras; the victims grafted onto the geography by the radiation, radiographed ... [which] unleashed an excess visuality that threatened the material and conceptual dimensions of interiority and exteriority".

THE NUCLEAR CULTURE SOURCE BOOK **ed. Ele Carpenter 2016**
A survey of aesthetic and critical studies made in response to the nuclear environment, including issues around Chernobyl and Fukushima, fallout, weapon testing, long-term waste storage, leakage as well as the vast infrastructure of mining, energy production, waste transport, and decontamination.

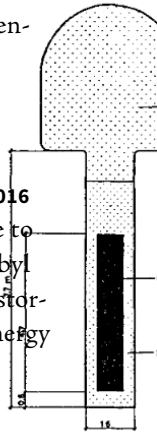

FIG. 2. Schematic picture of deposition hole with radioac
compacted bentonite (II). The tunnel backfill consists of
concept.

美術（アロス）と放射（エンテレケイア）・能

「Don't Follow the Wind」
展の
旗が立つ位置（トポス）

椹木野衣

汚れっちまった悲しみに
今日も小雪の降りかかる
汚れっちまった悲しみに
今日も風さえ吹きすぎる

中原中也『汚れっちまった悲しみに……』

東京から常磐道を北へ向かい、茨城県と福島県の県境を越えると、それまで平坦な土地を走っていた高速道は次第に高所の橋桁で阿武隈の山並みをまたぐようになり、車窓からは見事な景観が見渡せる。三基の原子炉が「レベル7」のメルトダウンを起こすという、世界でも最悪の原子力災害を引き起こした東京電力福島第一原子力発電所（以下、福島原発）の周辺に散在する「Don't Follow the Wind」（以下DFW）展の会場に向かっているとは、到底思えない。しかしながら、パーキング・エリアでも比較的眺わいのある、いわき市湯本のあたりを通り過ぎ、まもなく楢葉町、富岡町といった双葉郡に入るに従い、一般車両は激減し、逆にダンプトラックのような大型の工事車両ばかりが目立つようになる。道の脇に、電光掲示板を使って映し出された数字と記号は、「現在の常磐道の放射線量」だ。二・二マイクロシーベルト／毎時。東京都心部の放射線量が現在、〇・一二マイクロシーベルト／毎時ほどなので、おおざっぱに言って二〇倍ほどもある。車内は、あらゆる方向から照射され、車体を突き抜け、手もとの線量計に内蔵されたガイガーミュラー管を貫通し、あらぬ方向へと去っていくガンマ線を感知する音で、加速度的に喧しくなっていく。周囲が危険地帯となったことを警告するアラーム音は、ずっと鳴りっぱなしだ。だからといって、体調に「ただちに影

響が出る」ことはない。けれども、もう耳ではカウントすることができず、一定の持続音にまで達したちょうどその数だけ、放射線は僕らの身体を貫通し、細胞の一部を傷つけずにはいない。目にはまったくみえず、破壊力もごく微小だが、小さな高射砲で、外からひっきりなしに身体を打ち抜かれている状態だ。いい気などするはずがない。

しかしながら、この放射線が持つ「みえない」という性質、すなわち「みえること」と「みえないこと」をめぐる攻防は、DFW展について論じるうえでも、もっとも革新的、ゆえに危機的（クリティカル）な導入となる。まずは、そのあたりから話を始めることにしよう。

最初に区別しておきたいのは、「放射能」と「放射線」、そして「放射性物質」の違いである。と言っても、福島原発の事故以前は、この三つはさして厳密に区別されていなかった。そのいずれを指すうえでも、「放射能」とひと括りにされていた。言ってみれば、二〇一一年より前は、放射能とは、放射線でも放射性物質でもありえた。

しかし事故の以後は、原子力災害によって引き起こされた過酷で非日常的な事態に対応するため、この三つは可能なかぎり正確に使い分けられるようになった。簡単に言えば、放射能とは、外部からのなんらかの作用で核崩壊を起こした原子が放つ様々な目にみえない力のことだ。放射線とは、こうして外部へと放たれた核力が空間を移動する際の線状の運動と、その運動が孕むエネルギーのことを指す。そして放射性物質とは、これらの放射線を発し、そのような能力（＝放射能）を備えた線源となる物質のことを意味している。もう少し砕いて言えば、放射能とは抽象的な「概念」、放射線とは具体的な「能力」、放射性物質とは物理的な「対象」ということになる。

こうして考えてみたとき、よく言われる「放射能は目にみえない」「匂いもしない」「味もしない」「音も発しない」「付着していてもわからない」というのは、実はあまり正確な言い方でないことがわかるだろう。放射能は抽象概念なのだから、そもそも概念が目にみえるはずがない。他方、放射線は抽象概念ではなく、実質を備えた具体的な効力だが、耳で音楽を聞くことはできても、音波そのものはみえないのと同様、目にはみえない。しかし、放射性物質はどうだろう。たしかに僕らは放射性のセシウムやストロンチウム、あるいはプルトニウムといった微小の放射性物質を肉眼でとら

えることはできない。しかしこれらの核力を備えた物質が、現実の世界のなかで、純粋にそれ自体として存在することもありえない。福島原発の事故で、原子炉のなかでメルトダウンした核燃料から飛散した放射性物質は、原子炉を構成する様々な鉱物由来の素材、さらには外部環境中に放出されたあとは空気中の塵やほこり、雨や雪、そして土壌に落ちてからは土を形作る諸分子、都市部ではアスファルト面やコンクリート・ブロックの凹凸などと強く結合し、自動車や人間の移動で日々削られ、風で舞い上がり、移動して路傍にたまったり、下水に流れ込んでは汚泥として堆積し、目にみえる状態となる。

事実、都心からのDFW展への最寄りのアクセス・ポイントとなるインターが近づくと、かつては美しい水田や畑が眺められたであろう平地のところどころに、除染作業で出た放射性物質を含む土壌や枯れ木・枯れ葉などを緑色のシートで梱包した汚染物の仮置き場がみえてくる。いや、環境省の基準で呼ぶ「仮置き場」とは、汚染物から放射線が野方図に飛び出したり、放射性物質そのものが拡散したりしないよう、分厚い土嚢で遮蔽をした状態を指すので、これらは仮置き場の仕様を施す前の、いわゆる「仮・仮置き場」なのかもしれない。また、会場周辺に車で乗り入れるたびに増え

ているのは、黒いフレコンバックに詰み込まれたまま、空き地にぎっしりと並べられた汚染物でできた堤のような列だ。これは外部からみただけでも、あきらかに遮蔽がされていない。だから、真夏の太陽をもろに浴び、黒い色は猛暑の熱を十分に吸収し、雨風にもじかにさらされることから、そう長くは持たないことがはっきりと伺える。おそらくは、これらを順次収めるべき中間貯蔵施設の建造が、用地候補となる個人（被災者）からの土地取得のむずかしさから、遅々として進んでいないことのあかしなのだろう。けれども、当初の規定上の年限から、福島市をはじめとする中通りなどから、汚染土の移動だけはせねばならない。そのことから余儀なくされた、これらは「仮・仮置き場」でさえない、いわば打つ手なき放置状態なのだろう。走っても、走っても、黒いフレコンバックと緑のシートで表面を梱包された「毒塚」ばかり目に入ってくる異様な風景からは、「復興」が進んでいるという実感はまったく得ることができない。それどころか、なにかSF映画のセットをみているように現実感がない。それくらい帰還困難区域の全体は、広大な領域にわたって、風景そのものから「異化」されてしまっている。

このように、広義の放射性物質は、はっきりと「目にみえる」。どこそこに「在る」

と特定することができるし、危険だから「近づかない」ことも可能だ。接近すればビニール性のシートやフレコンバックに特有の「匂いもする」だろうし——そんなことはありえないが——もしも口に入れば、これらの汚染土に特有の保管方法からくる「味」だってするだろう。つまり、私たちは「放射性物質は目にみえない」という「偏見」そのものから、まずは解放されなければならない。この意味では、放射性物質、引いては放射能は目にみえる。そんなことは、「帰還困難区域」と呼ばれ、今なお檻のようなバリケードによって立ち入りを厳しく管理され、その実、いったん中に入れば、除染のための作業員や彼らを乗せた大小の車両がひっきりなしに行き交う「賑(にぎ)やかな死の街」の様子をみれば、誰の目にもあきらかなはずだ。

ところで私たちは、この「賑やかな死の街＝帰還困難区域」に、国内外一二人＝組の美術家の手を借りて、いま、様々な形態の作品を設置しつつある。これらの作品は、屋外や屋内、半屋外など様々な条件と多様な形態を取り、いくつかのエリアに分かれて展示されたものだ。もっとも、どのエリアも程度の差こそあれ、放射能によって酷く汚染されている。だから、圏内に作品を持ち込んだ時点では、むろんのこと放射性の能力など持たなかったけれども、時が経過するにつれ、雨風などで移動してきた放

射性物質が表面に降り積もり、ケースによっては作品の奥深くまで入り込み、随所で汚染されはじめている。そしてその程度に応じ、作品自体が放射能を持ち、放射線を発する放射性物質と化していく。作品がこの圏内の放射性物質と同化することで、これらの作品は、展示場所にあるがままにして、いわば、はっきりと「目にみえる」放射能の産物になりつつあるのだ。

こうして、放射能と美術作品という、本来ならまったく無縁であるはずの異質な要素同士のあいだに、具体的に特定しうる場所の点でも、放射性の物質になりつつあるという物性上の特質のうえでも、極めて密接な「重なり」（すなわち、美術作品＝放射性物質ということ）が生まれたことになる。今から、この両者の重なりについて、過去の美術が積み重ねてきた成果を参照しながら、いま少し込み入った考察を加えてみよう。

先の「放射能」をめぐる区別にならえば、実は、「美術」は典型的な視覚芸術とされながらも、「目にみえない」。目にみえるのは、「美術作品」でしかない。そして美術作

品は目にみえるけれども、私たちは「美術作品そのもの」を鑑賞しているわけではない。私たちが美術作品から受け取ることを期待しているのは、その作品から感受することができる「美術の力」であって、それは、またもや「目にみえない」。一枚の絵から私たちが美術の力を感受し、その結果として感銘や感動を受けるとき、それは、作品が私たちの心になんらかの強い働きかけをしたからであって、キャンバスの生地や、そのうえに塗り付けられた絵具そのものに心を動かされているわけではない。それは、あくまで「美術の力」が発せられるための物質的な媒介をなしている（もっとわかりやすく言えば、既製品としての絵具の使用例）にすぎない。

こうして考えてみたとき、美術と美術作品と美術の力（感受・鑑賞・感動）をめぐる三者のズレと重なりが、ちょうど、放射能と放射性物質、そして放射線との違いに該当することがわかるはずだ。べつだん、美術作品から放射線のように物理学的な作用が発せられているわけではない。だが、私たちがそこから感覚器官を通じて「なにか」を受け取っていることだけは確かである。そして、そのような作用を起こしうる物質のことを、単なる物質とは区別して、私たちは、より一般化のうえ「美術」と呼んでいる。ちょうど放射性物質そのものや、そこから発せられる放射性の力のこともすべて

含んで、対象に向かって能動的な働きかけをなす能力として抽象的に「放射・能」と呼んできたように。

ふたたび一枚の絵に即して言えば、帰還困難区域の中では、絵具やキャンバスは、あるがままにして「放射性の物質」となる。目にみえ、多様な形態をとりうる美術作品は、どのようなメディウムに規定されようとも、それがなんらかの物質に依存するかぎり、帰還困難区域の内部では、放射性物質でもありうるからだ。そして、この物的な美術作品を感受・鑑賞することで、私たちはそこから、なんらかの「美術の力」(感銘)を受け取る。もしも接近することができれば目でみることもできようが、しかし、それ自体に美術としての(たとえば抽象的な)「意味」があるわけではない。あくまで、それが一人一人の心に直接的な働きかけをするとき、私たちは、それを美術作品とみなし、能動的な力を持つ美術として評価し、歴史の一部として扱おうとするのである。放射線が目にみえないように、このようにして鑑賞者や歴史に働きかける力そのものも、放射能と同様、目にみえる対象ではない。帰還困難区域のなかで、このような物的対象と能力は、物質＝作品の置かれた地点で物理的に重なりながらも、本質的には異質な領域に属している。だからこそ、物質と能力からなる異質な両者を束ねるため

に、一種のメタ概念としての美術・能＝放射能が必要となるのである。かりにこれを伝統的なアリストテレス哲学の範疇で考えるならば、美術作品や放射性物質は実現された現実態としてのエネルゲイア、美術の力や放射線は潜在的な可能態としてのデュナミス、そして両者がひとつの能動態として抽象的に束ねられたものが美術、ないしは放射能ということになるだろう。

こうして私たちは、DFW展が、放射能汚染された帰還困難区域という特殊な会場を舞台としていることから、通常は思いつきもしない放射能と美術との重なり、放射線と美術の力、放射性物質と個々の美術作品という共通性について、にわかに考えをめぐらさざるをえなくなる。そして、たとえ帰還困難区域に足を踏み入れずとも、汚染地帯から離れた都心であっても、空調の利いた美術館のなかにいるがままにして、美術と放射能にまつわる、「みえるもの」と「みえないもの」との境界を、頭のなかで重ねることができるようになる。というよりも、いやおうなくそうさせられるのである。

DFW展は、このように美術と放射能の接点を通じて、私たちがいまいる「ここ」と、立ち入ることが制限された「よそ」とが切り離しがたく交わる問題でもある。DFW展は決して、汚染された「よそ」にあって、簡単に入場することができないから、

私たちがいる「ここ」とは無関係な領域で起きている特殊な（＝サイトスペシフィックな）展覧会にすぎない、というわけではない。それどころか、DFW展を通じて「ここ」（＝ノン・サイト）と「よそ」（＝サイト）はめまぐるしく出会い、交流し、その意味と意義を刻々と変化させる。

「ここ」と「よそ」との距離を超えた媒介と交流という点において、DFW展は、遠く一九六〇年代末にアメリカでアースワーク（ランドアート）を初めて提唱した、故ロバート・スミッソンの系譜を引くものと言えるだろう。よく知られたとおり、スミッソンは、美術の領域を美術館やギャラリーといった一定の閉じた面積（体積）を持つ室内から、その外に広がる広大な外部環境（事実上の無限）へと向けて開いた。美術館やギャラリーといった社会的な制度がおおむね人口が密集する都市部に位置し、人の手で管理・運営されているのに対して、まったく反対に、スミッソンは都市から遠く離れた無人の平原や打ち捨てられた廃屋、土壌汚染地帯などに目を向け、進んでそこに作品

を設置した。「作品」と言っても、それは美術館やギャラリーのように垂直・水平の壁や床、照明や監視など前提にしようもないわけだから、おのずと土砂や降雨、水や石・岩などと一体化し、風にさらされて、どこまでが作品で、どこまでが作品でないのかを区別できない、開かれた「環境」そのものとなる。スミッソンは、こうした作品＝環境が置かれた状態のことを、従来の古典的な美術作品が設置された状況から区別するうえで、「サイト」と呼んだ。サイトとは「特定の場所」のことで、他に置き換えられない固有の条件を持つ。たとえば、サイトに設置された作品は、サイトそのものとほぼ一体化してしまうから、絵画や彫刻のような移動ができない。ちょうどDFW展で、作品が帰還困難区域という置き換え不可能なサイトと密接な関係を持ち、それぱかりか帰還困難区域を広域にわたって汚染した放射性物質と一体化することで、時の経過のなかに投げ出されているのと同じように。しかし、繰り返すことになるが、そこは人の立ち入りが厳しく制限されているため、観客が自由になかに入って作品を鑑賞することは許されていない。スミッソンがサイトに設置した作品が置かれた場所も、特別に法的な立ち入りが禁止されているわけではなかったが、おおむね都市から著しく距離が離れていたり、手頃な交通手段がなく、接近すること自体がむずかしか

ったから、やはり作品を直接に鑑賞することはむずかしい。この延長線上に、スミッソンが、「同じ作品」の「別の有り様」として設定したのが、「ノン・サイト」（非・場所）と呼ばれる、もうひとつ別の展示の形態である。

ノン・サイトとは、文字通り「特定の場所（サイト）」を打ち消すわけだから、結果的に「普遍的な場所」を指し示す。美術において、そのような普遍性を担保するのは、端的に言えば美術館である。美術館の室内は、それがニューヨークにあったとしても、ベルリンにあったとしても、ロンドンにあったとしても、東京にあったとしても、こうした外部要因に由来する個別の条件を超越して、たがいに共通の一般性を持ちうる。言い換えれば、そのような土地ごとの固有性（＝サイト）を超える「どこ」でもない抽象性（＝ノン・サイト）を持つことで、すぐれた絵画や彫刻は世界のどこでみても、そこがノン・サイトであるかぎり、誰にとっても同じ価値を持つことが保証されることになる。同時に、歴史的な価値が認められた美術作品は、世界のどこでみたとしても、そこがノン・サイトであるかぎり、その同一性を保持されることで、併せてその普遍性も守られる。ニューヨークでみたセザンヌと、東京でみたセザンヌの同じ絵が、まったく同様に感動したにもかかわらず、場所の異質性に縛られ、そのつど異なる価値の表出

とされてしまっては、美術が持つ価値は気まぐれでバラバラなものとなってしまう。ノン・サイトは、そのような美術作品をめぐるアナーキーな状況を解消し、特性の場所が持つ性質に規定されてはならない美術の価値を束ねるために、どうしても必要な概念なのである。

いまや、逆に言えば、美術館が「ノン・サイト」であるということは、その外部環境が「サイト」であることが発見されて、初めて見出されたともいえる。しかしスミッソンがそうしたように、美術館と比べたとき無限とならざるをえない外部環境であっても、「サイト」というかたちなら美術作品を置くことができる。そう対比することで、初めて美術館での展示の特殊性（＝通常、私たちが考えてきた美術とは、ノン・サイトの産物にかぎられていたこと）も浮かび上がってきたのである。

このように考えてみたとき、サイトとノン・サイトとでは、実は――これまで述べてきた語義にさからうようだが――後者のほうが、ずっと特殊な場所であることに気付くだろう。私たちはもともと、スミッソンが好んだような辺境ではないにせよ、基本的には美術館というノン・サイトに属することのない、気まぐれで、なにが起こるかわからない外部環境のなかで暮らしている。その意味では、私たちは日頃、定義上

は特殊であるとされるサイトのほうになじんでいる。ところが、より普遍的とされる美術館のなかの展示空間はどうだろう。温度・湿度を管理され、照明で光量を制御し、一定の動線と順路で守られ、そのうえ、みる者はひっきりなしに監視されている。しかも、たいていは午前から夕刻に掛けて、限られた一定の時間しか開いていない。それ以外の時間に立ち入ろうとしても、堅く施錠されており、法的にも物理的にも入場することはできない。それこそが「普遍的＝一般的とされるノン・サイトの特殊性」なのである。

だが、ノン・サイトがこのように厳しく管理されているのにはわけがある。ノン・サイトが美術館を典型とするかぎり、その心臓にあたるのは収蔵機能にほかならない。美術館の究極の使命は、そこに収められた美術作品を、できるだけ変化がないまま後世に伝えることにあるからだ。だが、たとえ使命だからといって、それだけを優先してしまえば、美術館は昼の光も差し込まず、真っ暗で、空調を機械的に制御されただけのタイム・カプセル＝ブラック・ボックスのほうがよいことになってしまう。とはいえ、本来の第一義に沿っていえば、美術館にとっては、それが理想なのである。けれども、美術館のもうひとつの重要な機能は、市民の財産でもある価値ある美術作品に

日頃から接する機会を設け、生活を豊かにし、思慮をめぐらせ、今後、どのような美術作品を収蔵していくべきかを広く議論する機会を提供することにある。つまり、言ってみれば展示と収蔵は根本的に矛盾しているのである。この矛盾は原理的なものであるから、根本的には解消することがむずかしい。だが、展示の際に入念に気温・湿度・照明を調整し、警備にも念を入れ、時間と期間を一定のあいだに限定して公開すれば、その経年劣化は最小限に留められる。いわば「展示」とは、収蔵のあいまに設けられた、緩やかであるがゆえに恩恵のある作品の消耗（エントロピーの増大）なのである。

ところが、スミッソンの提唱したサイトでは、このようなことごとくが覆されている。まず、屋外の雨風に晒される中では、気温・湿度の管理などなすすべもない。むろん、気象も好天から猛暑、曇天から風雨、場合によっては暴風や台風、ハリケーンやサイクロンまで、いかんともしがたい。したがって作品は、絶え間ない風化・劣化の過程にさらされている。場合によっては、作品そのものが消耗・崩壊してしまうことも十分にありうる。しかしその代わり、サイトでの作品には、公開のための限定された開館時間などは存在しない。「展覧会」ではないのだから、とうぜん「会期」も存在しない。つまり、限定された「空間」の精緻な管理よりも、年限が読み切れず、

緩やかではあるが、ときに熾烈な「時」の経過のなかに作品は放置されている。この点でDFW展は、スミッソンの言う、サイトに置かれた展示の典型例であると考えうる。けれども、DFW展で12の美術家(集団)によって帰還困難区域に置かれた作品は、スミッソンの想定した外部環境よりも、さらに過酷な条件に晒されている。高濃度の放射能による汚染によって、絶え間なく放射線で貫かれ、風化の様態が加速されているからだ。けれども、そのことによってDFW展の作品群は、実は、スミッソンの考えた時の経過とともにある管理することができないサイトならではの美術の条件を、むしろ、いっそうわかりやすく提示し、さらに推し進めているとさえ言えるだろう。

ところで、スミッソンの唱えたサイト／ノン・サイトについて考えるうえでもうひとつ重要なのは、以上のような、サイトをめぐる非通例的な美術作品をめぐる新たな条件付けだけではない。サイトの作品は通常、容易にはみることができないから、これを鑑賞者に伝えるためには、やはりノン・サイトを活用せざるをえない。けれども、

もしもサイト／ノン・サイトとの関係を、前者が一次的な「本体」であるのに対して、後者は、それを伝えるための二次的な「記録」にすぎないと考えるならば、サイト／ノン・サイトの関係は結局、優劣の関係となり、両者がたがいに媒介し合うといっても、どこまでも対等にはなされないことになってしまう。ところが、スミッソンの提唱が真に重要なのは、たんに美術館の外界までもが発表の場所になったというのではなく、美術におけるサイトの意味を発見することで、同時に、それまではノン・サイトにあるしかなかった美術と美術館での展示形式そのもののあり方にまつわる根本的な刷新を計ったことにある。

先に触れたとおり、作品の本体がサイトにあるとするかぎり、たとえ写真やデータを駆使して作品を記録し、それをノン・サイトとしての美術館の展示室に設置したとしても、それはあくまで二次的なものでしかなく、美術作品としての「価値」（美術としてのカ）を発揮することはできない。けれどもスミッソンは、これらを副産物としての「記録」という考えからも解放した。従来は、しょせん写真やデータであるかぎり、絵画や彫刻などの古典的な美術作品としての本体に比べ二次的とされてきたそうした複製的な対象にも、それが「ノン・サイトにある」ことでサイトとの互換性を持つこ

とによって、これまで本体とされてきた作品と同等の価値が与えられたのである。

こうして、写真や映像、データといったそれまで二次的な地位に甘んじていた記録・複製・資料の価値は、ほぼ作品に準ずるものとなり、その延長線上に、現代のアートをめぐる映像や写真の優位も、数十年を経て築かれてきた。いま、私たちがノン・サイトとしての美術館や国際展で、絵画や彫刻以上に多くの写真や映像を目にしても、だからといってそれをはなから二次的だと決めつけることが少なくなったのは、スミッソンによるノン・サイトと作品概念の更新に多くを負っている。もっとも、スミッソンにしてみれば、そのような隆盛などとは無縁に、サイトに置かれた朽ち果て行く美術「作品」と、ノン・サイトでしっかりと保管された不変の「記録」とのあいだに、あくまで、どちらが優で、どちらが劣というわけではない、まったく新しい関係を築きたかっただけなのだろう。スミッソンはもともと、アンディ・ウォーホルのファクトリーに出入りしていた人物だったから、映画や複製概念に親しみ、ポップアートの資質を備えていた。彼にとってアースワークは、いわばポップアートの一大変種でもあったのだ。しかし、だからこそ、のちにさかんとなる巨大な地表的スケールを誇るアースワークとは根本的に異なり、サイトとノン・サイトとのあいだには、単

なる性質の違いからくる一方的な線引きなどではなく、たえまない可動性を持ち、めまぐるしく往還しうる、新しい美術の可能性が開かれたのである。

二〇一五年秋にワタリウム美術館で開かれるDFW展のための「ノン・ビジター・センター」は、スミッソンが立ち上げたこうしたサイト／ノン・サイトの互換性のうちの後者、すなわち同じ作品が備える分裂したふたつの展示価値のうち、記録的な側面の提示に該当する。急いで付け加えておけば、いま記録的と書いたが、それは「ノン・サイト」にあるかぎり、もはやたんなる記録ではありえない。言い換えれば決して、たんに「みに行くことができない」展覧会をめぐる概要や説明、代理の紹介ではない。それ自体がサイトという「よそ」にあるほかないこの作品を「ここ」へと翻案することで、「みに行くことができる」展覧会へと置き換え、そのことで別のかたちの「ここ」を立ち現そうとする、ノン・サイト型の展示なのである。

では「ここ」（ノン・サイト）にある記録は、いったいどのようにして「よそ」（サイト）に

働きかけうるのか。次に、このことが問題となる。そのため、これまでに示しておいた第一の問題――すなわち、美術と放射能、美術の力と放射線の力、美術作品と放射性物質の問題を、今度はスミッソンの提示したサイト（現場）／ノン・サイト（美術館）との往還に接続し、ひとつに束ねて考察することを試みる。

DFW展の最大の特色は、個々の美術作品と、それがみる者に及ぼす力が働く物理的な位置が極端にずれていることにある。このズレは、美術作品の設置されている場所が放射性物質によって酷く汚染された帰還困難区域にあり、時とともに作品そのものが放射性物質によって汚染され、そればかりか放射性物質そのものと化しつつあることと密接な関係を持っている。これがいかに特殊な状況であるかは、通常の美術展でのことを考えれば、すぐにわかるはずだ。通常、私たちが展覧会に足を運べば、美術作品はそこに物理的に存在している。当然のことだ。ゆえに私たちは作品の前で歩を止めて立ち、対象をじっくりと眺め、様々な想いにひたり、あるいは思案し、そこから美術の力（鑑賞）を得る。美術作品は肉眼でみることができ、美術の力そのものは目にみえない心理的な作用ではあるけれども、しかしそうだとしても、この両者が作品と鑑賞者を挟んで、ごく隣接した空間に凝集していることまでは疑いえない。

ところが、DFW展の場合はどうだろう。展覧会そのものは確かに二〇一五年三月一一日にスタートしている。だから、近づけないからといって、完全にクローズしているわけではない。それどころか、スミッソンの唱えたサイトの特徴にならって言えば、スタートした日からDFW展はいっさいの休みなくずっと続いており、そこには開館時間／閉館時間、および休館日といった継ぎ目がいっさいない。昼も夜も明け方も、雨の日も晴れの日も、豪雨の日も強風の日も、作品が設置された状態は、原則としてまったくそのままである。ただし、そこが外部環境である限り、不測の変形や劣化、破損、場合によっては盗難・遺失といったこともありうる。というより、そういう不測の事態が生ずるのが、サイトならではの特徴なのである。ノン・サイトでは決して起きてはならないことが、サイトにおいてはむしろ、その最大の特質であり、場合によっては魅力にさえ転化されている。

もっともDFW展の鑑賞者は、展覧会がスタートしているからといって、スミッソンのサイト作品のように距離や時間に頓着しなければ苦労しても現場に辿り着き、その結果、物理的な作品と鑑賞体験との位置を合致させることができる——というわけにはいかない。もしそのようなことを試みようとしても、本文の冒頭で記したとおり、

かりに会場最寄りのインターから下車し、そこから福島原発の事故現場が立地する大熊町～双葉町方面に向かおうとしても、作品が設置された帰還困難区域から先はバリケードで封鎖され、あらかじめ許可を取った者以外、入ることはできないからだ。つまりDFW展とは、「スタート」はしたけれども「オープン」はしていない――言い換えれば、終始「クローズ」しているけれども「スタート」だけはしている展覧会なのである（通常のノン・サイトでの展覧会では、両者は一致している。すなわち、展覧会がスタートすればおのずと会場はオープンとなり、会期が終了すれば、同時に会場もクローズする）。では、DFW展において会場はいつオープンするかと言えば、国や行政の事故対応をめぐる除染事業の進展や政策的判断によってバリケードが解かれ、誰もが入域することができる不可測な未来のことなのである。

もっと具体的に記しておけば、入域の際に私たちは、あらかじめ行政に提出して許可を得た通行証をそのつど提示する。そこには、入域する車両のメーカー、車種、色、ナンバー、そして入域する人員の氏名、連絡先、入域をめぐる注意事項への了承サインが記されていて、警備員によって照合される。私たちはパスポートや運転免許証のように、公的な機関が発行したIDを提示し、すみやかに認められなければならない。

このときの感覚は、住み慣れた自国内であるにもかかわらず、まるで私たちが異国に渡るときの緊張感ある通関の様子のようである。ヨーロッパもEU化が進んでからは事実上、陸路で国境にあたる通関はなくなり、パスポートを提示して通行許可を得ることはなくなったが、帰還困難区域への入域は、ちょうどあの頃の国境でのIDチェックを思わせるものがある。だから、もしもDFW展をみてみたいと申請もなく現地に向かう者がいたとしても、私たちが制止するまでもなく、行政による検問とバリケード封鎖で行く手を阻まれ、会場へ辿り着くことはできない。かりに、なんらかの許諾を得て入域することができたとしても、分散して設置された会場や作品を見つけ出すことは、設置場所（サイト）についての情報が与えられていない現時点では、事実上不可能であるといってよい。たとえ（幸運にも？）現地に足を踏み入れることができたとしても、結局、鑑賞体験と物理的対象としての作品が位置的に合致することは当分、ありえないのである。

繰り返すことになるが、にもかかわらず、展覧会自体がスタートしていることは、まぎれもない事実である。だから、DFW展で帰還困難区域に設置された作品に物理的に接近できなかったとしても、鑑賞体験そのものが成り立たないわけではない。そ

もそも、鑑賞体験と美術作品とが、時間的にも空間的にも合致して感じられるのは、両者の物理的／心理的な位置を、私たちが美術館というノン・サイトの内部で首尾よく重ねてみることができるからであった。言い換えれば、この両者が分離しているケースが、スミッソンの唱えたサイト／ノン・サイトの両立性なのである。物理的な対象としての美術作品は「ここ」から遠い「よそ」にあっても、その写真やデータを通じて、ノン・サイト＝美術館の内部で別のかたちで触れることで、鑑賞者は作品の力を、なんらかのかたちで感じ取ることができる。物理的な作品に対して二次的な意味しか持たなかった写真やデータが、にもかかわらず、一次的な鑑賞体験を構成しうるのは、こうして、「ここ」と「よそ」が距離を無化して媒介しうるからなのであり、そのことで「ここ」は「よそ」となり、「よそ」は「ここ」となる。もしくは「サイト」は不特定の「ノン・サイト」となり、「ノン・サイト」は特定の「サイト」となる。

DFW展でも、基本的にはこれと同じことが起きていると考えることができるだろう。じかに作品をみることができなくても、ノン・サイトとしてのノン・ビジター・センターに設置された展示を通じて、鑑賞者は与えられた「ノン・サイト」を非訪問者の立場から彼ら自身の「サイト」へと改変し、想像力のなかで組み立てなおすこと

ができる。両者がいかに距離的に、また高濃度の放射能汚染によって、あるいは法的に分断されていたとしても、私たちの想像力は、それを容易に乗り越えることができる。というよりも、美術の力（放射線）とは、そもそも、そのような境界越境能力のことではなかったか。この意味でDFW展は、通常の展覧会では、美術の力と美術作品が、たまたま位置的に隣接しているにすぎないことを、むしろ進んであらわにし、両者のズレを可視化さえする。DFW展を通じてあぶり出されるのは、特定の位置や物質に依存せず、純粋に美術の力として捻出される、本来の「美術」というあり方（エンテレケイア）の抽出であるかもしれない。

けれども、美術を美術史ではなく、より大きな文明の次元で考えれば、そのようなことは珍しいことではなかった。美術がいま私たちが知るような視覚に特化した芸術となったのは、ローマ時代まで遡る。ローマ帝国が、それまではローカルな一宗教教団でしかなかった「キリスト教」を国教として採用し、広大な帝国の全域に周知させ

るため、それまでは偶像崇拝を禁止し、絵に描いてはならなかったキリストの肖像や奇跡の数々を、文盲で聖書を読むことができない民衆にまで知らしめるため、初めて「美術」は生まれた。この意味では、美術が「目にみえる」ようになる以前は、（歴史的に時系列が転倒した物言いとなるが）美術とは必ずしも目にみえるものではなかった。たしかに、信仰への憶念や奇跡への讃美を観念として非視覚的に思い浮かべるためのきっかけとなる様々な抽象的装飾や聖地のありさま、口伝による語りの触発といった演劇的な要素はあったかもしれない。けれども、後世の美術とは決定的に違うことに、これらの物理的な対象は二次的な媒介物にすぎず、肝心なのは、あくまで観念の世界で焦点を結ぶ「目にみえない」世界観のほうであったはずだ。

この意味でどこまでも視覚的な美術とは、それを生み出したキリスト教や聖書の原理的な教えを破ることで誕生した。だとしたら、この禁秘を犯したことへの後ろめたさが長く尾を引いた中世のあとで、視覚芸術の全面的解禁としての文芸復興（ルネサンス）がいかにも異教的で多神教崇拝の古代ギリシアを模範とすることで花開き、キリスト教に由来し、今日に至るほとんどすべての美術が、偶像崇拝を肯定する信神の産物となったのは、たいへんに皮肉なことである。そう考えれば、美術における古代ギ

リシアのヘレニズム的異教性とキリスト教の非偶像崇拝とのあいだの捻れを解消するために、ヨーロッパに近代市民社会の到来を芽生えさせた新教徒（プロテスタント＝抗議する者）たちが、目にみえる過剰な装飾に溢れた教会の権威を否定し、聖書という「真理を読みとることはできても、像などみえはしない」原点に帰ろうとしたのは、至って当然のことであったと言ってよい。としたら、その流れを汲む清教徒たちの伝道によって開かれた新大陸アメリカで生まれた新しい美術が、二〇世紀の戦争で疲弊したヨーロッパに変わってようやく覇権を手にしたとき、装飾を極限まで削ぎ落とし、形式的な厳密さと意味の定義だけで成立するミニマル・アートやコンセプチュアル・アートといった「みえない美術」が生まれたことの背景には、依然としてキリストの教えをめぐる解釈の変奏（＝戦争）が続いていたのかもしれない。

しかし、その一方で、DFW展で作品を「みに行くことができない」のは、宗教をめぐる解釈とはまったく関係がない。それは、原子力発電所の過酷な事故によって導かれた悪しき結果の一端にほかならない。けれども、もとを正せば、福島原発があのような破局的な事故を起こしたのは、巨大地震と大津波にいつ晒されてもおかしくない日本列島に五四基もの原発を建設し、日々稼動させていたことに由来する。DFW

展はこの意味では、それ自体が日本列島という「サイト」に特有の展覧会と考えることもできる。キリスト教をめぐる信仰と思索が（たとえそれを批判するとしても）長くその精神史を支配している欧米には、巨大地震や大津波はほとんどまったくないと言ってよい。言い換えれば、だからこそ彼らは「ノン・サイト」という架空の抽象的な空間に、美術の起点を置くことができた。しかし、私たち日本列島に棲む者にとっては、美術をめぐる安住の地は存在しない。日本列島そのものが複数のプレートによって隆起した地殻変動の産物にほかならないからだ。東日本大震災によって、東北地方の少なからぬ美術館が機能停止を余儀なくされたように、日本列島では美術館さえ、無条件に「ノン・サイト」ではありえない。いつなんどき、火山の噴火や液状化の急襲によって作品が雨風に直接晒される「サイト」に変貌してしまっても、決しておかしくはないのである。

DFW展は、日本列島をめぐる自然条件に多くを負う展覧会にほかならない。その展示サイトを示す風にたなびく旗は、この列島の無情で荒ぶる自然を暗示すると同時に、それに逆らって、この「汚れっちまった」土地で、西洋由来の「美術」がいかにして可能かを試す、最初にして最後の機会とならなければならい。

Noi Sawaragi
Don't Follow the Wind

The road North out of Tokyo on the Joban expressway is straight and flat until we leave Ibaraki. As we gradually rise up on an elevated girder bridge and enter the Abukuma Mountains of Fukushima, it's hard to believe, looking out the windows at the sweeping views, that we are now in the second most contaminated place on Earth. In Japanese it's called the "difficult-to-return-to" evacuation zone,[1] or what might more easily be understood as a legal 'point of no return': an area with so much radioactive fallout from the three meltdowns at the TEPCO Fukushima Daiichi Nuclear Reactors (an International Nuclear and Radiological Event Scale level 7 disaster, on a scale of 1~7), that there is no viable framework for re-inhabitation. We are here to visit *Don't Follow the Wind*, an art exhibition installed in a landscape which is off-limits to the public, as it is still considered unsafe to be here. I am struck by the invisible character of this danger, radioactivity, and the radioactive particles which have made this area off-limits, and how radiation serves to establish the essential conflict between the visible and the invisible, and forms the criteria for discussing this project.

First, let's clarify terms. What do "radioactivity", "radiation", and "radioactive substances" mean?[2] Most of us didn't differentiate between these before the meltdown. They were interchangeable synonyms for "radioactivity". Now after the disaster, of course, through learning to deal with our new severe and extraordinary circumstances, we've come to use each with precision.

We've learned, for example, that the phrases "radioactivity is invisible", "radioactivity is odourless", "radioactivity is tasteless", "radioactivity is inaudible", and "radioactive contamination is undetectable even if it is affixed to us" are, in fact, mistaken. Radioactivity is an abstract concept, and therefore invisible. Radiation, on the other hand, isn't an abstract concept but rather a concrete force with substantial effects, so just like music is something that we can discern even though we can't see its sound waves, radiation too is invisible but manifests depending on how its particles or waves affect their surroundings. What about radioactive substances then? One certainly can't immediately visually identify microscopic traces of radioactive caesium, strontium-90, or plutonium with the naked eye. But these unstable and unbalanced substances immediately act upon their surroundings when released into the actual world. Scattered skyward in plumes by the meltdown explosions, radioactive substances eventually fell to Earth and immediately began effecting the physical world they encountered. Moved by rain, snow and wind, they gathered in drains and sewage points, and in this pooling and aggregating their movements became evident. These invisible traces, through engaging actual world processes, were made visible.

As you approach the highway interchange, the nearest access point from Tokyo for *Don't Follow the Wind*, you first notice the mounds of black or green plastic bags filled with contaminated soil, dead wood, dead leaves, and such, gathered regularly by the decontamination crews. This constant harvest becomes evident here and there throughout this green and pleasant land of former rice paddies and fields. It's an extraordinary motif which, once established returns time and again through the car window, a refrain of "toxic piles" of black and green plastic, all packed up but with no place to go. It adds to the sense of dis-reality, as if you are looking at a science fiction film set, but of course it's not fiction. Here you have the invisible radioactive substances made visible.

When people think of "art" they imagine the visual arts, but like radioactivity, art too is invisible. When we encounter art, what we tend to see is merely the artwork-as-substance. And while the

[1] Zones set by the nation to constraint inhabitation, to avoid danger for residence by the radioactive substances scattered by the nuclear disaster of the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station in March 2011.

[2] Radioactivity is the process by which a nucleus of an unstable atom loses energy by emitting radiation. Radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. Radioactive substances are unstable —because the strong nuclear force that holds the nucleus of their atom together is not balanced with the electric force that wants to push it apart—and it therefore they produce kinds of radiation which are destabilizing to other things in their periphery.

artwork-as-material is visible, we still might fail to appreciate the experience or meaning of the material that makes it art. We expect to experience an abstract power of art, something emanating, invisibly, one might say, almost like radiation. Because the *Don't Follow the Wind* exhibition is staged in this very peculiar zone-of-no-return, this place polluted by radioactive contamination, new metaphors which might not ordinarily occur to us are revealed: the relationship between radioactivity and art; the power of radiation and art; the affinity of radioactive substances and artworks.

Don't Follow the Wind proposes, through this juncture of art and radioactivity, an issue of 'here', the place where we are now, versus 'elsewhere', the places where we are not, places we may even be forbidden access to, and it proposes them in ways that bind and mutate, and having mutated, refuse to disengage. Just because *Don't Follow the Wind* takes place in a contaminated 'elsewhere', and is off-limits, doesn't mean that it is happening in some 'elsewhere' unrelated to 'here'. On the contrary, through *Don't Follow the Wind*, a whirlwind of encounters and exchanges between 'heres (= non-sites) and 'elsewheres' (= sites) are established, de-stabilising all meanings of 'location,' 'place' and 'site', and the significance of boundaries. In this way *Don't Follow the Wind* re-reconfigures site-specific art as a distributed and networked concept in the same way that radiation doesn't recognise borders.

This intermediary exchange between *Don't Follow the Wind* 's 'here' and 'elsewhere' is from the lineage of Robert Smithson, who first proposed the conceptual framework for what came to be known as Earthworks (Land art) in the US back in the 1960s. Smithson expanded the territory of art by working in the environment, to explore what art might become if it were not contained within the walls of museums and galleries. By creating art in the landscape he released it from the social-political system of museums and galleries, densely packed man-made urbanity and, in contrast, unleashed art into desert plains, abandoned houses, and post-industrial landscapes.

Although 'artworks', Earthworks are unlike art experienced in museums. Obviously they cannot avail themselves of clear horizontal or vertical planes, reliable consistent lighting, or protection. Open 'environments' naturally become inundated with dirt, rain, water, stone, rocks, and such, exposed to the elements, intrinsic with and inseparable from their surroundings. Smithson called this condition, where environments become artworks 'sites', to distinguish them from the conventional conditions of classically installed art. A 'site' in this case means an artwork which is integral to its location, incapable of being transported like paintings or sculptures. Synonymous with 'particularity of place', within a set of specific conditions, the artworks attempt to exist outside of any system of exchange value.

Unlike museums, artworks installed at 'sites' don't limit visiting hours; once created the exhibition theoretically never ends. The artworks are surrendered to the passing of time, moderate or brutal, they exist outside of the idea of limited space or time. Each individual artwork featured in *Don't Follow the Wind* has its own close relationship with its permanent 'site' in the "difficult-to-return-to" evacuation zone. By becoming integrated with the radioactive substances which are now an intrinsic part of the area, the artworks are embedded in the unknowable passing of time, where the sites remain off-limits until some day after the half-life of radioactive decay.

The *Don't Follow the Wind* exhibition is at once both typical, and an extreme example of art that exists in Smithson's usage of the term "site".[3] Extreme because the twelve works, placed in this zone-of-no-return by the artists, are exposed to conditions even more severe than Smithson could have anticipated. These works, constantly bombarded by radiation from the contamination, could experience accelerated deterioration along with that of their environment. Furthermore, the 'sites' which are acted upon by *Don't Follow the Wind* are strictly controlled to exclude human entry, so

[3] Smithson, Robert, "A Provisional Theory of Non-Sites", from *Unpublished Writings* in *Robert Smithson: The Collected Writings*, Jack Flam, ed, Berkeley, California: California University Press, 1996. Available at: http://www.robertsmithson.com/essays/provisional.htm

the audience is forbidden from freely visiting or experiencing the work. In Smithson's ‘site’ artworks, the act of approaching the work was intentionally difficult, but not impossible. Smithson's ‘sites’ were mostly installed in areas without reasonable transportation or other infrastructures. But Smithson also provided another important reference for *Don't Follow the Wind*, a model of ‘non-site’ artworks acting as an extension of his ‘sites’: an alternative practice of using art spaces to present what is not present.

As the artworks installed at ‘sites’ are hard to visit, for the work to reach interested viewers, alternative ‘non-sites’ have to be established. However, if we see the relation between ’site’ / ‘non-site’ as the former being the primary ‘real body’ versus the latter being just a ’record’ to communicate the former, a hierarchal relationship is created regarding the authentic whereabouts of the artworks, and an inauthentic record; no matter how the two forms of the artwork bisect each other, there is no equal basis to be found in the end. In this respect, what was important about Smithson's Land Art proposition, wasn't that setting the ‘site’ expanded the exhibition space to the world outside museums, but rather that by discovering the meaning of ‘site’ in art, he tried to reform the fundamental meaning of how art, until then, had been limited to the museum and exhibition formats. The *Don't Follow the Wind Non-Visitor Centre* exhibition, held at the Watarium Museum of Contemporary Art in Tokyo, 2015, was the latter of the two natures, the ‘site’ / ‘non-site’—that which ‘can be visited’. No longer simply the record of a ‘site’, it was an experiment to transpose the art which ‘cannot be visited’, like radioactivity, into the ‘can be visited’ exhibition, like a radioactive substance, turning it to a bound state in alternative form, by adapting the artworks which belong to ‘site’ = ‘elsewhere’ into ‘here’.

This ‘non-site’ presentation of *Don't Follow the Wind* at the Watarium Museum of Contemporary Art in Tokyo, in the autumn of 2015 was called the *Don't Follow the Wind Non-Visitor Center*. It was neither off-limits nor difficult to return to. So how did the artefacts of the ‘sites’ and artworks presented at the non-site *Non-Visitor Center* work in terms of the contaminated ‘elsewhere’ of the Fukushima exclusion zone? One characteristic of *Don't Follow the Wind* is the complete asymmetry between the locations where the individual artworks physically exist, and the location where their art functions. This misalignment is intrinsic to the fact that the ‘sites’ where the artworks are installed are heavily contaminated point-of-no-return zones, and that the works will presumably become contaminated by radioactive substances over time, and become radioactive substances themselves some day.

The *Don't Follow the Wind* exhibition began on 11 March 2015, and although it cannot be visited that doesn't mean it's closed. The works are there, installed as a matter of principle, on view every afternoon, night and morning, come torrential rain or tempest wind. Being unprotected in the elements, we can expect unpredictable deformation and deterioration, damage, and in some cases even theft or loss. Of course such unforeseen circumstances are inherent in the decision to place artwork in this ‘site’. What should never happen at ‘non-site’ art spaces is precisely what should happen at ‘sites’, and we can even anticipate, in some cases, that this asymmetry is capable of causing reversals in each poles' value.

One reason we enjoy the experience of appreciating the *Don't Follow the Wind* artworks is that these two poles correspond in time and in space, such that we can successfully superimpose them inside the ‘non-site’ *Non-Visitor Center* art space. To put it another way, their ‘site’ / ‘non-site’ disconnection creates a stability. Even though the artworks as physical objects are ’elsewhere’, distant from ‘here’, by bringing artefacts and documentation about them to the ‘non-site’ art space, viewers can sense the power of work they cannot visit, mediated by the reliably visible. The photographs and data have only secondary meanings compared to the actual work, yet because they construct a primal opportunity to experience and appreciate, they can relativise and mediate the physical distance between ‘here’ and ‘elsewhere’. ‘Here’ becomes ‘elsewhere’, and ‘elsewhere’ is ‘here’. ‘Site’ becomes unspecified ‘non-site’, and ‘non-site’ becomes a specific ‘site’. The invisible

become visible, and the visible become invisible.

This is how each visitor to the *Don't Follow the Wind Non-Visitor Centre* exhibition-as-'non-site' converts the 'non-site' provided into the 'site' of their own perspective, reassembled in their imagination. Divisions of mere physical distance, toxic levels of radioactive contamination, and legal restrictions: which of these can bar the mind's eye? Or perhaps I should ask "Doesn't the invisible power of art mean the ability to overcome such borders in the first place?" In that sense, *Don't Follow the Wind* rather casually reveals the fact that in art exhibitions the power of art (radioactivity) and artworks (radioactive substances) are only presumed to be adjoined, before proceeding to visualise their misalignment. What emerges through *Don't Follow the Wind* is the extraction of how originally invisible art is: not reliant on particular locations or materials, but rather worked out purely through the power of art.

The reason that this catastrophic accident occurred at the Fukushima Dai'ichi Nuclear Reactor is because we Japanese built approximately 54 nuclear power plants throughout the Japanese archipelago, one of the most tectonically volatile places on Earth; where massive and destabilising earthquakes and tsunamis are commonplace. Therefore *Don't Follow the Wind,* can be considered an exhibition unique to the 'site' of the Japanese archipelago, a by-product of relentless tectonic plate activity. Just like so many museums and other cultural facilities which experienced the impact of the Great East Japan Earthquake of 11 March 2011, there are no such things as unconditional places or 'non-sites'. Each must know that it can be forced to become a 'site', when its artworks can be directly exposed to tremors, rains, winds, earthquakes, volcanic eruptions, and surging tidal waves at any moment.

Don't Follow the Wind is nothing if not an exhibition largely attributable to the natural conditions of the Japanese archipelago. Blue flags, flying in the wind, indicate both the exhibiting 'sites' and the implication of the merciless and savage nature of the geology of the region; simultaneously indicating how this must be the first and also the last opportunity to test how art is possible in a land so "befouled" (Chuya Nakahara).[4]

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タイトル = 「Don't Follow the Wind」の旗が立つ場所（サイト）/ 非・場所（ノン-サイト）
For the "site / non-site" where the Don't Follow the Wind flags fly.
著者 = 椹木野衣（美術批評家）

[4] From poetry "Sadness that's been befouled", by Japanese poet Chuya Nakahara's anthologies *Yagi no Uta* ("Goat Songs"), 1934

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A Restatement: The Art of 'Ground Zero' (Part 29)
'Tanesashi Decontamination 2016' (III)

Installation view (third floor gallery) of "Shuji Akagi + Kio Kuroda – Tanesashi Decontamination 2016" at Hachinohe City Museum of Art. © ICANO, photo courtesy ICANOF.

So, just where are these temporary storage depots for radioactive material located? As the name suggests, in theory these storage depots are "temporary." At the same time, because they are "temporary," they are also extremely dynamic. The radioactive contaminated soil from Akagi's own house has for the time being been buried in his garden, while at homes that selected a different

option such material has been placed in a corner of their property like a tumulus. But if the administrative procedures for dealing with the nuclear disaster in Fukushima proceed smoothly, all this material should gradually be moved to the next location. In fact, the contaminated soil buried at Akagi's home has already been dug up and transported elsewhere.

These other locations are collective temporary storage depots scattered around Fukushima city, and with Akagi as my guide I made a tour of a number of these depots that are located in places either out of eyeshot or within eyeshot but no longer attracting attention due to their having become everyday "scenes." Why does Akagi, "*tsuchibo*" in hand, persist in so tenaciously pursuing these collective temporary storage depots, which are not regarded as particularly problematic, or perhaps semi-unconsciously ignored, by other people? Perhaps this is a result of Akagi having torn himself away from Fukushima city and lived as "an evacuee" – after the nuclear accident, Akagi fled with his family to Aizu where he rented an apartment and lived "temporarily," commuting every morning in his own car to his workplace in Fukushima city and returning alone to his home on weekends only to concentrate on taking photographs – thereby periodically distancing himself from his home and the surrounding area where temporary storage depots had become everyday scenes. Or perhaps it is attributable to something else, something etched more deeply in Akagi's mind. Now that he has finished his lengthy period of evacuation and returned with his family to his home in Fukushima city, one imagines this will gradually become clear. Might it further hasten the kind of transformation of Akagi into a figure like Kio Kuroda, mentioned in the previous installment of this column? That we do not know. What we can say at the least is that, even though Akagi has returned home, the problem of the temporary storage depots remains unresolved.

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Above: Shuji Akagi - "June 8, 2013." Below: "November 9, 2014." Both: © Shuji Akagi, courtesy ICANOF.

Properly speaking, the radioactive material transferred from home temporary storage depots to collective temporary storage depots should next be gradually gathered together at a super-collective temporary storage depot called an interim storage facility, which is designed to store contaminated soil and debris from a wider area. This facility is the responsibility of the state and is supposed to be built on a stretch of land in the "difficult-to-return zone" in Futaba district in the

Hama-dori area of Fukushima prefecture where the nuclear accident occurred. However, it would be difficult to say the work surrounding this is proceeding according to plan. In order to build the interim storage facility, the state needs to purchase or lease the land owned by the heads of the households that were forcibly removed from their homes when the area was designated a "difficult-to-return zone," but this process is proceeding slowly. I attended one of the construction plan briefing sessions in Tokyo (mainly for people who have evacuated to the metropolitan area) and many attendees expressed serious concerns that once they relinquished their land, this interim storage facility would become not a temporary facility as suggested by the term "interim storage," but a final disposal site, or in other words an immobile landing place.

Notwithstanding its size, the interim storage facility is still only a temporary storage depot for radioactive material with a time limit of 30 years. In other words, the source of the complications surrounding this problem, too, is the question of "temporariness," in which sense it is essentially no different from the temporary storage depot that was buried in Akagi's yard. Until a decision is made on a final disposal site, the dynamic mode of the temporary storage depots arising from their temporariness will not start working smoothly. Furthermore, Fukushima prefecture and the municipality in which the interim storage facility is due to be located agreed to its construction on the condition that the final disposal site would not be built in Fukushima prefecture. As for the decision on where in the Japanese archipelago this crucial final disposal site will be built, even an announcement on the candidate sites has yet to be made. In other words, even the "temporary temporary" storage depots that were built due to the fact that the temporariness of the interim storage facility, the super-collective temporary storage depots serving each district, and the temporary storage depots could not be guaranteed are still buried in their original locations because it has not been possible for their contents to be transferred to the next temporary storage depot.

This endless temporary retention naturally gives rise to a kind of "state of constipation" in the temporary storage depots. The dynamic nature of temporary storage depots is essentially

guaranteed on the assumption of forward movement. However, with no final disposal site in existence, this distinguishing characteristic has been reversed, and must now move backwards further and further. The temporary storage depots inevitably give rise to temporary temporary storage depots, which in turn give rise to temporary temporary temporary storage depots. If this "temporary temporariness" retreats without end, then ultimately our own bodies will probably end up having to be the final storage facility for this radioactive material. Because unless there is forward movement, the temporary storage depots must inevitably retreat closer and closer to our immediate vicinity. Which means none other than closer and closer to our physical bodies. Compared to the grandiose national project that is the final disposal site, this is something that is alarmingly routine, even familiar, within touching distance whenever and wherever we reach out our hands. Or rather, as if our extended arms themselves are parts of these "facilities," it represents the very ubiquitization and sharing of temporary storage depots. To put it in extreme terms, when this happens, each and every one of us becomes a moving temporary storage depot.

Only once in the video documenting Akagi's activities played at the exhibition at the Hachinohe City Museum of Art does Akagi, who travels by bicycle from one temporary storage depot to another without uttering a word the whole time, contact his family on his mobile phone. In the tone of his voice when he responds to a question by saying, "I'm riding my bicycle now" (using the colloquial term "*charichari*"), I sensed a temporariness very similar to the above-mentioned state of "temporary temporary" (*karikari*). Could it be that Akagi's activities of constantly moving around and measuring radiation dosages and continually recording the temporariness of temporary storage depots as if chasing after them have themselves taken on the "temporary temporariness" (*karikari-sei*) of temporary storage depots?

This strange maneuverability surrounding the fragmentation of temporary storage depots is something the likes of which was completely absent at Chernobyl, despite its similarities to Fukushima as a major nuclear disaster. The Chernobyl disaster, in which radioactive material spread over a wide area as a result of an explosion and fire at a nuclear power plant,

contaminated a large area of land and gave rise to an uninhabited landmass that extended over the horizon. The Fukushima disaster, however, has given rise to an unusual contaminated area due to Japan's small landmass and its status as an archipelago in which, despite the continued presence of slight contamination, people continue to go about their daily lives while conducting decontamination work. The peculiar temporary temporariness of the temporary storage depots scattered about this area has in fact brought about an unusual state of affairs that could best be described as "Japanese-style decontamination."

Shuji Akagi - "February 13, 2014, Fukushima Prefectural Museum of Art." © Shuji Akagi.

I am reminded of the time in 2013 when I was invited by Akagi to observe a decontamination operation at the Japanese garden at the Fukushima Prefectural Museum of Art. The people doing the decontamination work were slightly different from normal decontamination workers. Perhaps it was because it was a Japanese garden. Anyway, the people contracted to do this work were local gardeners. We watched as they lifted up the stones, plants and other objects with complex

surfaces and without uttering a single word proceeded to scrape moss, dirt and other material from the porous, complicated rounded surfaces covered with hollows and grooves. All the while producing scratching noises (*karikari*) with the tiny implements they used to clean plants and garden rocks.

Hi Red Center - "Street Cleaning Event" (1964). © Minoru Hirata.

Watching them work, I could even sense a mysterious condition that could only be described as "Zen-like." And in that place, where the meaning of the activity itself had turned into something akin to a vacuum, I was reminded of the happening, now regarded as historic, in which members of Hi Red Center set about thoroughly cleaning a tree-lined street in Ginza. At the same time I was astonished at the gap between this activity and the fact that it was actually an obvious contaminated area. There was something about it that made me think it could only be described as Japanese-style decontamination. Amid the stasis arising from the inevitable, endless movement back towards our "immediate vicinity," the temporariness of temporary storage depots has resulted in nothing but "decontamination" that produces nothing but scratching noises, giving rise to "ownerless action" for dealing with the "ownerless property" that is radioactive material.

"Shuji Akagi + Kio Kuroda – Tanesashi Decontamination 2016" was held from August 26 through September 11, 2016 at Hachinohe City Museum of Art.

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2016年11月29日

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八戸市美術館「赤城修司＋黒田喜夫――種差デコンタ2016」展示風景(会場3階)　© ICANOFカリ　写真提供:ICANOF

(承前)では、放射性物質のカリオキバとはいったいどこにあるのか。カリオキバは、＜仮置き場＞であることで、原理的に「仮」の存在である。しかし同時に、「仮」であることによって積極的に動的な存在でもある。赤城の自宅から出た放射性の汚染土は、一時的に庭の中に埋められ、

あるいはほかの選択をした家では塚のように敷地の一角に置かれているが、福島での核災害への行政的な手続きが円滑に進むならば、順次、次の場所へと移動していくはずのものである。事実、赤城の自宅の地中に埋められていた汚染土は、すでに掘り起こされて別の場所へと移動している。

別の場所というのは、福島市内に散らばって存在する、集合的なカリオキバのことで、私は赤城に案内され、なかなか目の届かない場所にある、もしくは届いたとしてもいつしか日常の「風景」として目を留められなくなっていく集合的なカリオキバを何箇所か見て回った。別の人たちにとっては特に問題視するには至らない、あるいは、なかば無意識的に見ないようにしているのかもしれないこれらの集合的なカリオキバを、なぜ、赤城は「ツチボウ」を手に、これほどまでに執拗に追い続けるのか。はたしてそれは、赤城が福島市内から身を引き剥がし、カリオキバが日常の風景と化した家やその周辺から周期的に距離を取ることができた「避難生活」――赤城は原発事故後、家族とともに会津へと出て、そこでアパートを借りて「仮（カリ）」住まいをしながら、毎朝自家用車で福島市内の勤務先へと通い、週末だけ自宅にひとりで戻って写真撮影に集中する生活を続けていた――の効果であったのか。それとも、これは赤城の精神により深く刻み込まれた別のなにかに起因するのだろうか。それは、赤城が長きに渡った避難生活を終え、家族とともに福島市の自宅に戻ったいま、次第にはっきりしてくるものと思われる。はたしてそれは、前回書いたような赤城の黒田喜夫化を、さらに促すことになるのだろうか。それはまだわからない。少な

なし子と赤瀬川原平

くとも言えるのは、赤城が家に戻ったにせよ、それとはまったく無関係に、カリオキバの問題はなにも解決していないということだけだ。

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戸別のカリオキバから集合的なカリオキバに移動した放射性物質は、本来であれば、今度は中間貯蔵施設と名付けられた、より広域にわたる汚染土などを保管する超・集合的なカリオキバに順次、集められていくことになっている。この施設は国の管轄となるが、原発事故の起きた福島県浜通りに位置する双葉郡の帰還困難区域に広がる一帯に建造されることになっている。ただし、その作業が順当に進んでいるとは言いがたい。中間貯蔵施設を建造するためには、帰還困難区域に指定され、強制的に家から出された戸主の持つ土地を、国が買い上げるなり、借り上げるなりして建造の許可を個別に取る必要があるのだが、それが遅々として進んでいないのだ。私は東京でその建造計画説明会（主に首都圏へ避難した人々を対象とする）に出席したことがあるが、そこには、いったん手放してしまえば、中間貯蔵施設が「中間貯蔵」という仮置き場ではなく、最終処分場＝移動なき着地点になってしまうのではないかという深い疑いが多数表明されていた。

そう、いかに大きな施設とはいえ、中間貯蔵施設もまた、30年という年限を区切った放射性物質のカリオキバであることに変わりはないのだ。つまり、この問題のこじれの原因もまた「仮」という点では、赤城の庭に埋められていたカリオキバと本質的に変わりがないという点にある。最終処分場が定まらない限り、カリオキバが持っている仮ゆえの動的な様態は、円滑には働き出さない。しかも、福島県や中間貯蔵施設が立地する予定の自治体がその受け入れを決めたのは、最

終処分場は福島県内には作らないという前提があってのことなのだ。そして、肝心の最終処分場の建設予定地をこの日本列島のどこに絞り込むかについては、まだ候補地の公表さえされていない。つまり、中間貯蔵施設も、地域ごとの超・集合的なカリオキバも、一時的なカリオキバも、その一時性さえ確保できないことでやむなく作られたカリ・カリオキバも、結局は次のカリオキバに身を移すことができないまま、いまはまだその場に留め置かれたままなのだ。

この出口のない仮性の留め置きは、おのずと、すべてのカリオキバに一種の〈糞づまり状態〉を生み出さずにはおかない。カリオキバの動的な性質は原則、前進を前提に担保されている。ところが、最終処分場が存在しないことでその特性が逆転し、今度は延々と後退せざるをえなくなるのだ。カリオキバはカリ・カリオキバを生み、カリ・カリオキバは次にカリ・カリカリオキバを生み出すほかない。この〈カリカリ性〉が無限後退すれば、やがて最後には、私たちのからだそのものが、放射性物質の貯蔵施設の最末端を担わなければならなくなるだろう。前進がない以上、カリオキバはますます、身近な場所へと後退せざるをえなくなるからだ。そして、私たちにとってもっとも〈身近〉なのは、もって字の通り「身」そのもののほかにない。ここは、最終処分場という遠大な国家的プロジェクトに比して驚くほど日常的で、卑近でさえあり、いつでもどこでも手を伸ばせばすぐそこにある。それどころか、伸ばされる腕そのものが「施設」の一部であるような、カリオキバの遍在化と分有そのものだ。極端なことを言えば、そのとき、私たちの一人一人が動くカリオキバになるのである。

私は八戸市美術館での赤城展で流されていた、彼の活動を記録した映像で、自転車に乗り、カリオキバからカリオキバへと終始無言で移動し続ける赤城が、一度だけ携帯電話で家族に一報を入れたとき、「いまチャリチャリしているところ」と答えたその「チャリチャリ」という声の響きに、あの「カリカリ」とよく似た仮性と動態の共存を感じた。もしかしたら、たえまなく移動して放射線量を計測し、カリオキバの仮性を追うように記録し続ける赤城の活動そのものが、カリオキバの〈カリカリ性〉と化しているのではあるまいか。

カリオキバの細分化をめぐる、こうした奇怪な運動性は、同様の甚大な核災害で比せられるにせよ、チェルノブイリではまったく見られなかった性質のものではないだろうか。爆発炎上した原子力発電所から大規模拡散した放射性物質で広大な土地を汚染したチェルノブイリの事故は、地平線の彼方まで広がる無人の大地を生み出したが、福島での事故は、軽微な汚染が残り、それでも人がデコンタ＝除染をしながら日常を維持し続けるという、狭い国土と列島ゆえの異例な汚染地帯を生み出した。その中に散らばるカリオキバに特有の仮の仮性は、実は「日本的除染」とでも呼ばれるべき異例の事態を生みだしているのである。

赤城修司「20140213福島県立美術館」　© Shuji Akagi

いま私は、その赤城に誘われ、2013年に福島県立美術館の日本庭園での除染作業を見学させてもらったときのことを思い出している。作業に当たっていたのは、通常の除染作業員とはやや異なる人たちだった。対象が日本庭園だったからなのかもしれない。それを請け負っていたの

は、地元の庭園業者たちだったのである。私たちが目撃したのは、庭に置かれた石や植木といった入り組んだ表面を持ち、あらゆるところに窪や溝を刻んだ多孔質の複雑な曲面から、コケや土をひたすら無言でこそげ落とす人たちの姿だった。植木や庭石を手入れする小さな手道具で、カリカリ、カリカリと音を立てながら——。

ハイレッド・センター「首都圏清掃整理促進運動」1964年　撮影：平田実　© Hirata Minoru

そこには、なにか禅的と表現するしかないような奇怪な境地さえ感じられた。そして、行為の意味そのものが真空のようになった場に、かつてハイレッド・センターが銀座の並木通りを徹底して掃除し、今では歴史的に評価されているハプニングを連想すると同時に、実はそこがまぎれもない汚染地帯であることとのギャップに唖然とさせられた。それは、もはや日本的除染としか言いようのないなにものかだった。どこまでも〈身近〉まで無限に後退せざるをえない停滞の中で、カリオキバの仮性が物理的にカリカリカリと音を立てながら、そこでは、まったくなにも生み出すことのない「掃除」へとひたすら特化され、放射性物質という主（あるじ）なき「無主物」への対処のための「無主為」を生み出していたのである。（この項・了）

※　「赤城修司＋黒田喜夫――種差デコンタ2016」　展は、八戸市美術館にて2016年8月26日～9月11日の会期で開催された。

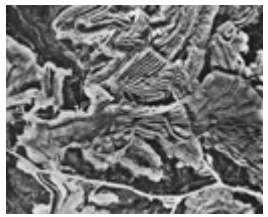
著者近況：『「釜山ビエンナーレ2016」報告 ――アジアの中の日本・前衛・美術　菊畑茂久馬×山口洋三×椹木野衣』に登壇予定。12月17日（土）、福岡市・Rethink Booksにて開催。
詳細：　http://rethinkbooks.jp/event/1782

ESSAYS

SELECTED INTERVIEWS WITH ROBERT SMITHSON

Entropy Made Visible (1973)

Interview with Alison Sky



On Site #4, 1973. This interview took place about two months before Smithson's death. Although published posthumously, Smithson and Sky completed the editing of the text together and Smithson provided all the illustrations.

ROBERT SMITHSON: O.K. we'll begin with entropy. That's a subject that's preoccupied me for some time. On the whole I would say entropy contradicts the usual notion of a mechanistic world view. In other words it's a condition that's irreversible, it's condition that's moving towards a gradual equilibrium and it's suggested in many ways. Perhaps a nice succinct definition of entropy would be Humpty Dumpty. Like Humpty Dumpty sat on a wall, Humpty Dumpty had a great fall, all the king's horses and all the king's men couldn't put Humpty Dumpty back together again. There is a tendency to treat closed systems in such a way. One might even say that the current Watergate situation is an example of entropy. You have a closed system which eventually deteriorates and starts to break apart and there's no way that you can really piece it back together again. Another example might be the shattering of Marcel Duchamp Glass, and his attempt to put all the pieces back together again attempting to overcome entropy. Buckminister Fuller also has a notion of entropy as a kind of devil that he must fight against and recycle. Norbert Weiner in The Human Use of Human Beings also postulates that entropy is a devil, but unlike the Christian devil which is simply a rational devil with a very simple morality of good and bad, the entropic devil is more Manichean in that you really can't tell the good from the bad, there's no clear cut distinction. And I think at one point Norbert Weiner also refers to modern art as one Niagara of entropy. In information theory you have another kind of entropy. The more information you have the higher degree of entropy, so that one piece of information tends to cancel out the other. The economist Nicholas Georgescu-Roegen has gone so far as to say that the second law of thermodynamics is not only a physical law but linked to economics. He says Sadi Carnot could be called an

econometrican. Pure science, like pure art tends to view abstraction as independent of nature, there's no accounting for change or the temporality of the mundane world. *Abstraction rules in a void, pretending to be free of time*.

One might even say that the whole energy crisis is a form of entropy. The earth being the closed system, there's only a certain amount of resources and of course there's an attempt to reverse entropy through the recycling of garbage. People going around collecting bottles and tin cans and whatnot and placing them in certain compounds like the one over on Greenwich Avenue across from St. Vincent's Hospitals. Well this seems to be a rather problematic situation. Actually right now I would like to quote from Georgerscu-Roegen, The *Entropy Law and the Economic Process*, about what he calls entropic bootlegging. It's an interesting conception I think. This is what he says about recycling waste materials. "This is what the promoters of entropy bootlegging fail to understand. To be sure, one can cite numberless scrap campaigns aimed at saving low entropy [low entropy in his definition is raw materials before they're processed into refined materials. In other words raw ore would be low entropy and high entropy would be the refined material such as steel]… by sorting waste. They have been successful only because in *given circumstances* the sorting of, say, scrap copper required a smaller consumption of low entropy than the alternative way of obtaining the same amount of metal. It is equally true that the advance of technological knowledge may change the balance sheet of any scrap campaign, although history shows that past progress has benefited ordinary production rather than scrap saving. However, to sort out the scrap molecules scattered all over the land and at the bottom of the sea, would require such a long time that the entire low entropy of our environment would not suffice to keep alive the numberless generations of Maxwell's demons needed for the completed project." In other words he's giving us the indication that recycling is like looking for needles in haystacks.

Now, I would like to get into an area of, let's say, the problems of waste. It seems that when one is talking about preserving the environment or conserving energy or recycling one inevitably gets to the question of waste and I would postulate actually that waste and enjoyment are in a sense coupled. There's a certain kind of pleasure principle that comes out of preoccupation with waste. Like if we want a bigger and better car we are going to have bigger and better waster productions. So there's a kind of equation there between the enjoyment of life and waste. Probably the opposite of waste is luxury. Both waste and luxury tend to be useless. Then other's kind of middle class notion of luxury which is often called "quality." And quality is sort of based on taste and sensibility. Sartre says Genet produces neither spit or diamonds. I guess that's what I'm talking about.

ALISON SKY: Isn't entropy actually metamorphosis, or a continual process in which elements are undergoing change, but in an evolutionary sense?

SMITHSON: Yes and no. In other words, if we consider the earth in terms of geologic time we end up with what we call fluvial entropy. Geology has its entropy too, where everything is gradually wearing down. Now there may be a point where the earth's surface will collapse and break apart, so that the irreversible process will be in a sense metamorphosized, it is evolutionary, but it's not evolutionary in terms of any idealism. There is still the heat death of the sun. It may be that human beings are just different from dinosaurs rather than better. In other words there just might be a different situation.

There's this need to try to transcend one's condition. I'm not a transcendentalist, so I just see things going towards a… well it's very hard to predict anything; anyway all predictions tend to be wrong. I mean even planning. I mean planning and chance almost seem to be the same thing.

SKY: I with the architectural profession would recognize that. In their grand masterplan schemes for the world, architects seem to find the "final solution" to all possible situations.

SMITHSON: They don't' take those things into account. Architects tend to be idealists, and not dialecticians. I propose a dialectics of entrophic change.

There is an ongoing aspect of things that fascinates me like my recent involvement with Central Park (see "Frederick Law Olmsted and the Dialectical Landscape," *Artforum,* February 1973). You see that photograph there showing a pit in Central Park. Now you might say that's a kind of architecture, a kind of entropic architecture or a de-architecturization. In other words it's not really manifesting itself the way let's say Skidmore Owings and Merrill might manifest itself. It's almost the reverse of that, so that you can observe these kinds of entropic building situations which develop around construction. That pit will eventually be covered, but it's there right now with all its scaffolding, and people have been confused by that pit, they think it has something to do with the Met [Metropolitan Museum of New York]. There's a lot of graffiti on it attacking the Met, but it's really the city.

SKY: It's ironic that we've been able to perpetuate this attitude of set design solutions throughout the world. Traveling through Europe you can go for miles and it all looks exactly alike and like everywhere else. Mimic Lefrak City architecture is covering the earth. How did this manage to take over as opposed to the opposite view exemplified in places like Rome where there are no two buildings, angles, textures, etc., the same. Ruins melt and merge into new structures, and you get this marvelous and energetic juxtaposition occurring - with accident a large part of the whole process.

SMITHSON: Well, Rome is like a big scrap heap of antiquities, America doesn't have that kind of historical background of debris.

But I'd like to mention another mistake which is essentially an engineering mistake and that's the Salton Sea in southern California, which happens to be California's largest lake. It happened back during Teddy Roosevelt's administration.

There was a desperate attempt to try to reroute the Colorado River. The Colorado River was always flooding and destroying the area. There was an attempt to keep the Colorado River from flooding by building a canal, in Mexico, and this was illegally done. This canal was started in the delta of the Colorado and then it was rerouted back toward Mexicali, but what happened was that the river flooded into this canal and the canal overflowed, and fed back into the Imperial Valley which is below sea level. So that this thirty mile lake was created by this engineering mistake, and whole cities were inundated, the railroad also was submerged, and there were great attempts to try to fight back this deluge, but to no avail. Since then, people have come to live with this lake, and recently I was out there I spent some time in Salton City which is a city of about 400 people. And another example of blind planning is this maze of wide boulevards that snake through the desert. Now it was the idea that they would turn this into a huge retirement village or whatever, maybe a new Palm Springs, but the bottom fell out of that so that if you go there now you just see all these boulevards going all through the desert, very wide concrete boulevards and just sign posts naming the different roads and maybe a few trailer encampments near this city. It's impossible to swim in the Salton Sea because barnacles have grown all over the rocks. There is some water skiing and fishing. There's also a plan to try to desalinate the whole Salton Sea. And there's all kinds of strange schemes for doing that. One was to bring down slag from the Kaiser Steel Company, and build a dike system. So that here we have an example of a kind of

domino effect where one mistake begets another mistake, yet these mistakes are all curiously exciting to me on a certain kind of level - I don't find them depressing.

SKY: There's an inherent energy level present in an accidental or mistake occurrence. I was listening to a discussion of the I.M. Pei buildings near Washington Square Village, and apparently in the two towers owned by New York University an attempt was made at "total control." Even the curtains were specified so as not to disturb the "esthetic resolution" of the building façade. The third tower is not owned by N.Y.U. and houses the people replaced by the construction. There people were free to choose their own curtains and you get an incredible diversity of styles and colors which I find much more dynamic. Ironically the white curtains so carefully controlled have since faded to different tones of white so the process occurred anyway.

SMITHSON: Right. It's like the Anchorage earthquake that was responsible for creating a park. After the earthquake they set aside a portion of earthquake damage and turned that into a park, which strikes me as an interesting way of dealing with the unexpected, and incorporating that into the community. That area's fascinated me quite a bit. Also, the recent eruptions outside of Iceland. At Vestmann Islands an entire community was submerged in black ashes. It created a kind of buried house system. It was quite interesting for a while. You might say that provided a temporary kind of buried architecture which reminds me of my own *Partially Buried Woodshed* out in Kent State, Ohio where I took 20 cartloads of earth and piled them on this woodshed until the central beam cracked. There was a problem from one of the local papers. They didn't really see that as a very positive gesture, and there was a rather disparaging article that went under the heading "It's a Mud Mud Mud World."

But basically I think that those preoccupations do escape architects and I'm thinking of another problem that also exists, that of mining reclamation. It seems that when they made up the laws for mining reclamation they wanted to put back the mines the way they were before they mined them. Now that's a real Humpty Dumpty way of doing things. You can imagine the result when they try to deal with the Bingham pit in Utah which is a pit one mile deep and three miles across. Now the idea of the law being so general and not really dealing with a specific site like that seems unfortunate. One person at Kennecott Mining Company told me that they were supposed to fill that pit in; now of course one would wonder where they were going to get the material to fill that pit in.

SKY: Did you ask them?

SMITHSON: Yes, I mean they said it would take something like 30 years and they'd have to get the dirt from another mountain. It seems that the reclamation laws really don't deal with specific sites, they deal with a general dream or an ideal world long gone. It's an attempt to recover a frontier or a wilderness that no longer exists. Here we have to accept the entropic situation and more or less learn how to reincorporate these things that seem ugly. Actually there's the conflict of interests. On one side you have the idealistic ecologist and on the other side you have the profit desiring miner and you get all kinds of strange twists of landscape consciousness from such people. In fact there's a book that the Sierra Club put out called *Stripping*. Strip mining actually does sort of suggest lewd sex acts and everything, so it seems immoral from that standpoint. It's like a kind of sexual assault on mother earth which brings in the aspect of incest projections as well as illicit behavior and I would say that psychologically there's problem there. There's a discussion of aesthetics in this book *Stripping* from the point of view of the miner and from the point of view of the ecologist. The ecologist says flatly that strip mines are just ugly and the miners says that

beauty is in the eye of the beholder. So you have this stalemate and would say that's part of the clashing aspect of the entropic tendency, in other words two irreconcilable situations hopelessly going over the same waterfall. It seems that one would have to recognize this entropic condition rather than try to reverse it. And there's no stopping it; consider the image that Norbert Weiner gives us - Niagara Falls.

In fact they even shored up Niagara, speaking of Niagara. They stopped Niagara for a while because it was wearing away. And then they put these steel rods into the rock so that it would maintain its mutual appearance.

SKY: Have they been able to stop it?

SMITHSON: They did stop it.

SKY: From wearing away?

SMITHSON: Well, it's still there. It didn't fall spare yet. Niagara looks like a giant open pit quarry. In other words it has high walls which offend people greatly in the strip mining regions. There are defects called "high walls" that exist in the strip mining areas and there's a desire on the part of ecologists to slope these down. The cliffs all around Niagara suggest excavation and mining, but it's just the work of nature. So there's constant confusion between man and nature. Is man a part of nature? Is man not a part of nature? So this causes problems.

SKY: There is definitely some sort of perverse fascination attached to the process of inevitable and impending destruction that will occur either in your own environment or be observed vicariously because people persist in living at the bases of volcanos, on earthquake zones such as the fault line which is supposed to destroy all of California, on top of sinking landscapes such as Venice which is a city built entirely on rotting wooden pilings and will eventually fall into the sea.

SMITHSON: Well, that may be something that's human - that's human need. It seems that there's almost a hope for disaster you might say. There's that desire for spectacle. I know when I was a kid I used to love to watch the hurricanes come and blow the trees down and rip up the sidewalks. I mean it fascinated me. There's kind of pleasure that one receives on that level. Yet there is this for something more tranquil - like babbling toward mining regions and volcanic conditions - wastelands rather than he usual notion of scenery or quietude, tranquility - though they somehow interact.

SKY: I think man turns to the wooded glens in the last moments for the most part. He probably wouldn't like to admit it but I don't think it's of prime importance to him - from a fascination viewpoint. I mean he really hasn't done much to protect these pockets of tranquility. At the last moment, after it's almost all destroyed he starts screaming "put up the trees" but only in a token gesture sense. That's always the answer, especially in public spaces in a city like New York - stick up a few isolated trees.

SMITHSON: Well, it seems that in a city like New York where everything is concrete here's this craving to stick up a tree somewhere.

Also in regard to the origin of parks in this country it's interesting to note that they really started as graveyards. There's something in the mid-19th century that's called the "rural graveyard movement" where there was an attempt to get away from the dreary little churchyard graveyards. They introduced a kind of sylvan setting so that nature would intermingle with the graveyards, and they developed a whole funerary school of art you might may. I know for a fact over near Fort Lee there are all these vaults - little pyramids, you know, for the dead.

There is an association with architecture and economics, and it seems that architects build in an isolated, self-contained, ahistorical way. They never seem to allow for any kind of relationship outside of their grand plan. And this seems to be true in economics too. Economics seem to be isolated and self-contained and conceived of as cycles, so as to exclude the whole entropic process. There's very little consideration of natural resources in terms of

what the landscape looks like after the mining operations or farming operations are completed. So that a kind of blindness ensues. I guess it's what we call blind profit making. And then suddenly they find themselves within a range of desolation and wonder how they got there. So it's rather static way of looking at things. I don't' think things go in cycles. I think things just change from one situation to the next, there's really to return.

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Entropy Made Visible, interview with Alison Sky On Site # 4, (1973)

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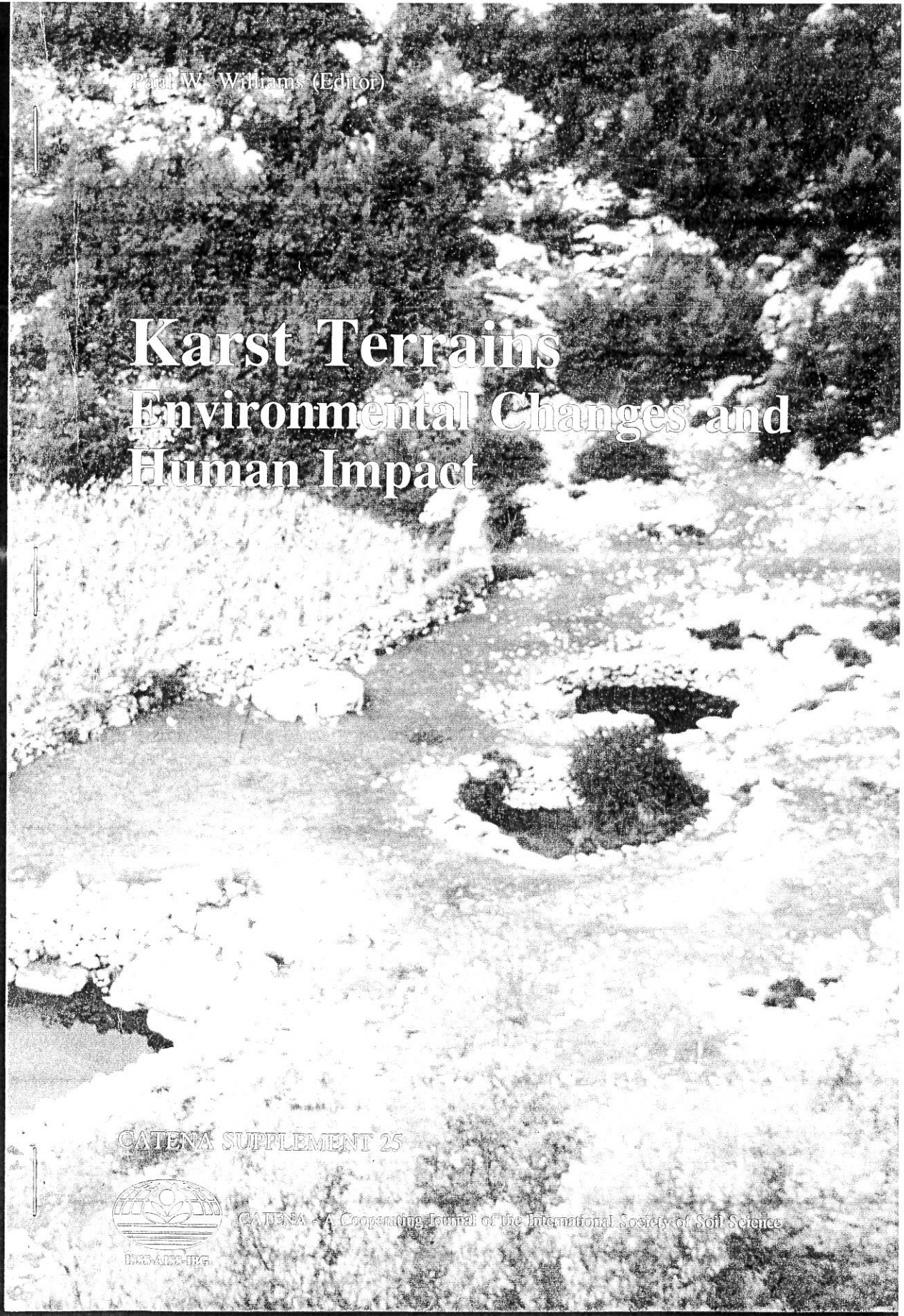
Karst Terrains
Environmental Changes and Human Impact



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Impact of Acid Rain on Karst Environments

S.T. Trudgill & R. Inkpen

Summary

Karst weathering rates are likely to be unaffected by an increase in CO_2 levels, but dramatically affected by a decrease in rainfall pH from other sources, particularly SO_2^{2-}. The impact on natural karst weathering depends on the buffering capacity of the soil. Building studies suggest that weathering rates will increase as SO_2^{2-} levels rise with polluted urban areas having higher weathering rates than rural areas. At a smaller scale the impact of acid dissolution depends on whether a surface is rainwashed and so eroded or sheltered and so in an area of deposition and crust formation.

1 Introduction

This paper reviews recent work on the effects of acid rain on building stones and explores its likely effects on karst. The interactions of limestone weathering and atmospheric conditions raises two important questions in the context of geomorphology and environmental management. Firstly, to what extent will acid rain alter the rates, processes, landforms and runoff water quality of limestone areas? And secondly, to what extent may carbonate processes ameliorate the effects of acid rain and also absorb increased levels of carbon dioxide?

Under natural systems, pH values as low as 2 are rare and the values do not commonly exceed 11. Rainfall equilibrated with atmospheric concentrations of carbon dioxide (0.03%) has a pH of 5.6, the acidity being derived from carbonic acid (H_2CO_3) formed from water and CO_2 which then rapidly dissociates to yield H^+ and hydrogen carbonate:

$$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^- \quad (1)$$

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Other sources of acidity can include nitric acid and sulphuric acid, derived from volcanic or bacterial sources or from the burning of fossil fuels, by the combination of nitrogen oxide and sulphur dioxide gases with water. These can give rise to pH values of rainfall lower than 5.6, when it is commonly referred to as 'acid rain'. This term implies that much of the acidity is in solution, but acid particulate matter may form a significant proportion of acid deposition.

The limestone weathering reactions involve bases which accept H^+, such as carbonate ions (CO_3^{2-}) derived from the dissociation of limestone in water. The CO_3^{2-} combines with H^+ to yield HCO_3^-. Thus, the dissolution process is driven by the production of $H^+$and is accelerated by increasing carbon dioxide in solution or H^+ from the dissociation of other acids such as H_2SO_4 or HNO_3.

2 The effect of carbon dioxide on solution rates

Atmospheric carbon dioxide levels with which rainfall equilibrates are of the order of 0.03% or 300 ppm. BOLIN and KEELING (1963) reported that carbon dioxide concentrations varied globally from 308 to 317 ppm with latitude, with lower values in polar regions, and with season, with higher northern winter and southern winter values (tab. 1). More recently KEELING et al. (1976) published data showing that mean concentrations at Mauna Loa in Hawaii (19°N) changed from 315 ppm in 1958 to 330 in 1974. Similarly, CHAN & WONG (1990) show changes from 325 ppm in 1969 to 335 in 1981 at an ocean weather station (50°N) and from 330 ppm in 1975 to 345 in 1987 for Alert in Canada. Given that there are both global variations in CO_2 and compelling evidence for recent increases, what could this mean for limestone weathering?

If one considers first the effect on calcite solubilities, taking a lowest value of 308 ppm from tab. 1, a highest recent value of 345 ppm and extrapolating the rates from Mauna Loa at approximately 1 ppm per year (MACDONALD 1982), then for a possible projected year 2050 value of 412 ppm the effects increasing CO_2 on solubilities are in fact minimal. The graph published by SMITH & MEAD (1962) for the relationship between % carbon dioxide and calcium carbonate in solution at 10°C shows a very steep curve in the area of interest of the form:

$$y = 249.9984\ x^{.3209}$$

Changing x from .0308 to .0345 % and from that to .0412 % results in increases in calcium carbonate in solution from 81.8 to 84.9 (+ 3.1) and then to 89.8 (+8) mg l^{-1} respectively. Global variations in calcite solubility from spatial carbon dioxide

Latitude	Mean values		Monthly values		
			78°N	2.5°S	90.0°S
78.0°N	313.85				
60.0°N	314.2	J	315.7	314.8	313.0
40.0°N	314.6	F	316.4	315.1	312.6
32.5°N	314.8	M	316.9	315.35	312.4
27.5°N	314.8	A	317.2	315.6	312.4
22.5°N	314.65	M	317.2	315.85	312.5
17.5°N	314.55	J	315.5	316.05	312.8
12.5°N	314.85	J	309.9	316.	313.2
7.5°N	315.1	A	308.0	315.6	313.4
2.5°N	315.2	S	308.8	315.6	313.5
2.5°S	315.2	O	311.8	314.3	313.6
7.5°S	315.05	N	313.7	314.1	313.5
12.5°S	314.85	D	315.0	314.4	313.3
17.5°S	314.55				
30.0°S	313.95				
50.0°S	313.4				
90.0°S	313.0				

Tab. 1: Smoothed average values of the CO_2 concentrations (PPM) (from BOLIN & KEELING 1963).

variations alone (i.e. ignoring the effects of temperature on both CO_2 and $CaCO_3$ solubility) are therefore likely to be only of a few mg l^{-1} and projected increases will only increase the effect by the order of 10mgl^{-1}.

The sensitivity of erosion rates to these increases in concentration can be estimated using a formula from ATKINSON & SMITH (1976)

$$\text{Erosion rate (mm/ka)} = \frac{(P - E) \cdot H}{1000 \cdot \rho}$$

where:

P = mean annual precipitation in mm
E is the mean annual evapotranspiration in mm
H is the mean hardness of at least 50 water samples in mgl^{-1} and
ρ = specific gravity of the rock

For a temperate area with 1000 mm rainfall and 600 mm evapotranspiration, using the ρ value for calcite of 2.71 g cm^3 and changing hardness from 81.8 to 84.9 mgl^{-1} results in an increase in erosion rate of less than 0.5 mm/ka (about 4%). With a hardness of 89.9 mgl^{-1} the increase is 1.2 mm/ka or just under 10%.

The effect over the last 50 years or so of the increasing carbon dioxide on limestone solution is barely measurable; perhaps an extra 0.02 mm of erosion loss.

3 Causes of variations in pH

RAISWELL et al. (1980, p.26) define the relationship between CO_2 and pH as:

$$[H^+]^2 = K_{(2.2)} \times K_H \times [CO_2\,(g)] \qquad (2)$$

where [ ] signifies concentration and K values are equilibrium constants:

$$K_{(2.2)} = \frac{[H^+]\,[HCO_3^-]}{[H_2CO_3]} = 4.5 \times 10^{-7}$$

$$\text{and } K_H = \frac{[H_2CO_3]}{[CO_2\,(g)]} = 3.8 \times 10^{-2}$$

Thus

$$[H^+] = 4.5 \times 10^{-7} \times 3.8 \times 10^{-2} \times [CO_2\,(g)] = 1.71 \times 10^{-8} \times [CO_2\,(g)]$$

They quote the general figure for the partial pressure of atmospheric CO_2 as 0.00032 (0.032 % or 320 ppm) which calculates at:

$$[H^+] = 1.71 \times 10^{-8} \times 0.00032 = 2.3 \times 10^{-6} \text{ mol } l^{-1}$$

and since $pH = -\log_{10}[H^+] = -\log_{10}[2.3 \times 10^{-6}] = 5.64$.

			[CO2(g)] (ppm)	pH
Lowest value	(BOLIN & KEELING,	1963)	308	5.639
Highest value	(BOLIN & KEELING,	1963)	317	5.632
Mauna Loa	(KEELING, et al., 1976)	1958	315	5.634
		1974	330	5.624
	(CHAN & WONG 1990):			
	Ocean	1969	325	5.629
		1981	335	5.621
	Alert	1975	330	5.624
		1985	345	5.615

Tab. 2: Calculated pH values for pure water equilibriated with varying carbon dioxide concentrations.

For the values of $[CO_2(g)]$ quoted above, the pH values for pure water equilibrated with atmospheric carbon dioxide are shown in tab. 2. It can be seen that the effect on pH is very small. Even extrapolating to the year 2050 with carbon dioxide at 412 ppm only gives a pH of 5.57. While remembering that pH is a logarithmic scale, the actual effects of increased carbon dioxide in the atmosphere are liable to have very little effects on rainfall acidity, and certainly the decreases in pH are within the frequently available measurement accuracies. Thus, taking a recent maximum drop in pH from 5.63 to 5.62 and a possible drop to 5.57 in the year 2050, the effects of increased carbon dioxide alone on calcite solubility are liable to be limited. This therefore focuses attention on other acids, such as sulphuric and nitric acids.

Many observations show that the pH of rain has fallen significantly (tab. 3).

Location	Past Values	More Recent Values
South East England	4.5 - 5.0	4.1 - 5.0
Southern Norway	5.0 - 5.5	4.7
Southern Sweden	5.5 - 6.0	4.3
Northern Sweden	5.5 - 6.0	4.3

Tab. 3: Past (1956 - 1959) and more recent (1972 - 1978) rainfall pH values (from Environmental Resources Ltd 1984).

LIKENS & BUTLER (1981), taking pH 5.6 as a reference point, record increases in acidity in North Eastern America of up to 30-40 times from 1955-56 and show some changes since 1930. Since the effect of carbon dioxide increases on pH is likely to be small, other possible sources must be considered. Rainfall pH may decrease from the effect of increasing sulphuric acid concentration (primarily from SO_2) and from the effect of increasing nitric acid concentration (primarily from NO_x, especially from vehicle emissions).

The precise relationships between increasing H+ and calcium carbonate solubility are difficult to specify unless other factors are specified or at least assumed to be constant. However, a decrease of 1 pH unit indicates an order of magnitude greater hydrogen ion concentration: pH 5 = 1 x 10^{-5} moles per litre H^+, pH 4 = 1 x 10^{-4} and so on.

Generalised curves for $CaCO_3$ solubility and pH developed by CORRENS (1949) are published in LOUGHNAN (1969) indicating that solubility increases from less than 1 millimole (mM) (0.001 mole) per litre at pH 8 to around 4.5 mM l^{-1} at pH 7. The graph shown is virtually linear below this pH value at 1 pH unit 5 mM l^{-1} but the curve for pH < 6 is not given and no conditions are given. More fundamentally, at equilibrium in the calcite + water system, HEM (1970, p.23) gives the formula:

$$\frac{[Ca^{2+}]\ [HCO_3^-]}{0.97 \times 10^2} = [H^+]$$

This cross-checks with the data provided by PICKNETT (1964) on molar calcium and H^+ concentrations using values of HCO_3^- calculated from the calcium values (assuming a ratio of 40:60 calcium:carbonate + 1 for hydrogen, calculating on a mg l^{-1} basis and converting to molarity from HEM's tab. 9). HCO_3 values are numerically similar to Ca values in molarity, so an approximation can be made by

$$[Ca^{2+}] = [H^+] \times 97$$

Back-calculation using PICKNETT's data gives the same results for Ca within 0.0001 mole. Thus one may calculate that with an externally induced H^+ change, equilibrium values for Ca in solution increase as follows:

pH	Ca moles l^{-1} x 40080 =	mg l^{-1}
5.6	0.01557	624
5.0	0.03114	1248
4.0	0.09848	3947

However, this is misleading as it assumes a supply of H^+ to keep equilibrium pH low. In nature, either water of high acidity will be flowing over one point, not allowing equilibrium to be reached because of low solid-solvent contact or the water will be flowing down further limestone or standing in a pool, and in these cases the H^+ will decrease as the reaction continues. PICKNETT's experiments controlled pH by the use of buffers, which does not mimic natural dissolution processes. Nevertheless, the calculations indicate the high initial dissolution potential of acid rain.

4 Implications of acid deposition for soil covered surfaces

The impact of acid deposition on limestone weathering under soil depends substantially on the pathway of water flow and the chemical properties of the soil. For a soil body, an important property is that of *buffering*. This term implies, in general, that the acidity can be controlled or offset by chemical reactions in the soil. Soils can vary considerably in their ability to buffer acidity, and weakly buffered systems, with few bases, are susceptible to rapid acidification. Limestone dissolution may then take place at the soil-bedrock interface. Conversely, strongly buffered systems can receive high amounts of acid deposition but show little change in pH. This will be the case with soils with high amounts of calcium carbonate particles in the soil which can weather to offset the increased acidity inputs. Thus, there may be higher rates of weathering in the soil, with increased solute load in runoff, but there will be little impact on bedrock weathering. Either way, increased rates of weathering are to be expected, but they will have different geomorphological implications. For low buffer capacity soils, sub-soil dissection of bedrock will tend to increase and for high buffer capacity soils surface lowering will be caused by losses within the soil mass itself. In both cases, solute loads in runoff can be expected to increase, though in carbonate rich soils, subsoil re-deposition of carbonates may occur, with little change in drainage water solute concentrations.

The relationships between soil acidity and rates of limestone weathering in and under soil have been investigated by TRUDGILL (1975, 1978). Measurement of the weight losses of limestone tablets inserted into the soil profile showed that there was little variation in weight loss down carbonate-rich soil profiles but considerable variation in rates of corrosion under carbonate-free soils and in the carbonate-free:carbonate-rich subsoil interface. Erosion rates varied widely with the acidity of the soil, in carbonate-free soils being greatest where podsolic soils overlie limestone. In carbonate-rich soils there was little erosion of underlying limestone even where essentially carbonate soils had a leached, acid, upper horizon (tab. 4).

The data suggest that there are order of magnitude changes in erosion from rendzina and calcareous soils to acid brown earths and again to podsols. Whether acid deposition would actually effect the associated pH changes from around 6-8 to 5-6 and 4-5, respectively, is an open question. It is unlikely that carbonate rich soils will become more acid as the carbonate weathering is able to offset this, maintaining a weakly acid surface soil. It is likely that any weakly buffered soil is already acid from long periods of post-glacial leaching, but it is possible that such soils could be further acidified by acid deposition. If they are further acidified to, say pH 3, then erosion rates could increase. COSBY et al. (1985) recognise that during catchment acidification, there is an initial increase of solute levels in runoff as bases are mobilised as part of the buffer capacity reaction. A threshold is reached when soluble bases have been weathered, mobilised and lost, with a drop in solutes in runoff and extreme soil acidification. In western Ireland, where acid peats have formed over limestone under high rainfall conditions, erosion rates can be as high as 1 - 2 mm a^{-1} (TRUDGILL 1973), with associated marked sub-soil bedrock dissection. Only long-term monitoring of pH changes and weathering rates will be able to reveal if acid deposition has such an effect.

Soil type	pH range	Erosion rate (g a^{-1}).
Podsol	4-5	0.10 - 0.30
Acid brown earth	5-6	0.02 - 0.10
Rendzina	6-8	0.01 - 0.02
Calcareous brown earth	7-8	0.01 - 0.02

Tab. 4: Measured erosion rates under different soil types, Malham, North Yorkshire, UK (from TRUDGILL 1985).

5 Building stone weathering

While the impact of acid deposition on the weathering of natural karst systems has not been widely studied, the impact on limestone used for building stone has been extensively researched (BUTLIN et al. 1988, AMOROSO & FASSINA 1988). This section outlines the main chemical weathering processes and effects associated with the atmospheric pollutants SO_2 and NO_x. The variables controlling the weathering trends associated with acid deposition are also considered. Particular attention is given to the effect of SO_2, the pollutant most widely studied in this context.

5.1 Chemical weathering processes

Deposition of pollutants onto stone can be by one of two routes, wet or dry (fig. 1). For wet deposition, the relative importance of sulphuric acid for stone weathering increases as rainfall pH decreases below 5.6. Nitric acid can also contribute to a decrease in rainfall pH, but its relative importance for weathering is difficult to assess as it is present in low concentrations and what little reaction product is formed is rapidly removed from the stone. NO_2 does, however, act as a catalyst for the oxidation of SO_2, aiding its incorporation into cloud and water droplets.

Table 5 outlines the main reactions between pollutants and limestone. Both reaction products, gypsum and calcium nitrate, are more soluble than calcite and are preferentially removed from the stone. These acids accelerate the rate of surface recession of limestone above that expected in 'natural' atmospheres. The amount

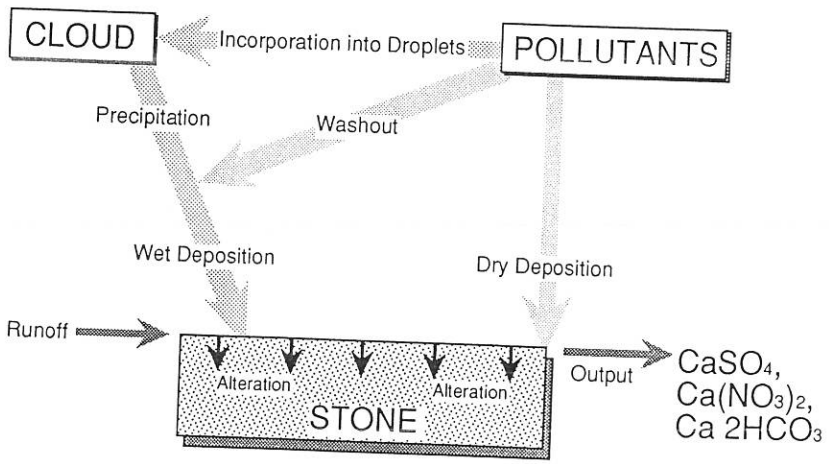

Fig. 1: Depositional routes for atmospheric pollution (modified from INKPEN 1989).

Dissolution

Sulphuric Acid

$$Ca^{2+}CO_3^{2-}(aq) + 2H^+SO_4^{2-}(aq) \rightarrow Ca^{2+}SO_4^{2-}(aq) + CO_2(g) + H_2O(1)$$

Nitric Acid

$$2(H^+NO_3^-)(aq) + Ca^{2+}CO_3^{2-}(aq) \rightarrow Ca^{2+}2(NO_3^-)^2(aq) + H_2O(1) + CO_2(g)$$

Sulphation

Basic Reaction[1]

$$SO_3(g) + CaCO_3(s) + H_2O(g) \rightarrow CaSO_4 2H_2O(s) + CO_2(g)$$

Reaction Stages[2]

First Stage $CaCO_3(s) + SO_2(g) \rightarrow CaSO_3(s)$

Second Stage $CaSO_3(s) + \frac{1}{2}O_2(g) \rightarrow CaSO_4(s)$

Tab. 5: Reaction of SO_2, NO_x and Limestone (Sources: JAYNES[1] 1985, AMOROSO & FASSINA 1988, BRIMBLECOMBE 1986, LIVINGSTONE[2] 1985).

of stone removed depends not only on the properties of the rainfall and runoff such as pH and amount, but also on how they interact with the structure of the stone.

Sulphation describes the direct reaction of SO_2 with the stone surface (dry deposition). Kinetically, this is a two stage process that results in the strong chemical bonding of SO_2 to the stone (LIVINGSTON 1985). Essential for this reaction is the conversion of SO_2 to SO_3 in the atmosphere and the presence of water vapour (at relative humidity of at least 80%; SERRA 1978). Prolonged sulphation creates a gypsum crust. Such crusts usually consist of at least a layer of gypsum of variable thickness (up to 250 µm) overlying a transitional zone of unaltered calcite, calcite crystals and gypsum growth (DEL MONTE et al 1986). The black colour of the crust results from the presence of carbonaceous particles in it (CHENG et al. 1978).

Prolonged direct gas/solid reaction is not possible without washing or 'refreshing' of the stone surface (JUDEKIS & STEWART 1976). Without wetting, reaction products build up in the surface layer and prevent further reaction. The interaction of the stone and air flow can also affect the amount of material deposited. Both increased roughness across a surface and greater condensational than evaporative

forces at a surface enhance deposition.

The relative importance of dissolution and sulphation for weathering can be assessed by comparing the dry leached weight losses from samples sheltered from rainfall to the unleached weight losses from samples exposed to the rainfall or unsheltered samples (JAYNES & COOKE 1987, INKPEN 1989). Unsheltered samples weather by both dissolution and sulphation; sheltered samples by sulphation only. Comparing the above weight losses indicates the minimum contribution of sulphation to the weathering of unsheltered samples. Both of the above UK studies suggest that about a third of weight loss on unsheltered samples results from sulphation.

5.2 Weathering patterns

Spatial and temporal trends in weathering rates tend to mirror those of SO_2 levels (fig. 2) which have increased 16-fold from 1880 to 1976 (FASSINA 1988).

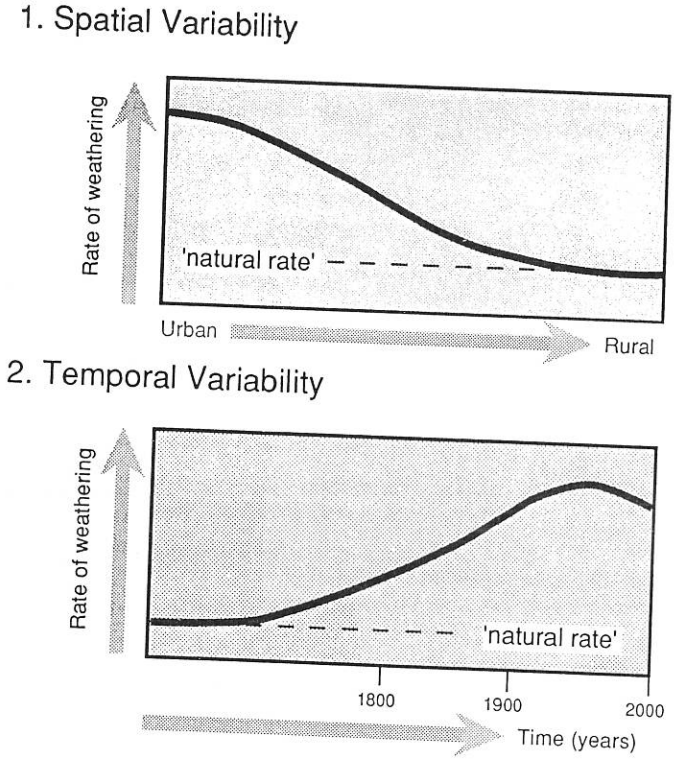

Fig. 2: Spatial and temporal variations in SO_2 and weathering (modified from COOKE 1989).

Recently, however, some urban areas have shown trends towards lower SO_2 levels (fig. 3). Spatially, levels of SO_2 decrease from urban to rural areas. Weathering rates should follow both these temporal and spatial trends. DRAGOVICH (1986) found that the recession rate of surfaces of marble gravestones lettering increased as SO_2 levels increased over time. Recession rates in Sydney, a commercial area, remained fairly constant at 0.17 mm per 100 years despite an increase in motor traffic. This suggests that a rise in NO_x on its own is not sufficient to accelerate weathering rates. At an industrial site, Wollongong in New South Wales, weathering rates increased from 0.17 to 0.28 mm in 1907 to 0.3 mm per 100 years in 1930, dates when plants likely to raise SO_2 levels started operation. Although extrapolation from these results is difficult, given the sample size of 24 gravestones, they do suggest that weathering rates vary with SO_2 levels over time.

SHARP et al. (1982) used the differential recession between lead plugs and the surface of a balustrade to measure surface loss of Portland Stone since 1718 at St. Paul's Cathedral, London. Contemporary weathering rates were also measured using four exposed horizontal micro-erosion meter (MEM) sites on St. Paul's. Excluding an extreme mean of 0.319 mm over a year (1980-81) at the southwest MEM site, the two rates were the same at 0.078 mm per year. Remeasurement of the MEM sites over one, five and ten years (TRUDGILL et al. 1989; TRUDGILL et al. 1990, TRUDGILL et al. forthcoming) has shown a general convergence of site recession rates to 0.04 mm per year, but with no statistically significant decline

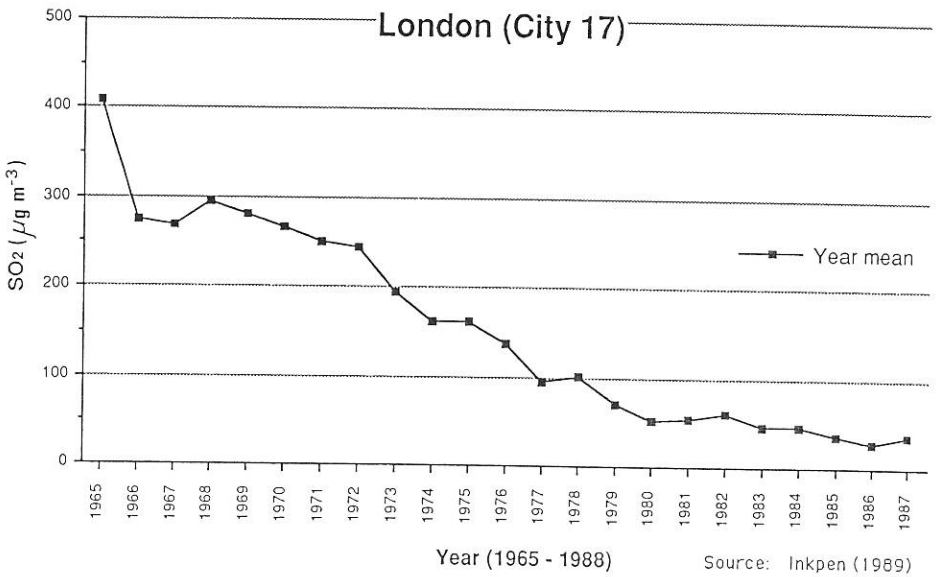

Fig. 3: Example of recent decline in SO_2 levels in London (Source: INKPEN 1989).

in rates over the ten years.

It might have been expected from fig. 3 that current recession rates would be lower than those of the balustrade which integrates the effects of over 250 years of varying and higher pollution levels. Direct comparison of these sets of measurements is difficult as each were taken in different runoff environments (wash zones for the lead plug and drip zones for the MEM). In addition, the mean is not a good way of summarizing the data (TRUDGILL et al. 1989) making comparisons and inferences difficult. Given the variation in means over the building, long and short term recession rates appear to be roughly similar (fig. 4).

The 'memory' effect (SMITH et al. 1988, COOKE 1989, BERG 1989) may also be important in assessing long term weathering rates within the St. Paul's data. The memory effect describes the delayed weathering action of salts deposited in the stone by past weathering events. It increases the weathering rate of building stone above that of 'fresh' stone. For St. Paul's the MEM recession rates over the ten years reflected not only the current decline in SO_2 levels, but also weathering from the 250-plus years of the stone memory.

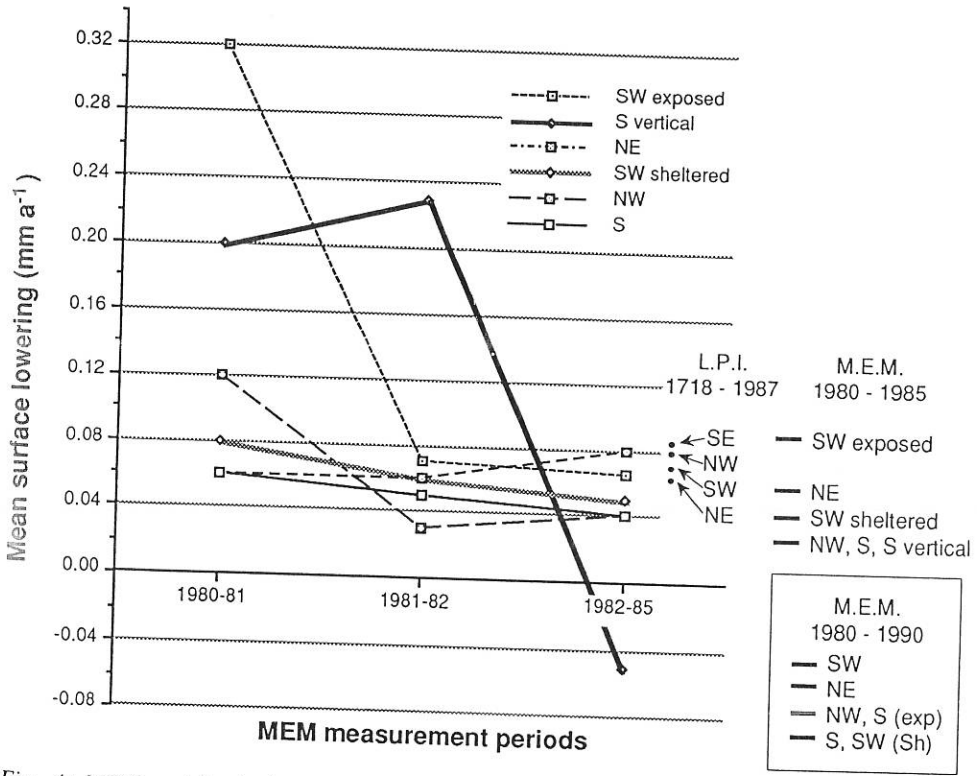

Fig. 4: MEM and lead plug recession rates at St. Pauls Cathedral, London (modified from TRUDGILL et al. 1989).

Marble gravestone studies (tab. 6) illustrate the historic trend of distinctly higher weathering rates in urban areas. Extending these studies to assess the contemporary impact of acid deposition is not possible as their rates have a memory component. Methodological problems also restrict their usefulness (LIVINGSTON & BAER 1988), particularly the retarding of initial surface loss by their polished surfaces.

Small standard tablets have been used to measure current rates of weathering by acid deposition (tab. 7). Weight loss from unsheltered tablets are higher in urban than in rural areas, although INKPEN (1989) suggests that the distinction is becoming less clear as SO_2 levels between the two converge (fig. 5). Results from these studies are difficult to translate directly to buildings as tablets are less complex weathering systems with little weathering memory.

Climatic variables such as temperature and precipitation also influence weathering rates, albeit indirectly through their affect on domestic heating needs. These variables tend to be secondary to those of SO_2 levels and microclimate (GEROME-KUPPER 1984, INKPEN 1989).

Ambient SO_2 levels may not be a good indicator of the uptake of SO_2 by the stone. LUCKAT (1981) used a circulating film of hydrogen peroxide (Immission Rate Measuring Apparatus, IRMA) to represent uptake of SO_2 by limestone. COOKE & JAYNES (1987) and INKPEN (1989) determined SO_2 uptake by measuring the sulphate content of sheltered tablets. In each study unsheltered

Location	Author	Urban	Rural
Belgium	KUPPER & PISSART (1976)	0.239	0.120
Haifia, Israel	KLEIN (1984)	0.500	-----
Philadelphia, USA	FEDDEMA & MEIERDING (1987)	3.500	0.500
Co. Durham UK	ATTEWELL & TAYLOR (1988)	0.95[1] 1.15[2]	0.20[3] 0.70[4]

1-Jarrow, 2-Consett, 3-Quebec, 4-Esh

Tab. 6: Urban/rural weathering rates from gravestone studies (all rates in mm/100 years).

Study	Study area	Lithology	Size	Shape	Means of Exposure	Results
HONEYBOURNE & PRICE (1977)[1]	Garston London	Portland stone (Lst)	100 x 50 x 50 mm	Standard prisms	Stood on end of glass in specially constructed wooden frame	Weight loss at Westminster twice that at Garston
LUCKAT (1981)	West Germany	Baumberg Sst Krenshien Mushelkalk Lst	50 x 50 x 10 mm	Square tablets	Standard nylon carousels	Weight loss greater in urban and industrial areas than in rural areas. Weight loss related to SO_2 uptake
GEROME-KUPPER (1984)	Belgium	Petit Granit (Lst)	50 x 50 x 10 mm	Square tablets	Suspended by nylon on a pole	Definite higher urban rates compared to rural areas. Precipitation and site variables, including SO_2 were major influences on decay
JAYNES & COOKE (1987)	Southern England	Portland stone Monks Park (Lsts)	50 x 50 x 10 mm	Square tablets	Standard nylon carousels	Definite urban/rural and exposed/sheltered difference in weight loss. SO_2 levels suggested as a major influence in decay variability
INKPEN (1989)	Southern Britain	Portland Stone Monks Park	50 x 50 x 10 mm	Square tablets	Standard nylon carousels	Definite urban/rural and exposed/sheltered differences in weight loss. Urban/rural differences less or not significant after 2 years of exposure. SO_2 major influence on rate of stone decay

1 - Cited in JAYNES (1985)

Tab. 7: Weathering patterns from table studies.

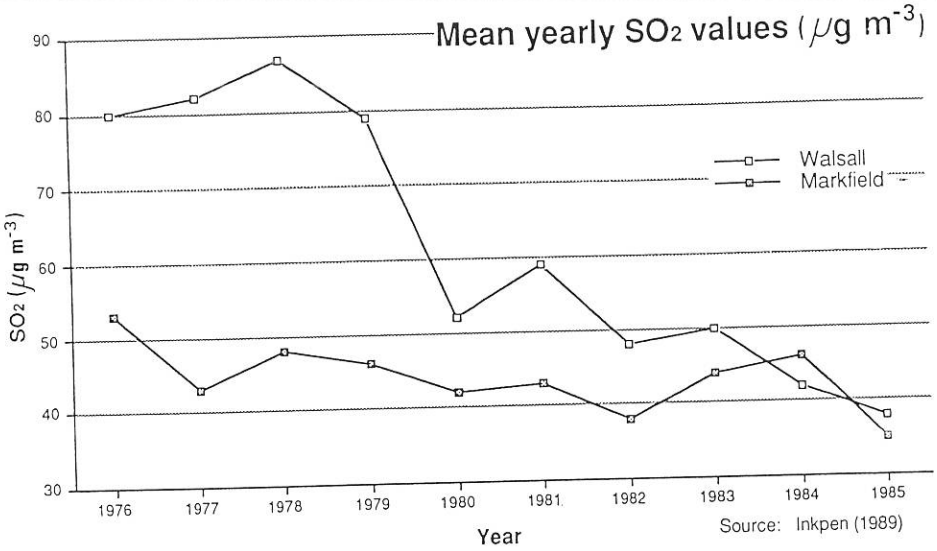

Fig. 5: Example of convergence of urban and rural SO_2 levels in some areas (Source: INKPEN 1989).

tablet weight loss was better correlated with the indices of uptake than with ambient SO_2 levels. Differences in acid deposition influence spatial differences in weathering on an individual building. Of primary importance is the pattern of rainfall and runoff over the building (CAMUFFO et al. 1982) and the influence building architecture has on this. Areas washed by rainfall or runoff are erosional areas; those which are not are depositional areas where material can accumulate by sulphation and general deposition.

Erosional areas weather by dissolution and removal of products from the stone surface. REDDY (1988) used the chemical composition of runoff to calculate surface recession for standard marble and limestone microcatchments in the northeast USA. The data suggested that rainfall characteristics were important for weathering on these surfaces. Recession was proportional to rainfall amount with some deviations at high rainfall events possibly because these were also high intensity events where dissolution became transport controlled. Normalizing the data for rainfall amount suggested that rainfall pH was also important for recession. Combining the two produced the hydrogen ion loading (hydrogen ion deposited per mm of rainfall per m^2 of stone surface). Regression analysis implied that this was also statistically significant for recession. On the more porous limestone catchments the relationship was less significant, probably because of the greater sensitivity of the surface moisture on these limestones to meteorological conditions. Although other environmental variables, such as antecedent SO_2 levels, were not significant for recession rates, this may be due more to the low ambient levels at

the site, rather than to their lack of importance elsewhere. The ratio of erosional and depositional areas on a building varies with each rain event. It is sensitive to the differing intensities and magnitudes of rain events that will produce runoff on different parts and proportions of the building each washing away differing amounts of deposition crust.

6 Conclusion

The projected increase in CO_2 levels by 2050 will not significantly alter rainfall pH or weathering rates, although decreases in rainfall pH from other sources, such as SO_2, could dramatically increase weathering losses. The impact of acid deposition depends on the water path and chemical soil properties. Strongly buffered soils can offset greater acid deposition by reactions of bases in the soil. Soil weathering may be increased, but sub-soil weathering will be relatively unaffected. Weakly buffered soils are more susceptible to sub-soil weathering, but where the soil is already acidic the impact of an additional acid input is unclear.

Studies of limestone building materials indicate some possible patterns for the magnitude and nature of weathering from acid deposition. Weathering rates mirror long term temporal variations in SO_2 levels. Shorter term trends are harder to detect due to the influence of the 'memory' effect. Spatially, urban areas have higher SO_2 levels and higher weathering rates than rural areas. On buildings differences in weathering rates are closely related to the degree of exposure of a surface.

Acknowledgements

Thanks to Terry Bacon & Alistair Nandlal for drawing the figures. R. Inkpen particularly wishes to record thanks to the Department of Geography at Exeter University where this work was completed.

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3_
BURIED MEMORY

THE PATTERN OF THE PAST GUY **(***Primary geodetic lines)* **Underwood 1969**

Underwood divines that the 'earth'sforce' is mademanifest in 'lines of influence' and their discontinuities that cover the earth's surface - what he calls in Chapter 4, 'Primary geodetic lines' - and which affect all of earth's lifeforms. These lines of influence were primarily read by dowsing and Underwood claimed ancient sites and tracks were deliberately positioned to coincide with the lines and discontinuities they produced(the 'patterns' of the past).

SHELL MIDDEN ARCHAEOLOGY IN JAPAN: AQUATIC FOOD ACQUISITION AND LONG-TERM CHANGE IN THE JOMON CULTURE **Junko Habu et al.**

In discussing temporal variablities found across Jomon shell middens Habu et al. suggest shell middens are pivotal in calibrating change in human behaviours - from 'mobile generalists' to collector/settlers - and changing environmental responses such as coastline movement, resource depletion and related fauna distributions. In concluding that a fine grained chronological trail will be inferred in further multidisciplinary approaches to midden assemblages, they embark upon a loop of (epistemic) shell harvesting in the midst of decay's attentuations.

MALANGGAN: ART AND MEMORY A MELANESIAN SOCIETY **Susanne Küchler 1999**

Küchler's work in Papau New Guinea documented the construction of /malanggan/, perishable monuments to the dead,which, after a while were moved and then left to decay. Once decomposed, the remains are gathered to fertilize the land. The rituals around malanggan draw on the absence of any physical presence as a mental resource created in theobject's disappearance. Memory is inscribed not by reflection on any fixed memorial but in a process that slowly draws such an ambivalent materiality into other ecologies and expressions of value.

FURTHER READINGS

JAPANESE PREHISTORY: THE MATERIAL AND SPIRITUAL CULTURE OF THE JŌMON PERIOD **Nelly Naumann 2000**

Naumanns study surveys early Jomon (c. 14,000–300 BC) remains in relation to prehistoric ideas concerning living, the cult of the dead, and the after-life. Cosmological implications of burial topographies including shell middens, clay ware and stone-circles all materially read as remnants of a connected culture concerned with constant cycles of death and new life.

CARTOGRAPHIES OF THE ABSOLUTE **Alberto Toscano and Jeffrey Kinkle 2015**

Taking account of the recent history of aesthetic attempts to make cognizant the forces that subject and subjectivate us, Toscano and Kinkle foreground new strategies in the dialectics of 'cognitive mapping' to attempt to puncture those vastly inflated hyperobjects that seem to invisibly determine both our and the planet's existence. They urge that the registering of how any 'cartographer' is organized to make representations in the world is a necessary part of this program and one they argue essential to any radical art practice.

ONTO-CARTOGRAPHY: AN ONTOLOGY OF MACHINES AND MEDIA **Levi Bryant 2014**

Bryant presents a heuristic route map for our material emancipation under new forms of egalitarian structures ('machines') based on a materialism neither human nor non-human but where "…onto-cartography is the investigation of structural couplings between machines and how they modify the becoming's, activities, movements, and ways in which the coupled machines relate to the world about them. It is a mapping (cartography) of these couplings between machines (onta) and their vectors of becoming, movement, and activity.

Chapter 4
Primary Geodetic Lines

THE effect of geodetic lines upon vegetation, and their use by men and animals, must be of greater interest than detailed descriptions of the phenomena. Yet in order that future investigators may receive assistance in perceiving and identifying these manifestations it is necessary for their characteristics to be defined—where possible with the aid of diagrams.

The three "primary" lines are so called to distinguish them from the secondary effects they produce. The water line, the aquastat and the track line have much in common: they appear to be generated within the Earth; to involve wave-motion; to have great penetrative power; to form a network on the face of the Earth; to affect the germination and manner of growth of certain trees and plants; to be perceived and used by animals; to affect opposite sides of the animal body, and to form spiral patterns. They are controlled by mathematical laws which involve in their construction the number 3; and in their spiral patterns, the number 7.[1] They played a prominent, and possibly fundamental, part in the religion of many widely scattered primitive peoples.

Negative and Positive Influences

The lines are of two kinds, affecting opposite sides of the body. Those affecting the left side are known as "negative," and those affecting the right side "positive." (These terms have no electrical significance in this context, but are those used by students of eastern philosophies, geomancies, and religions in which "Earth currents" play a part.) Water lines are negative. Aquastats and track lines are positive.

To perceive the water line the dowser must grasp the rod strongly

[1] This seems to throw light on the mystic sanctity of these numbers, which has been accorded them from earliest times.

with his *left* hand, so putting the muscles of that arm into tension, and making it more susceptible to reflex action. His hold on the rod with his right hand must be light. But for perception of the positive lines he should reverse his grip, which should now be strong with the right hand, and light with his left.

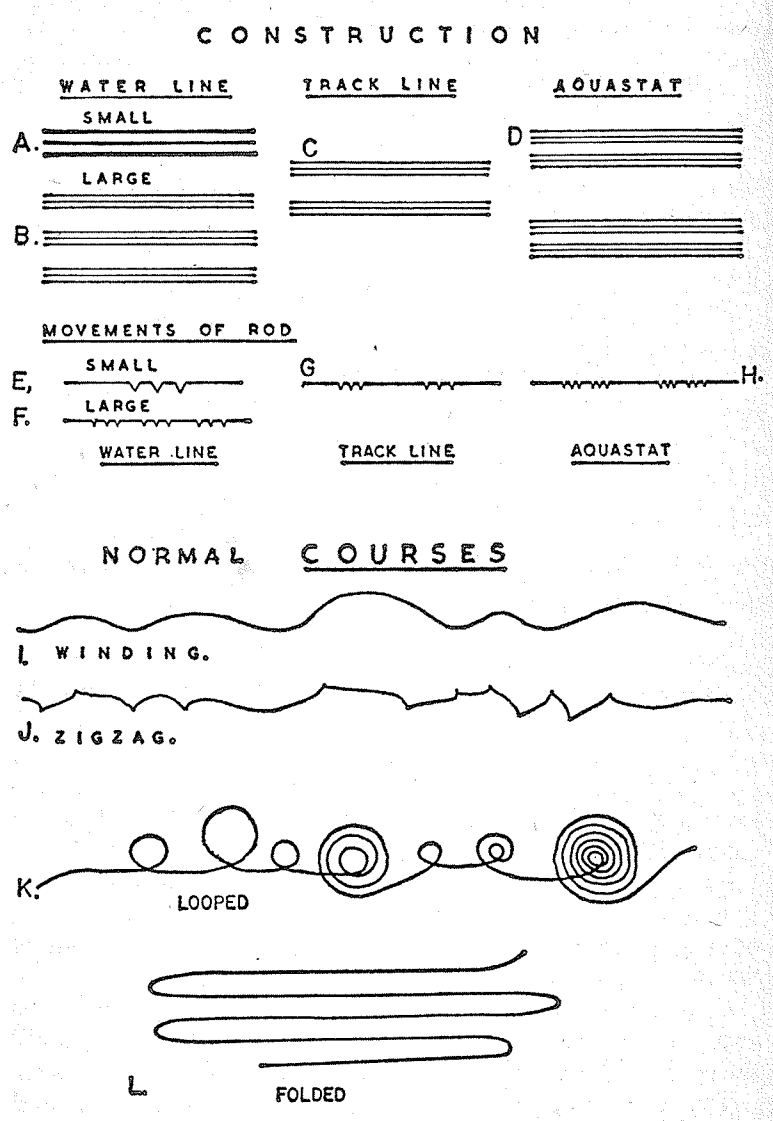
Construction and Patterns

Fig. 2, *A-D*, shows the construction of the three primary lines. Each is triple, or may be composed of a multiple of three narrower lines of no measurable width. These are "hair lines," of which each set of three is known as a triad. Though the hair line is the smallest perceptible geodetic line, there are indications that each hair line is also triple, its parts being too close together to be perceived separately.

Geodetic lines are therefore composed of triads of varying kinds, numbers, and arrangements. This applies also to the secondary lines described later. The beginner is unlikely to be capable of perceiving hair lines, in which case he will obtain one reaction from his rod for each triad.

The Water Line is negative, and therefore requires a left-handed grip on the rod. The width of the line varies considerably. When small, it may seem to the dowser that it consists of one triad of hair lines (*A*)—in which case his rod will dip strongly three times (*E*). When larger (say about 3 feet wide) each line will be observed to be triple (*B* and *F*), consisting of three triads formed from nine hair lines. At about 6 feet in width, nine triads composed of twenty-seven hair lines are perceptible. Where the line is of extreme width, twenty-seven triads composed of eighty-one hair lines may be perceived. How far this subdivision continues, if it does, has not yet been established.

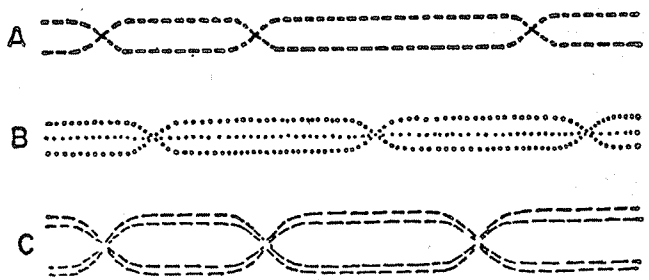
The Track Line is positive, and requires a strong right-handed grip. It consists of two parallel triads (*C*). These produce two sets of three dips of the rod, with an interval between (*G*). The usual width is 12-24 inches. Track lines appear to have had little significance in the layout of sacred sites, though they sometimes affected minor details of construction, or were specially marked. Examples of this are furnished by Stones 32 and 150 at Stonehenge,



2 Primary Lines.

which are dealt with in a later chapter. Almost all animals recognize, make use of, and follow track lines, and all old roads are aligned upon them.

The Aquastat, too, is positive. The rod should be held as for the track line, except that the right-handed grip, while remaining firm, should not be so strong that it will respond to a track line. Aquastats consist of two pairs of triads running parallel (*D*), as in the case of track lines. The rod will give either four dips, or four sets of three tremors, at the time when the aquastat is crossed (*H*).



3 Reticulation: (*A*) Track Line, (*B*) Water Line, and (*C*) Aquastat.

It should be remembered that when the rod is held in any of the ways required, in order that it may respond to a specific geodetic line, it will not be affected by either of the other two types of line.

Geodetic lines normally take winding courses (*I*), but they may also be zigzag (*J*), looped (*K*) or, more rarely, folded into hairpin bends (*L*). They usually maintain one general direction for considerable distances.

All the primary lines "reticulate." That is to say that the two outer lines of a water line, or the two halves of a track line or aquastat, cross and recross each other diagonally (Fig. 3). The triads of which they are composed also reticulate.

Occasionally a water line and an aquastat will run together on approximately the same course. In order to identify these, I call them "holy lines." They are most numerous on important sites.

Two or more primary lines of the same type may run parallel and close together. These are then known as multiple lines. When

geodetic lines run close together, either in multiples or in labyrinths, or when converging on a blind spring, their individual width is greatly reduced.

Multiple water lines had special religious significance. They are easily missed, because the dowser is inclined to pick up the first line only, and to assume that it is a single line. Possibly it is for this reason that their presence is frequently indicated on sacred sites by notches or grooves on stones.[2] Multiples of all numbers up to 12 (except 7 and 11) have been found, but none in excess of 12. Multiple water lines are frequently accompanied by multiple aquastats, which suggests a relation between these two forms of primary line, though many do not reveal any such association.

Though loops in primary lines are usually small, some of them may be several hundred feet in diameter. A line may make several loops at the same place, either overlapping or spiralling around another. Or, in rare cases, as many as six loops are to be found enclosing the same small spot. Special importance appears to have been attached to loops—particularly when these occur in multiple water lines, and where several loops appear on the same spot. Small multiple loops are sometimes marked by standing stones.[3] Lines making many small loops are frequently marked by Stone Rows, and some by stone circles.[4] Loops must not be confused with the lines of "nodes" and "branch spirals" described later. The largest loop so far found encloses the Budbury Circle at Bradford-on-Avon. (This was one of the first sites I identified by dowsing. It contains neolithic remains, but has not yet been properly excavated. It also has several mazes. But prefabricated houses have now been erected over part of it.) On this site there are two loops one within the other. The larger is approximately 700 feet in diameter, and is marked by a lynchet. The inner loop consists of three pairs of geodetic lines, and these are marked by two ditches with a mound between. Its diameter is 300 feet.

The ditch which encloses Stonehenge is on a loop 350 feet wide, and another large loop occurs west of the Avenue and about 200 yards north of the Heel Stone. Signs of the ditch by which this

[2] See Stonehenge, Dartmoor, the Acropolis at Athens, and the Avenues at Carnac in Brittany.

[3] See Stones 11 and 28 at Stonehenge; the "Z" Stones at Avebury, and numerous Stone Rows on Dartmoor.

[4] See Stanton Drew, the Rollright Stones, Wayland's Smithy, and Dartmoor.

loop was marked are visible from the air, especially in dry weather, when the difference in colour of the grass is marked.

Blind Springs and Primary Spirals are intimately connected, and should be considered at the same time. Blind springs are centres upon which primary lines converge, and from which they emerge. Their effect is to cause the converging lines to take a spiral course. These spirals are called "primary spirals." They enclose the spring and, after numerous coils, terminate upon it.

The blind spring was the esoteric "centre"[5] of the Old Religion, as well as being the actual centre of its monuments. In early biblical days such a site was venerated as a place where God dwelt, and a Beth-el or House of God was consecrated by marking it out and separating it from the profane space around it. It then became "Holy Ground."[6] Since all prehistoric monuments are enclosed by the spirals produced by one or more springs, the reasonable assumption is that their positions were determined by these phenomena. The blind spring designated the spiritual centre of the site, while the spirals bestowed that "divine protective sanctity" postulated by students of the Old Religion.

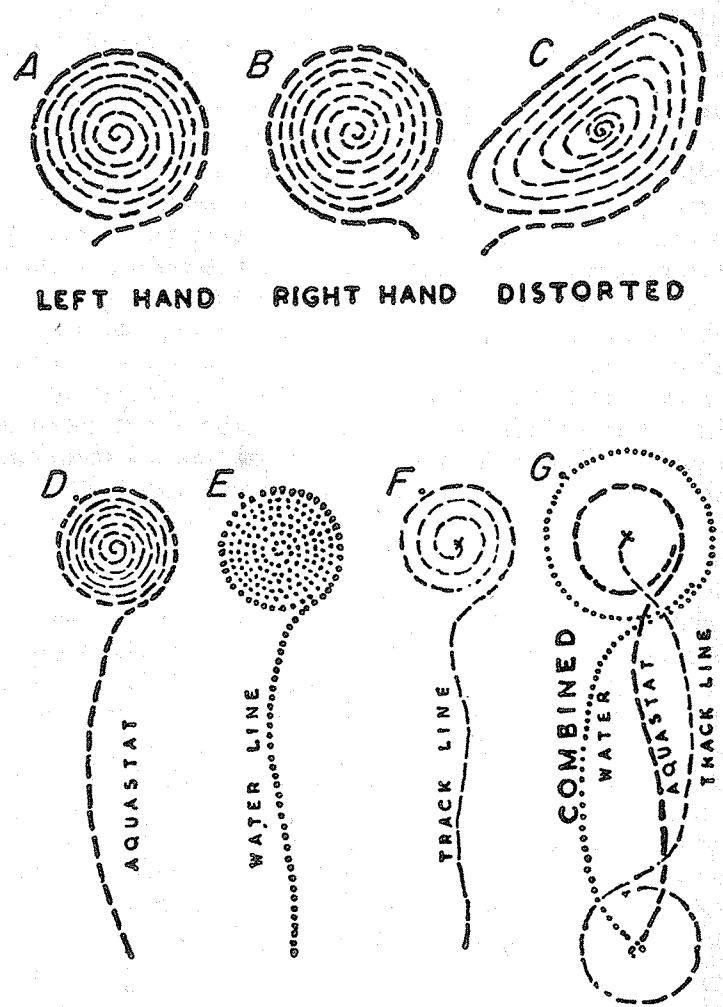
Blind springs divide primary lines into sections which run from one spring to another. These sections are lituus-shaped—each section has one end straight where it leaves a spring, while at the other end it forms a primary spiral encircling the next spring. Primary spirals almost invariably are left-handed from the outside to the centre, as is the commoner form in nature (Fig. 4, *A*). Examples of right-handed primary spirals (Fig. 4, *B*) occur on Merlin's Mount at Marlborough, on the eye of the White Horse at Uffington, on Dragon's Hill which lies below it, on the cromlech at the west end of the Alignment of Menec at Carnac, and on No Man's Land, at Conkwell, near Bath. The greatest number found on any one site is at the Erechtheum on the Acropolis at Athens, all compartments of which are located upon such spirals, of which there are sixteen.

The usual diameter of primary spirals is 10-15 feet, but some are over 2000 feet. The smallest identifiable as such is 2 feet. Although usually circular, they are occasionally asymmetrical, with the focal point away from the true centre (Fig. 4, *C*). They may also be *D*-

[5] Professor M. Eliade deals fully with the subject of religious centres in his *Patterns in Comparative Religion* (Sheed and Ward, 1958).

[6] Exodus, III, 5.

shaped, as at the North Barrow at Stonehenge, or oval or roughly rectangular, or even leaf-shaped, as at Downton Moot, near Salisbury, and at the Troy Town Maze at Somerton, near Banbury. Where they are irregular in shape this appears either to have been caused by nodes (page 44) or by nearby stronger primary lines which repel them, and so push them out of their natural circular form.



4 PRIMARY SPIRALS. In 4*G* only the outer coils of the spirals are shown.

One of the most remarkable and important characteristics of primary spirals is that the number of their coils is invariably governed by the number 7. This fact, coupled with the universal sanctity of the spiral symbol in the old religions, may throw light upon the peculiar significance associated with that figure.

The water line and aquastat both produce spirals of 7 (or a multiple of 7) coils, and never any other number (Fig. 4, *D* and *E*). Forty-nine coils (7 × 7) appears to be the limit.

Track line spirals are normally of 3½ coils or a multiple of that number (Fig. 4, *F*).

A single blind spring may produce several spirals, according to the number of primary lines which converge upon it, but each spiral can be traced individually to the common centre without interference with another (Fig. 4, *G*).[7] The outer coil of a primary spiral is picked up by the dowser without difficulty, but the inner coils can be perceived only after he has become tuned in to the outer coil, or to the parent line which produced both. The grip on the rod should be somewhat weaker when following the inner coils.

Large water line spirals expand and contract slightly annually, but primary lines and blind springs remain fixed. For example, some years ago the outer coil of a water spiral with a radius of 900 feet was marked where it crossed the surface of a road. Observations made on many subsequent occasions showed that the radius expands about 3 feet from January to June, and then contracts to its original length by the following January.

When aquastats form spirals they split into two lines, one half forming the spiral, and the other half proceeding direct to the blind spring, as in Fig. 5, *A*. The two halves reunite at the spring, then proceed to the next one, where the same pattern occurs again. It follows that every aquastat spiral has two straight (non-spiral) lines at the spring, one entering and the other emerging, in addition to the spiral. One is weak and one is strong in influence. The weak line can be perceived only if the dowser is tuned in to the primary aquastat which has produced it. Water line and track line spirals have only one straight line in addition to the spiral itself. This is strong in influence, and leads from the spring.

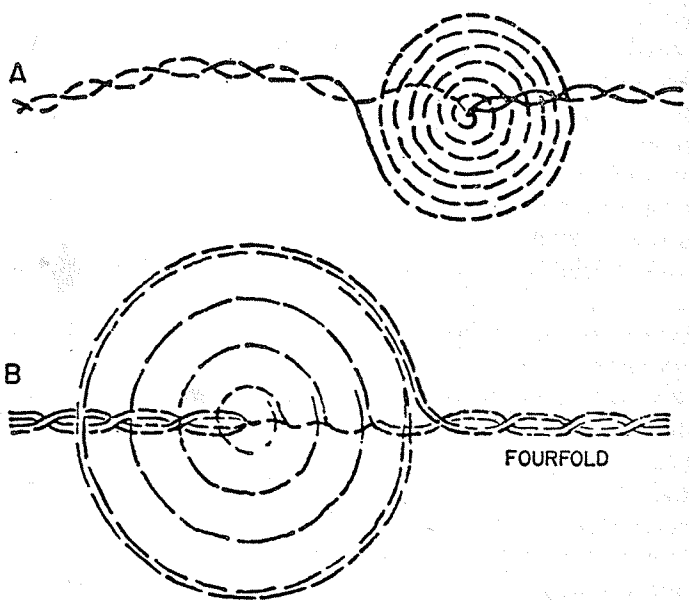
With multiple aquastats and water lines the spirals may take the

[7] Stone 68 in the West Kennet Avenue at Avebury marks a blind spring enclosed by at least sixteen spirals.

following pattern: The line splits as before, but the straight half if still a multiple (or if the number of its triads is even) usually splits again, and so on. The result is that a fourfold multiple spiral may form four spirals before reaching the blind spring (Fig. 5, *B*).

Multiple water lines act in the same way, except that the line never splits at the last and smallest spiral.

As to the position of spirals, where (as occasionally happens) all three types of primary line follow similar and approximately



5 Splitting: (*A*) Single, and (*B*) Multiple Aquastat.

parallel courses from one spring to another, then the water line and aquastat spirals will be at one end of the section and the track line spiral at the other (Fig. 4, *G*).

It will be found that where an underground stream breaks through to the surface, spirals will occur on the water line at the end of the section nearest the surface spring. This might be a pointer to some method not yet discovered whereby the direction of the flow of underground water might be determined in places where no visible surface spring exists.

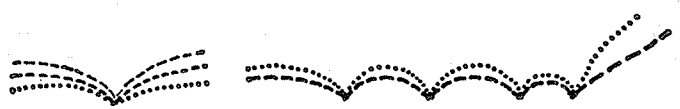
Because there can be no vortex without motion, the facts seem to suggest that some form of current exists in the primary lines. It is interesting to note that writers on those eastern philosophies which involve the conception of certain health-giving lines of force refer to them as "Earth currents." The Fung Shui of China provides an example, and in *Kim,* Kipling refers to "the mysterious earth currents which thrill the clay of our bodies."

It is generally assumed by professional water diviners that the water line occurs directly above underground streams, but this cannot be so where the water lines form spirals. In such places it is obvious that only the straight sections of water lines between the spirals can follow the course of the stream. There are many recorded cases of amateur dowsers who have successfully sunk wells on water lines without any apparent knowledge of blind springs and their spirals. These well-sinkers must have been very lucky, since they would not have found underground water beneath the perimeter of a water line spiral which had influenced their rods.

A blind spring is the proper site upon which to sink a well, and all competent professional dowsers do this, and have always done so. Their method of locating blind springs, springheads, knots, crossing streams—or whatever name they give them—appears to be by tracing several water lines to a common centre. This is because modern water diviners are not aware of the primary spirals as such. But some professionals, of whom Mr. Jack Fry is one, say that they find areas surrounding strong blind springs where water reactions are perceptible everywhere. Others find several linear "circles" enclosing such springs, and use them for estimating quantity and depth. It seems likely that these "areas" and "circles" are water line spirals which cannot be traced precisely with the crude twig generally used, or by negative dowsers. As mentioned earlier, negative dowsers perceive a field of force on either side of a water line rather than the clear water line itself, and which is perceived by the positive dowser.

The coils of a small primary spiral of, say, seven coils and 10-30 feet in diameter are easily counted. The dowser can follow the coils until they lead him to the blind spring. However, this is not practicable where great spirals are concerned. A forty-nine-coil spiral, 250 feet in diameter, would involve a walk of over three miles, and some such spirals have been found to be more than 2000 feet wide. In such cases the dowser should first tune in to the

outer coil, and follow it until he is able to make a rough estimate as to the probable position of its centre. He should then walk in that direction. After he has left the outer coil of a spiral, he will get a further reaction at a short distance, and subsequently a series of similar reactions at approximately equal distances until these cease at a blind spring. The reactions are likely to number one less than the coils, since the central one may not be perceptible. This method will usually lead the dowser to the right spot, for the reason that the reaction of the coils when crossed at right-angles is stronger than when they are crossed diagonally. If he strays off course the rod will fail to respond. Having located the supposed blind spring, he will be able to check by tracing a few coils back from that spot. There will also be several geodetic lines radiating from the centre.

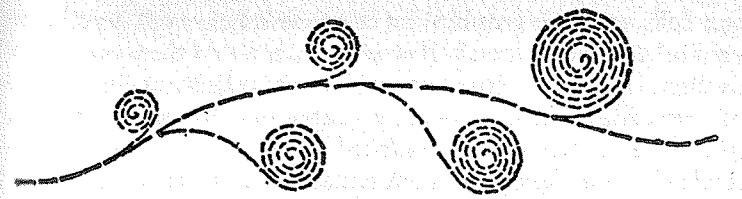


6 Nodes.

Nodes are sharp bends in primary lines which are responsible where they occur for a zigzag course (Fig. 6). Some may denote small blind springs. Either they are isolated, or they may occur in great quantity at a distance of a few feet. Their presence on opposite sides of a primary line cause it to bend. There may be long intervals without either blind springs or nodes, during which the line will pursue its normal wavering course. Nodes may produce small branch spirals. More nodes seem to occur over rocky subsoils than in districts where the subsoil is clay.[8]

Branch Spirals are small spirals diverging from geodetic lines (Fig. 7.) Unless they are the object of a special search, they may easily be missed. They usually consist of seven coils, 5-20 feet wide, which originate at nodes. They may be found in spaces enclosed by the parent line and adjacent geodetic lines. A number of them may occur in line and, very occasionally, in clusters covering the whole of an enclosed area. Where clusters occur on prehistoric sites they are usually marked by turf mazes, dry-ponds or pits.

[8] *Theory of Water Finding by the Divining Rod*, Benjamin Tompkins (1899).



7 Branch Spirals.

There are several examples of branch spirals at Avebury. One is in the fork at the E. end of the S.W. Mound, which has been shaped to enclose it. In the medieval period and later, branch spirals were almost essential for habitation sites.

General Notes on Divining Geodetic Lines

Tuning In. When the dowser picks up a geodetic line he becomes tuned in to that line. Provided he does not alter his hold on the rod, he will be comparatively insensitive to other lines, even when these are of the same type. Without this selective power it is unlikely that animals would be able to follow track lines without straying off course.

Following. It is important for a student to be able to follow geodetic lines at a reasonable pace. Though a beginner will have to cross and recross the lines diagonally, counting the triads or hair lines each time, the dowser of experience will have acquired the knack of following single hair lines or triads to which he has tuned in. He will walk along them, as animals do. The swaying of his body across the line as he walks will be sufficient to enable him to pick up that hair line each time it is crossed, and the rod will dip regularly as he does so. He will know at once should the line alter course. If he strays off the line, he will be warned by the abrupt cessation of reactions. In open country it is possible to operate at a fair walking pace, but on important sites, which are usually crowded with other primary lines, it is safer—even for the expert—to go slow and walk across the *whole* composite line each time.

Sensitivity. Young people are more sensitive to the geodetic influence

than adults, and it is possible that everyone is born with powers of perception equal to those of other animals, but that these gradually fade from disuse. A schoolmaster of my acquaintance discovered that when a class of boys in the 14-year age-group was shown the use of the rods, not one of the boys failed. Sensitivity may be retained until late in life, but it is more usual for it to have practically disappeared at the age of forty. Even so, it may be revived by practice and patience. Good places for practice are old wells (for water lines and aquastats), old lanes and animal paths (for aquastats and track lines) and barrows (for large spirals).

Blindfold Dowsing. There are numerous established cases of diviners operating blindfold, notably John Mullins, Bleton, and others. All such men have been negative dowsers, and I know of no positive dowsers able to do so. I cannot myself do it. When in complete darkness, blindfolded, or when both eyes are shut, I lose all power to perceive any geodetic line; but should there be any light, however faint, dowsing is as certain as in daylight. This may explain the prominent place taken by light in old religions and philosophies, as for example those of the Parsees and the Freemasons, and also possibly the importance of the Eyes of Horus in the ancient Egyptian religion, where the right and left eyes have a different significance.

This latter thought came to me when I discovered that if a positive dowser closes his left eye he will be unable to perceive the water line, though he will have no difficulty in locating the aquastat and track line. If the right eye is closed, he will respond to the water line only. I found this out by chance when dowsing in winter on a day when I had a cold in my right eye and had to shut it in protection against the east wind.

Permanence. The permanence of primary geodetic lines and blind springs may be confirmed at stone circles of similar stone structures. I never found any evidence of the variation of primary lines on any of the sites I surveyed, with the exception, of course, of the slight variations characteristic of large spirals. I found that the primary lines on such sites are marked by strict convention, and that from time immemorial they have remained stationary—otherwise the markings would now be inaccurate and ineffective. Any apparent discrepancies may be accounted for by the fact that some

stones have been removed from their original positions. But the dowser can usually determine not only whether they have been moved, but he can also identify their original position, particularly if these stones were deliberately placed in a recumbent position by the early architects or priests. Examples of stones which should have been left in a recumbent position are the great stone at the E. end of the West Kennet Long Barrow; the four great recumbent stones which formerly lay at the E. end of Wayland's Smithy, and which have now been set erect; Stones 42 and 45 at Stonehenge; and the Sofa Stone at No Man's Land, Conkwell, near Bath, which has been displaced by foresters.

Due to the permanence of the established patterns of primary geodetic lines within them, prehistoric structures should now be more easily identified, together with their principal features such as gates, roads, and temples. Study of geodetic lines, used in conjunction with the instructions I have been able to give for tuning in to them and following them, should be sufficient to enable such places to be roughly mapped previous to excavation, thus eliminating a great deal of trial and error, as well as possible damage.

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Shell midden archaeology in Japan: Aquatic food acquisition and long-term change in the Jomon culture

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ABSTRACT

This paper reviews recent progress of Japanese shell midden archaeology and discusses how the information from shell middens can help answer some of the key questions in anthropological archaeology today. Over the past several decades, shell midden archaeology in Japan has made significant advances both in terms of theory and method. Active interaction with Japanese and Anglo-American archaeology has resulted in the development of new theoretical approaches, including environmental archaeology, zooarchaeology, and hunter-gatherer archaeology. Methodologically, the adoption of the flotation and water-screening methods has enabled archaeologists to collect quantitative data of faunal assemblages, and sometimes of floral assemblages as well. The dense distribution of shell middens in northeastern Japan and its changes through time are closely related to the regional and temporal variability of the prehistoric Jomon culture (ca. 14,000–500 BC). In this article, shell middens from four regions of Japan are examined: 1) Tohoku, 2) Kanto, 3) Chubu, and 4) Western Japan. The final section of this paper discusses the implications of regional and temporal variability observed among these shell middens.

1. Introduction

Studies of shell middens in Japan have assumed vital roles in the early development of Japanese archaeology, particularly the archaeology of the prehistoric Jomon period (ca. 14,000–500 BC). The first "scientific" excavation of an archaeological site in Japan (see Imamura, 1996, 39–42) was conducted at the Omori shell midden by an American zoologist, Edward Morse, in 1877 (Morse, 1879). Because shell middens were easily identified through surface surveys, archaeologists of the late 19th and early 20th centuries focused their primary research efforts on shell midden sites. During the 1920s and 1930s, many of these shell middens became type sites for establishing Jomon chronological framework on the basis of pottery typology. Skeletal remains from shell middens provided early physical anthropologists with invaluable information to investigate the population history and lifeways of prehistoric people on the Japanese islands (e.g., Kiyono, 1949). Early studies of shell midden distribution made archaeologists realize that the coast lines during the Jomon period were further inland (e.g., Esaka, 1965).

Over the past several decades, shell midden archaeology in Japan has made significant advances in terms of both theory and method. Active interaction with Japanese and Anglo-American archaeology has resulted in the development of new theoretical approaches, including environmental archaeology, zooarchaeology, and hunter-gatherer archaeology (e.g., Akazawa, 1980; Matsui, 1992, 1995, 1996). Methodologically, the adoption of the flotation and water-screening methods has enabled archaeologists to collect quantitative data of faunal assemblages, including shellfish, fish and mammals, as well as environmental indicators, such as land snails (e.g., Isarago Kaizuka Iseki Chosadan, 1981). Early development and systematic applications of daily growth line analysis of clam shells have allowed Japanese scholars to infer the seasonality of shellfish collecting and site occupation (e.g., Koike, 1980). Isotopic analyses of human skeletal remains excavated from shell midden sites have provided invaluable information about prehistoric diet (e.g., Yoneda, 2010).

Given this background, it is clear that Japanese shell midden studies can contribute significantly to understanding key questions in various subfields of environmental anthropology, including historical ecology, cultural ecology, evolutionary ecology and paleontology. These questions include the origins and antiquity of aquatic or marine food exploitation and its consequences, the mechanisms of long-term change in human-environment

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interaction, and human impacts on the local and regional environment. The following sections provide an overview of Japanese shell midden archaeology and discuss how the information from shell middens can help answer these questions. Methodological developments in recent shell midden studies in Japan are also reviewed.

2. Regional variability of shell middens

Overviews of Jomon shell midden archaeology in English can be found in Barnes (1993), Habu (2004, 72–77), Imamura (1996, 67–77), and Kobayashi (2004). Because of their visibility on the ground, many of the large shell middens in Japan have been known for decades. By 1959 (Sakatsume, 1959: ii–iii), 2337 shell middens from the Jomon (ca. 14,000–500 BC), Yayoi (ca. 500 BC–AD250), Kofun (ca. AD250–710) and Nara/Heian (AD710–1192) periods were known. The far left column of Table 1 shows the breakdown of this number for each region (For the location of each region, see Fig. 1). These data indicate that shell middens are distributed more densely in northeastern Japan, especially in the Kanto region (near Tokyo), than in southwestern Japan. The middle column of the table, also taken from Sakatsume (1959), shows the number of shell middens from the Jomon period only. As shown in this column, the data display an even heavier concentration in the Kanto region. More recently, Oikawa (1995) and his colleagues produced a Shell Mound Database, which lists archaeological sites associated with organic remains (Sokendai, 2010). As of 1995, over 4000 sites were listed (Oikawa, 1995), the majority of which are shell middens. Oikawa's (1995) data are presented in the far right column of Table 1. While the total number is significantly larger than that in Sakatsume (1959), the relative frequency for each region shows similar patterns.

The denser distribution of shell middens in northeastern Japan, especially in the Kanto region and, to a certain extent, the Tohoku region, corresponds with a higher density of Jomon sites in northeastern Japan (see Habu, 2004, 2008; Koyama, 1978). What are the implications of this regional variability? How was this related to the changes through time in the number of shell middens in each region? In the following sections, shell middens from four regions of Japan are examined: 1) Tohoku, 2) Kanto, 3) Chubu (including Tokai, Chubu Mountain and Hokuriku in Fig. 1), and 4) Western Japan (Kinki, Shikoku, Chugoku and Kyushu in Fig. 1).

3. Tohoku

Tohoku refers to the northern region of Honshu (the largest island of Japan, see Fig. 1). Most of the shell middens in this region are located on the Pacific side, especially along the coast of Iwate and Miyagi Prefectures (Fig. 2). A dense concentration of Jomon shell middens in the Matsushima Bay area (Miyagi Prefecture) is especially well-known. On the Japan Sea side, the contribution of shellfish to the Jomon diet must have been limited, as only a small number of shell middens are present. This distribution pattern is different from that of Jomon settlement sites (sites associated with one or more pit-dwellings), which are abundant on both the Pacific and Japan Sea sides.

Table 1
Numbers of shell middens in each region by Sakatsume (1959) and Oikawa (1995).

Region	Sakatsume, 1959		Oikawa, 1995
	All periods	Jomon only	All periods
Hokkaido	127 (5.4%)	11 (1.0%)	224 (5.6%)
Tohoku	280 (12.0%)	190 (17.1%)	611 (15.2%)
Kanto	1038 (44.4%)	664 (60.0%)	1592 (39.5%)
Chubu	210 (8.9%)	89 (8.0%)	459 (11.4%)
Kinki	48 (2.1%)	14 (1.3%)	119 (3.0%)
Chugoku	305 (13.1%)	62 (5.6%)	432 (10.8%)
Shikoku	46 (2.0%)	17 (1.5%)	71 (1.8%)
Kyushu	210 (9.0%)	61 (5.5%)	313 (7.8%)
Okinawa	73 (3.1%)	–	195 (4.9%)
Total	2237 (100.0%)	1108 (100.0%)	4016 (100.0%)

Studies of shell middens have played key roles in the development of Jomon archaeology in Tohoku. During the early 20th century, excavation of the Satohama shell midden (Early–Final Jomon) (Miyagi Prefecture) provided archaeologists with solid data to establish a pottery chronology on the basis of stratigraphic information (Matsumoto, 1919). By the 1970s, a group of archaeologists at Tohoku University began to combine the idea of stratigraphic excavation with the water-screening method. Their goals were threefold: 1) to understand the process of shell midden formation, 2) to estimate the time-span in which each layer was accumulated, and 3) to infer seasonality of hunting and fishing activities. Their focus on the site formation process paralleled the works of Schiffer (1976, 1987) and others in North America who advocated "behavioral" archaeology. In terms of methodology, these Japanese archaeologists adopted a standardized method, in which they sub-divided cultural layers as much as possible, obtained soil samples from individual layers, and screened the soil samples with fine mesh (typically down to 1 mm mesh) to retrieve quantitative data of faunal remains and artifacts.

The excavation of the Nakasawame shell midden, a freshwater shell midden in Miyagi Prefecture (Late–Final Jomon), is a good example of an application of this excavation method (Matsui et al., 1984; Suto, 1984, 1995). The results indicate that subsistence activities focused on freshwater resources, including freshwater mussel (*Unio douglasiae nipponensis* von Martens), Japanese mystery snail (*Cipangopaludina japonica* von Martens), carp (Cyprinidae), and catfish (*Pseudobagrus tokiensis* Döderlein). The site residents also visited the coastal zone to exploit marine food resources, such as asari clam or Japanese littleneck (*Ruditapes philippinarum* Adams & Reeve) and sardine (*Sardinops melanostictus* Schlegel). Based on these results, the excavators concluded that the subsistence focus of the residents of inland sites, such as Nakasawame, included a wide range of resources.

Similar methods were applied to a series of excavations of such shell midden sites as Satohama (Fujinuma and Okamura, 1982), Tagara (Fujinuma, 1986), and Ohora (Kinno, 2001), as well as some non-shell midden sites (Shindo, 1990; Suto, 1997).At the Satohama shell midden, remains of 83 taxa of shellfish, 40 taxa of fish, 19 taxa of birds, and 10 taxa of mammals were retrieved from Final Jomon layers. Asari clams constituted 63.1% of shellfish remains, and 36.1% of fish remains were sardines. Based on seasonality analysis of asari clam (Koike, 1987) and faunal studies, Okamura and Kasahara (1987) presented a "subsistence calendar" of Satohama residents. According to the calendar, fishing and shellfish collecting on the inner bay beach were most common during the spring and early summer even though these activities occurred on a smaller scale in other seasons.

As indicated above, Oikawa (1995)'s Shell Mound Database listed 611 sites from the Jomon to Heian periods in Tohoku. Review of prefectural site maps, site databases and other syntheses allowed collection of detailed information of 408 Jomon shell middens. Fig. 3 shows the numbers of shell middens, settlement sites (sites associated with one or more pit-dwellings) and pit-dwellings from the Initial to Final Jomon periods in Tohoku. As some of the shell midden sites are associated with shell layers from multiple Jomon sub-periods, the total number of shell middens in Fig. 3 (604) is larger than 408. Fig. 3 shows several important characteristics. First, no shell middens are known from the Incipient Jomon. Second, the number of shell midden sites from each sub-period increased significantly from the Initial (54) to the Early (130) Jomon. The

Fig. 1. Prefectures and regions of Japan.

number remained fairly steady for the Middle (129) and Late (137) Jomon periods, with a slight increase for the Final (154) Jomon. This pattern shows a marked contrast with the changes in the number of settlement sites and the total number of pit-dwellings through time. Both the number of settlement sites and the number of pit-dwellings peaked during the Middle Jomon period (Fig. 3), and they decreased significantly for the Late and Final Jomon periods.

Excavations of representative shell middens from each Jomon sub-period have also revealed aspects of long-term changes in shell midden construction. Choshichiyachi (Aomori Prefecture) is a good example of an Initial Jomon shell midden site (Ichikawa, 1980). It consists of a group of small shell middens, the thickness of which measures 20–70 cm. No pit-dwelling from the same period was identified, and only a few artifacts were associated with the middens. Given these lines of evidence, Choshichiyachi was likely to have been a special purpose site with limited activities.

Early and Middle Jomon shell middens tend to be larger in size and associated with large amounts of artifacts. For example, at the Takonoura shell midden (Early–Middle Jomon; Iwate Prefecture), the shell-layers measure as thick as 1.6 m (Kinno, 1987). Some of the Early and Middle Jomon middens also functioned as cemeteries. Many of them are located on hillsides and form a circular configuration. Typically, these large shell middens are part of large settlement sites with many pit-dwellings. The Sakiyama shell midden (Early–Middle Jomon; Iwate Prefecture) is a good example of this type (Takahashi, 1995). The size of Late and Final Jomon shell middens vary. The construction of large shell middens continued (e.g., the Final Jomon Ohora shell midden; Iwate Prefecture), but very few are associated with a large number of pit-dwellings. Many of the small shell midden sites have no pit-dwellings, probably being special purpose sites away from settlements. Some of them are associated with a large number of "evaporation pots" for salt-making (see Habu, 2004, 231–233). Thus, these sites represent not only the acquisition of aquatic food resources but also had close ties with salt-making.

In summary, the history of Jomon shell middens in Tohoku can be divided into three phases. The first phase, the Initial Jomon, was the time when aquatic food resources began to be systematically exploited. The size of shell middens from this phase is usually small, and many of them were probably special purpose sites. The second phase corresponds to the Early and Middle Jomon, during which large shell middens associated with many pit-dwellings were constructed. This implies that intensive shellfish exploitation near residential bases became an important part of subsistence activities. The number of shell midden sites increased slightly from the second to the third phase, the Late and Final Jomon. This is in contrast with the number of settlement sites, which showed a significant decrease from the Middle through to the Final Jomon. In other words, a decrease in the number of large settlements at the end of the Middle Jomon period was not caused by a decline of aquatic food

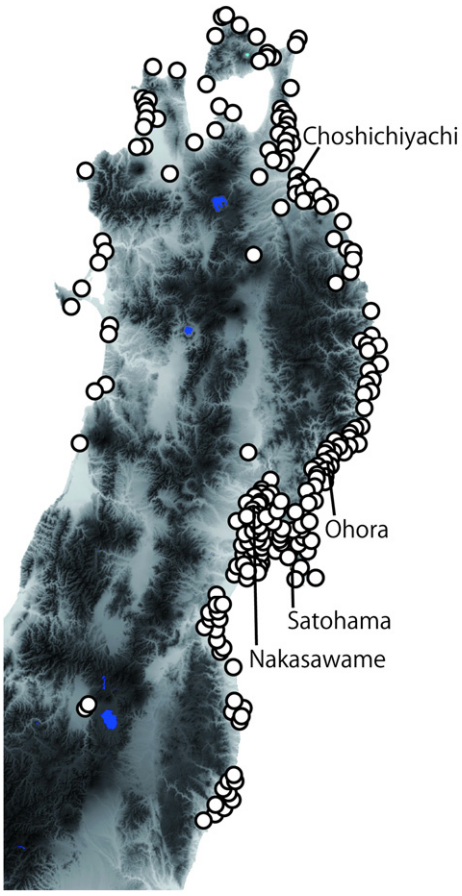

Fig. 2. Distribution of major shell midden sites in Tohoku.

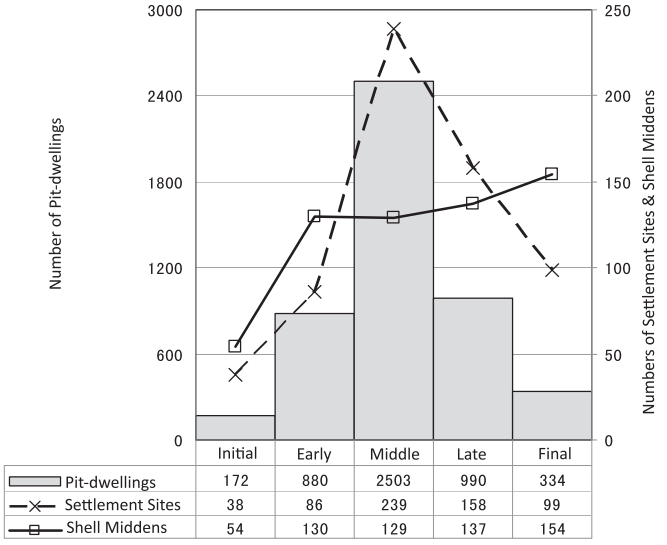

Fig. 3. Changes in the numbers of shell middens, settlement sites and pit-dwellings (compiled from Akita-ken Kyoiku Iinkai, 2001; Aomori-ken Kyoiku Iinkai, 2009; Fujinuma et al., 1989; Fukuda, 1992, 1998, 2007; Iwate-ken Kyoiku Iinkai, 2001; Kusakabe et al., 1991; Miyagi-ken Kyoiku-cho Bunkazai Hogo-ka, 2009; Sato et al., 1998).

exploitation. Most of the Late and Final Jomon middens were constructed away from residential sites and are likely to have been special purpose sites for shellfish collecting and salt-making.

4. Kanto

As indicated in Table 1, the Kanto region is known for an abundance of shell middens. The oldest shell midden in the Kanto region is Natsushima (Kanagawa Prefecture). It is associated with Initial Jomon pottery, and an oyster shell from the bottom layer of the midden is associated with a radiocarbon date of 9450 ± 400 uncal. BP (M-769) (2σ: 9293–7320 BC) (see Habu, 2004, 248–250; Imamura, 1996: 60–62). At this site, evidence of intensive shellfish collecting, as well as fishing and hunting of some sea mammals, is clear. Nevertheless, it is unlikely that marine food dominated the Initial Jomon diet, as shell middens account for only a small portion of the Initial Jomon sites in this region. Habu (2004: 249) suggests that the residents of Natsushima and other Initial Jomon shell middens may have been serial specialists (*sensu* Binford, 1980), who intensively exploited marine food only seasonally and whose staple food for the rest of the year was terrestrial.

Within the Kanto region, regional and temporal variability of shell middens have attracted the attention of many researchers. Many shell middens are clustered in the following three areas: 1) the western half of Tokyo Bay (present-day Tokyo and Kanagawa Prefecture), 2) the eastern half of Tokyo Bay (Chiba Prefecture), and 3) the shoreline of present-day Lake Kasumigaura (Ibaraki Prefecture).

On the western half of Tokyo Bay, many large settlements associated with small shell middens appeared in the second half of the Early Jomon period. Representative examples include Kitagawa, Nanbori, and Nishinoyato (Kanagawa Prefecture). Towards the end of the Early Jomon period, all of these shell middens were abandoned. This was followed by the disappearance of almost all the settlement sites in this area (Habu, 2001). Biologists such as Matsushima and Koike (1979) suggest that the retreat of the sea level after the "Climatic Optimum" might have resulted in the loss of complex coast lines, which then resulted in the decrease in the habitat of littoral mollusc species. Given the scarcity of reliable radiocarbon dates from these sites, the causal relationships between the sea level retreat, changes in the coastal habitat, and the disappearance of shell middens need to be further examined. Shell midden construction on the eastern half of Tokyo Bay and in the Lake Kasumigaura area started during the Initial Jomon and peaked during the Middle and the Late Jomon. An abundance of shell middens in the former area is particularly noticeable. Table 2 shows changes in the number of shell middens on the eastern half of Tokyo Bay. As revealed in the bottom row of this table, the number of shell middens in this area multiplied from the Early to Middle Jomon and it further increased from the Middle to Late Jomon. The latter increase is small in number but noteworthy because this increase occurred in the number of large, so-called "horseshoe" shaped shell middens (see the second row). Some of these middens measure over 100 m in diameter, and most of them are associated with many pit-dwellings. Examples include Horinouchi (over 200 m in diameter; Late Jomon), Kainohana (about 80 m in diameter; Late Jomon – Aikens and Higuchi, 1982, 156–164), Kasori North (about 130 m in diameter; Middle Jomon), and Kasori South (about 170 m in diameter; Late Jomon).

It is worth noting that site density (calculated based on the total number of all sites) and the frequency of large settlements in the

Table 2
Changes in the number of shell middens in the east Tokyo Bay Area (compiled from Chiba-ken Kyoiku Iinkai, 1983).

Shell midden type	Initial	Early	Middle	Late	Final	Total
Small shell midden	45	45	107	107	24	284
Horseshoe-shaped shell midden	0	1	38	53	0	92
Total	45	46	145	160	24	376

Kanto region peaked during the Middle Jomon period, and they decreased significantly from the Middle to the Late Jomon (e.g., Imamura, 1996; Koyama, 1978). Many scholars believe that this is a reflection of the growth and decline of subsistence-settlement systems that were based on an intensive exploitation of plant food. Despite this overall decline in site density at the end of the Middle Jomon period, large shell middens on the eastern half of Tokyo Bay continued to flourish through to the Late Jomon period. This may parallel the change from the Middle to Late Jomon in Tohoku, but a dramatic decrease in the number of shell middens from the Late to the Final Jomon is unique to Kanto.

Because of the large size of these "horseshoe-shaped" shell middens, many scholars assume that an extreme intensification of marine food exploitation occurred at these sites. However, Suzuki (1986) suggests that the seemingly large size of horseshoe-shaped shell middens is due to their longer duration than smaller middens. If this was the case, the uniqueness of these large middens is not the intensity in marine food exploitation per unit time but the long duration of shellfish collecting at the same location. Suzuki's (1986) simulation study also indicates that the maximum caloric intake from shellfish for an Isarago resident would have been only 7–9 percent of the average daily caloric intake. In conclusion, he emphasizes the importance of shellfish may have been its abundance from the late winter to early spring, when other food resources were scarce. Assuming that large shell midden sites in the eastern half of Tokyo Bay were simultaneously occupied settlements, Horikoshi (1972) suggests that the territory of each settlement was only 2–3 km in radius. This is much smaller than the average size of hunter-gatherer site territory of ca. 10 km in radius (e.g., Binford, 1980; Vita-Finzi and Higgs, 1970). If Horikoshi's assumption is valid, this overcrowding must have severely restricted the residential mobility of site occupants (cf. Rosenberg, 1998).

Lastly, but not least importantly, recent excavation of the Middle and Late Jomon Nakazato shell midden (Kita-ku Kyoiku Iinkai, 2000), a lowland shell midden in Tokyo, has made archaeologists realize the importance of understanding variability among Jomon shell middens in the Kanto region. Accumulation of oysters (*Crassostrea gigas* Thunberg) and oriental clams (*Meretrix lusoria* Roding) at this site is extremely thick (as thick as 4.5 m). Unlike large, "horseshoe" shaped middens, Nakazato is not associated with many artifacts. Instead, features with wooden frames, burnt cobbles, burnt shell fragments and charcoal were recovered. Nakajima (2000), the principal investigator of the site, suggests that these features represent steaming of shellfish. Given these characteristics, it is likely that Nakazato functioned as a special purpose site to collect and process shellfish.

5. Chubu

The Chubu region can be divided into three sub-regions: Tokai (the Pacific side of Chubu), Hokuriku (the Japan Sea side) and Chubu Mountain (see Fig. 1). The majority of shell middens in this region are located either in the Tokai or Hokuriku sub-regions. As shown in Table 1, the total number of shell middens in the Chubu region is not large. This does not mean, however, that shell midden archaeology in Chubu did not produce important results. Excavations of three shell middens are particularly noteworthy.

In the Tokai sub-region, the discovery of the Mazukari shell midden changed the archaeologists' view of early Holocene transgression (Yamashita et al., 1980; Yamashita, 2008). Boring tests prior to the construction of a train station on the Utsumi Plain of Chita Peninsula revealed the presence of a large number of potsherds and shell fragments deep under an alluvial deposit. Subsequent boring tests indicated that an Initial Jomon shell midden is located on top of a "buried hill". A radiocarbon date of 8330 ± 260 uncal. BP (Gak-7950) (2σ: 7542–6366 BC) was obtained from granular ark (*Tegillarca granosa* L). The elevation of the top of this shell midden is about 10 m below the present-day sea level (BSL). On top of this shell midden is an accumulation of marine silt and sand deposits over 12 m thick (i.e., the top of these deposits is about 2 m above present-day sea level). They must have accumulated after the shell midden was abandoned during and after the Holocene transgression period. Artifacts and ecofacts reported from this site are similar to other Jomon shell middens in Tokai. They include a large number of potsherds, 30 stone tools, a bone tool, shells, fish and mammal remains, and human skeletal remains. The discovery of the Mazukari shell midden is important in three respects. First, prior to this excavation, most archaeologists assumed that Jomon shell middens are typically located on top of hills, and thus practically no shell middens were lost due to the Holocene transgression. Data from Mazukari, on the contrary, revealed that this was not the case. Second, geologists and biologists indicate that the sea level was as low as −40 m asl at about 10,000–9000 years ago. The sea level began to rise ca. 9000 years ago, and it became roughly the same as the present-day sea level or slightly higher between 6500 and 5500 years ago. In this context, marine transgression during the Initial and Early Jomon period was a phenomenon in which the sea water flowed into the deep, coastal valleys that were formed during the Pleistocene. Under this circumstance, marine transgression could have occurred even when the sea level itself was lower than the present-day sea level (Yamashita, 2008, 7). Third, the excavation of Mazukari made archaeologists realize that the topography during the early–middle Holocene was radically different from that of today (Yamashita, 2008, 8). After the discovery of this shell midden, archaeologists began to pay more attention to buried valleys and hills, which must have been prominent during the Jomon period but are now covered by the later sediment. This in turn is affecting their excavation plans as well as the way Japanese archaeologists reconstruct Jomon landscapes.

Another good example of the lowland shell midden in Tokai is the Muro shell midden cluster (Aichi Prefecture). Located on the Atsumi Peninsula, this shell midden cluster consists of seven Late–Final Jomon shell middens, the largest of which is the Onishi shell midden. Radiocarbon dates from these middens range from 1400 to 500 BC. Unlike typical shell middens in this region, relatively few artifacts and fish/mammal bones were found from these middens. Most of the shell assemblage (77–95%) is dominated by a single species, oriental clam (*M. lusoria* Roding). The elevations of these middens are not high, only about 1–3 m above sea level (Iwase, 1998, 2003; Iwase et al., 2002). Given these lines of evidence, Iwase (2003) suggests that these middens were special purpose sites, where clams were intensively processed possibly for trade. For the moment, the residential area of people who harvested these shells is not known. Measurements of clam shells from Muro indicate that the distribution of shell size here differs from the natural distribution. Only a few of the shells measure below 3 cm in length. The most commonly harvested clams were between 4.0 and 4.5 cm in length. Iwase (2005) suggests that the Jomon people, who were well aware of the conservation of their resources, collected the clams selectively on the basis of their size. Results of daily growth line analysis indicate that, although the clams were collected throughout the year, the peak of the clam collection was from the spring to summer (Kuramoto, 1996, 1997; Toizumi, 1998).

In the Hokuriku sub-region, the excavation of the Torihama shell midden has provided new lines of evidence to infer characteristics of Jomon subsistence and wood-working (Torihama Kaizuka Kenkyu Group, 1979–1987). Located at the meeting point of two rivers in Fukui Prefecture, Torihama is a waterlogged Early Jomon

shell midden site. It was also associated with Incipient and Initial Jomon remains. The site was first excavated in 1962 by a research group of Doshisha and Rikkyo Universities. After several additional small-scale excavations, a series of rescue excavations were conducted from 1975 to 1986 prior to a major river improvement program. In particular, the 1975 excavation, which covered 184 m^2, resulted in the discovery of large amounts of organic remains. They included a lacquered comb, rope, basket and fabric fragments, coprolites, and macro plant remains such as bottle gourds (*Lagenaria* sp.), egoma [*Perilla frutescens* (L) Britton var. *japonica*] or shiso mint (*P. frutescens* var. *crispa*), and chestnut (*Castanea crenata* Siebold & Zucc.). Later, the 1981 excavation revealed the presence of dugout canoes (see Habu, 2010). Based on the analysis of macro and micro floral remains, Nishida (1983) suggests that the function of the Torihama settlement changed through time from a temporary nut-gathering camp of the Initial Jomon to a sedentary village site of the Early Jomon.

6. Western Japan

As evident from Koyama's (1978) study, Jomon site density for southwestern Japan (the Kinki, Chugoku, Shikoku and Kyushu regions) is much lower than that for northeastern Japan. With the exception of part of Kyushu (Saga, Nagasaki and Kumamoto Prefectures), relatively few shell midden sites have been known from these regions. However, two recent excavations of submerged shell middens have contributed significantly to Jomon environmental archaeology: Awazu and Higashimyo.

The Awazu site (Iba et al., 1999; Iba, 2000) is located at the bottom of Lake Biwa in Shiga Prefecture, the largest freshwater lake in Japan. Previous surveys of the lake-bottom and lake shores by the Board of Education of Shiga Prefecture identified approximately 100 sites that were submerged. One was the Awazu site associated with two Middle Jomon shell middens. When a new ship route was proposed in 1990, two areas of the lake-bottom were drained with vertical steel sheet piles and pumps, and a test excavation was conducted prior to dredging a channel. This revealed the presence of Initial Jomon artifact and ecofact concentrations as well as a new Middle Jomon shell midden: Shell Midden No. 3. Radiocarbon dates from the Initial Jomon layers include 9600 ± 110 uncal. BP (NUTA-1825) (2σ: 9268–8706 BC [94.8%], 8669–8657 BC [0.6%]) and 9290 ± 140 uncal. BP (NUTA-1835) (2σ: 9121–9003 BC [4.3%]; 8918–8896 BC [0.7%], 8872–8250 BC [90.4%]) (Toshio Nakamura, personal communication). These layers included large amounts of plant-based organic remains such as nuts, including chestnuts (*C. crenata* Siebold & Zucc.), but with no shells. These layers were also associated with plant seeds, including bottle gourds (*Lagenaria siceraria* (Molina) Standl.) and beans (*Vigna* spp.).

Shell Midden No. 3 consisted of alternate layers of shells and nutshells dated to the Middle Jomon period. A total of 78% of the shells are *shijimi* or seta freshwater clam (*Corbicula sandai* Reinbardt). Daily growth line analyses indicate that 62% of these clams were collected in July and August, and 88% were collected from May through October. Nutshell remains were dominated by three taxa: acorns (genus *Quercus*), horse chestnuts (*Aesculus turbinata* Blume, 31%), and water chestnuts (*Trapa* sp. 28%). Acorn remains includes both deciduous oaks (*Quercus* subgenus *Quercus*) and evergreen oaks (*Quercus* subgenus *Cyclobalanopsis*), but 98% were identified as a single species of Japanese evergreen oak [*Quercus. gilva* Blume, also called *Cyclobalanopsis. gilva* (Blume) Oerst., Japanese name *ichii-gashi*]. In addition to shells and nuts, remains of fish (crucian carp: *Carassius*spp., carp: *Cyprinus carpio* L, bagrid catfish: *Pelteobagrus nudiceps* Sauvage, and catfish: *Silurus* spp.), reptiles (soft-shell turtle: *Pelodiscus sinensis* Wiegmann), boar (*Sus scrofa* L) and sika deer (*Cervus nippon* Temminck) were also recovered (Iba, 2000, 139–142).

The excavation of the Awazu site provided several lines of evidence to infer Jomon subsistence activities and their changes through time (Iba et al., 1999; Iba, 2000). First, archaeologists who analyzed the Awazu data concluded that the alternate layers represent seasonal cycles of subsistence activities by the Middle Jomon residents of this site: intensive shellfish collecting and fishing in the spring to early summer, and nut collecting in the fall. Judging from the evidence of intensive food-processing activities and the scarcity of pottery and other artifacts, it is likely that Midden No. 3 was a seasonal laboring site. Second, simulation studies of caloric estimates of excavated food remains indicate that the total estimated caloric value for Midden No. 3 is 20,210,775 Kcal, of which nuts represent 52%, fish 20.0%, shellfish 16.7%, reptiles 0.1% and mammals 10.8%. Third, results of this excavation suggest the importance of nuts in overall Jomon diet. In particular, an abundance of horse chestnuts (38.9% of the total estimated diet) indicate that, by the beginning of the Middle Jomon period, the Jomon people had mastered a sophisticated processing technology to remove the tannic acid. Finally, Iba et al. (1999, 143–144) suggest that changes in the nut assemblage from the Initial to the Middle Jomon periods were related to the climate and vegetation change: evergreen oaks that thrive in the warm climate replaced deciduous oaks (for the climate change during these periods, see Endo and Kosugi, 1989).

Higashimyo (Saga-shi Kyoiku Iinkai, 2006, 2008) is another excellent example of a submerged Jomon shell midden. Located in Saga Prefecture in northwestern Kyushu, Higashimyo is dated to the Initial Jomon period. Today, the site is buried under the alluvial deposit of the Saga Plain. During the Initial Jomon period, however, the site was on a low hill, facing the mouth of a river that flew into the Ariake Sea. The site is dated to ca. 5900–5700 BC (Nakamura, 2008). The end of the site occupation is marked by a marine clay deposit, which preserved Initial Jomon organic materials in anaerobic conditions. The first excavation from 1993 to 1996 yielded 167 burnt cobble clusters (probably remains of earth ovens), 19 stone tool clusters and 7 burials, as well as large numbers of potsherds and lithics. Most of these archaeological remains are dated to the Initial Jomon period. The second excavation, which started in 2003, revealed the presence of six shell middens, all of which are dated to the Initial Jomon period. Table 3 lists the estimated size of these six shell middens. Full-scale excavation of Shell Midden No. 2 and its surrounding area was conducted from 2004 to 2006 (Saga-shi Kyoiku Iinkai, 2006, 2008). In addition to the shell midden itself, over 158 storage pits were found. Many of these pits were associated with baskets, wooden vessels and other fibrous raw materials. The number of baskets was more than 700. There were also many wooden vessels and fibrous containers, presumably for storing nuts. The most abundant type of acorn remains was evergreen oak (*Q. gilva*), followed by a small amount of deciduous oak, such as sawtooth oak (*Quercus. acutissima* Carruth.), and walnuts (*Juglans* spp.). Some of the storage pits seemed to have been recycled to store raw materials for wood-working and basket-making. Although Jomon wood-working sites have previously been

Table 3
Size of the six shell middens at Higashimyo (Saga-shi Kyoiku Iinkai, 2008).

Midden no.	Long axis (m)	Size (m^2)
No. 1	30	300
No. 2	40	400
No. 3	20	200
No. 4	45	430
No. 5	15	40
No. 6	55	330+

reported (see Habu, 2004, 214–221), this site is currently the oldest example with a substantial amount of such remains.

In sum, the richness of organic materials from the Higashimyo site has provided archaeologists with an excellent opportunity to examine not only the exploitation of aquatic food but also diverse subsistence activities and food storage. Large amounts of baskets and wood containers demonstrate that the antiquity of sophisticated craft work goes back to the Initial Jomon period.

7. Discussion and conclusion

From the above, it is clear that Jomon shell midden archaeology has provided clues to answer several key questions in Japanese and world archaeology. The first issue is the beginning of intensive marine food exploitation and its consequences. Data from Natsushima, Mazukari and other Initial Jomon shell middens indicate that intensive exploitation of marine shellfish in Honshu go back to ca. 8000–7000 BC. This timing corresponds to the transition from highly mobile generalists (foragers *sensu* Binford, 1980) of the Incipient Jomon period to more sedentary specialists or collectors (Binford, 1980) of the Early Jomon period (see Habu, 2004: 245–252). It is likely that intensive shellfish collecting occurred as part of the rapid expansion of target food resources and following subsistence intensification during the Early Holocene. This does not imply, however, that shellfish and other marine food became the staple food during and after the Initial Jomon period. As discussed above, the contribution of shellfish to the Initial Jomon diet seems to have been limited. For the Early to the Final Jomon periods, there is no evidence indicating heavy reliance on shellfish or other marine food. Carbon and nitrogen isotope studies of Jomon skeletal remains suggest that terrestrial food dominated the bulk of the Early to Final Jomon diet in Honshu (Yoneda, 2010). These lines of evidence indicate that the importance of Jomon shellfish collecting was not its dominance in the overall diet or its caloric value. As pointed out by Suzuki (1986), a main advantage of shellfish is its seasonal abundance when other food resources were scarce. Results of growth line analyses at Satohama and Muro partially support this proposition. Equally importantly, shellfish collecting must have provided diversity in Jomon food and subsistence strategies, which helped decrease the vulnerability of Jomon subsistence-settlement systems to climate change and other disturbances. Thus, a failure in shellfish collecting could have caused a major problem in Jomon subsistence-settlement systems even if its caloric contribution was small. For example, the decline of shell midden construction in the western half of the Tokyo Bay and the following disappearance of settlement sites at the end of the Early Jomon period are suggestive of the critical role of shellfish in the overall Jomon foodways and subsistence activities.

Second, Jomon shell midden archaeology can contribute to an understanding of long-term changes in human-environment interaction. Discoveries of buried or submerged lowland shell middens, such as Mazukari and Higashimyo, have provided new data with which to reevaluate the impacts of Early Holocene marine transgression on people's lifeways and landscapes. Quantitative data of temporal and regional variability in the number of shell middens are excellent sources to infer long-term changes in the exploitation of aquatic food and its regional variability. An abundance of shell middens in the Tohoku and Kanto regions correspond to the higher density of Jomon sites in these regions than in the other regions. In this regard, one could make a general statement that aquatic food was important in the development of complex hunter-gatherer cultures in Tohoku and Kanto. On the other hand, the growth and decline of shell midden construction in these regions do not quite overlap with those of settlement sites. An abundance of Late Jomon shell middens after the decline of overall site density at the end of the Middle Jomon implies that shellfish exploitation was not negatively affected by the factors that caused a significant decrease in overall site density. Archaeological studies of changes in other aspects of Jomon subsistence-settlement systems, as well as analyses of climate data (e.g., Kawahata et al., 2009), will be key to develop models of long-term culture change.

Third, excavations of lowland shell middens, such as Awazu and Higashimyo, have revealed that the archaeology of submerged shell middens is critical not only for the study of aquatic food but also terrestrial food, especially nuts, and organic artifacts. Both Awazu and Higashimyo indicate the importance of nut collecting in the Jomon diet. In particular, data from Awazu helped archaeologists understand the seasonal cycles of both aquatic and terrestrial food acquisition.

Fourth, Jomon shell midden data shed light on the issues of resource conservation and human impacts on the local environment. Clam shell measurements at Muro indicate that the residents collected only large clams. This was interpreted as a reflection of their resource conservation efforts. Not all the Jomon shell middens show similar patterns of shell measurements, however. For example, Ishizuka's (2009) study of shell measurements of yamatoshijimi brackish clam (*Corbicula japonica* Prime) at 12 Early Jomon sites in Saitama Prefecture indicates that size selection occurred only in the early phase of the shellfish collecting, and that overharvesting eventually forced the residents to exploit all sizes of shellfish that were available in the area. In order to further pursue the issue of resource conservation vs. overexploitation, accumulation of similar data from other shell midden sites will be critical.

Finally, methodological developments in Jomon shell midden studies are also noteworthy. Excavations of Nakasawame and Satohama in Tohoku combined water-screening and flotation methods with their detailed stratigraphic approach to obtain quantitative data of ecofacts and artifacts. Excavators of the Isarago shell midden in Tokyo used arbitrary layers as their sampling unit to conduct simulation studies of the shell midden volume and caloric contribution of shellfish to Jomon diet. In both cases, the amount of information retrieved from these samples is enormous. When combined with other scientific analytical methods, such as AMS dating and micromorphology, these data can provide archaeologists with solid databases to infer changes in subsistence strategies with a fine-grained chronological scale.

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MALANGAN: ART AND MEMORY IN A MELANESIAN SOCIETY

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The article contributes to the anthropological study of art with the analysis of an ethnographic example well known to those working with museum collections and to anthropologists working on Melanesian societies. The art is known under the indigenous term as *Malangan*. It is a collective term for sculptures and dances as well as for the mortuary ceremony and ceremonial exchange. *Malangan*-art is ephemeral, left to rot, burned or sold to European visitors after the sculptures have been displayed on the grave and have been transacted as primary items of value in the exchanges. This article investigates the implications of impermanence for the transmission of the imagery embodied in the art. The imagery of *Malangan*-art is invisible for most of the time, recalled from memory for production, display and transaction in the concluding phase of the mortuary ceremony. *Malangan*-sculptures are reembodiments of memorised imagery, a fact which is both ethnographically and anthropologically interesting.

Approaches to non-western art and material culture are numerous and follow mainstream anthropological theory in their development. The subject has been treated by Layton in a recent work on the anthropology of art (Layton 1981). Two main trends in the analysis of non-western art, however, deserve to be mentioned since they have inspired the present analysis of Melanesian art. Following the concern in early writings with technique and form on the one hand and social and cultural content on the other (Boas 1955; Firth 1952), most recent studies aim to reveal the dynamic relation between these two (Forge 1970; Bateson 1973; Biebuyck 1973; Munn 1966; 1973; 1977; Strathern & Strathern 1972; Gell 1975; Lévi-Strauss 1983). Within a number of these studies is a concern with the relation between social and cultural reproduction which is especially central to recent and forthcoming work (Forge 1970; Munn 1973; Gell 1975 n.d.; Morphy 1984; n.d.).

This article develops a methodological and theoretical approach which takes a novel perspective on the dynamic and mutual relation of cultural and social reproduction by questioning the relation between the form given to art and the process of its transmission. This perspective is the conclusion of my own attempt to come to terms with ethnographic material collected in a Melanesian society and follows a line of enquiry which most recently has been argued by Sperber (Sperber 1985). Like Sperber, I shall ask how it is possible that the imagery embodied in the art has a continuity irrespective of the temporary existence of particular works (cf. Sperber 1985: 80). The question, however, is

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not why and how imagery continues, but what difference its mode of transmission creates in the appearance of the art. It is also suggested that a particular mode of transmission is historically specific and central to processes of social and cultural development.

The question of transmission is central to the art tradition known as *Malangan* which serves as example in this paper. *Malangan*-art is ephemeral, its objects being destroyed or sold to western art collectors soon after their public display. The imagery of the art, therefore, is not transmitted from one generation to the other through the preservation of material culture. Rather than being subjected to permanence or persistent innovation, objects are reproduced so that each is reminiscent of an object seen in the past. The imagery which characterises these objects is recurrent and stereotypic, but nevertheless varying to such an extent that no one object is the exact replica of the other. This tension between the redundancy and variability of imagery is anthropologically interesting, since such cultural objects are a product of the mnemonic processes of retention and recall. The generation of variability is embedded in performance and in a mnemonic technique whose application involves culturally elaborated cognitive operations. This technique is central to the capacity to reproduce works that are convincing and compelling in their visual appearance (cf. Gell 1985; n.d.).

An approach to such art cannot restrict itself to iconographic and contextual analysis, but has to ask for the properties of objects that are remembered and reproduced and for the relation of these properties to the mnemonic process. Constancy and variation in the art, therefore, will be analysed with respect to the mnemonic process and culturally elaborated cognitive operations. The concern with the interpretation of meaning adhering to the imagery will thus be replaced by an inquiry into the possibility of its reproduction.

The practices surrounding the transmission of imagery integrate linguistically and ecologically diverse areas into a region. It will be argued that the operation of the visual mnemonic system as articulated in *Malangan*-art is central to the development of such a regional social system.

The ethnographic material referred to in this article was collected during fieldwork in northern New Ireland, one of the islands in the Bismarck Archipelago in North-East New Guinea. Northern New Ireland is a subgrouping of the New Ireland-Tolai languages and comprises seven Austronesian languages spoken in geographically and ecologically distinctive areas on the island.[1] These areas are cross-cut by matrilineal clans that are scattered throughout the northern part of the island and are integrated into a regional form of social organisation through the operation of the *Malangan*-system.[2] The complexity of the *Malangan*-system has been discussed elsewhere and will thus only be mentioned when necessary in this article.[3]

Social history and cultural reproduction

Kinship and art are mutually related at all levels of complexity. One level where this mutuality can be recognised is language, another is the form given to art objects. *Malangan*-art is sculptural, its production being described as *tetak* or 'the

dissecting and joining of skins'.[4] The sculptures are conceptualised as 'skins' which replace the decomposed body of a deceased person and thus provide a container for the life-force (*noma*).[5] Absorbed into the artistic system, this life-force is rechannelled to the living in the form of power. This power constitutes political authority and is derived from the control over the re-embodiment of the memorised imagery into new sculptures. The right over the reproduction of the imagery of a sculpture is transacted in the ceremonial exchanges which accompany the display of the sculpture.

Malangan-art is thus in the widest sense a model of social immortality. This model evokes the independence of social reproduction from uncertainties embedded in marriage, birth and death. It does this by means of absorbing these events into the process of cultural reproduction. This process redefines as the source of the continuous situations that are experienced as introducing discontinuities into social relations. As model and medium of social reproduction, *Malangan*-art plays an active part in the manipulation and legitimation of inter-generational and inter-group relationships.

The destruction of sculptures immediately following their ceremonial display and transaction can be accounted for with this cultural simulation of processes of social reproduction. Like the human body after death, so the sculpture after it has been 'killed' in ceremonial exchange has to decompose to set free the force so that it can be rechannelled into people and sculptures. A modern version of destruction is the sale of objects to Europeans. The currency received from the sale is utilised for a further reproduction of the sculpture and is thus returned to the ceremonial system. As a result of this integration of interests generated in the art market into the indigenous system, European collections of these artefacts are rather large, dating from the earliest expeditions in the 1840's to the present day and comprising approximately 4,000 objects.

What is valued in this society is not the real sculpture, but the memory thereof. This memory is used in disputes over land and resources and in the legitimation of political authority. Value is thus not attributed to the objects, but to the memory of their imagery and to the right over their reproduction which is transacted in the exchanges. The greatest value is attributed to a form of ownership which is called *wun in e Malangan* or 'the source of *Malangan*', allowing the owner to produce an infinite number of sculptures. The term for 'source' can also be translated as 'womb' and as 'smoke', all translations referring to the reproductive capacity surrounding this ownership. The acquisition of this reproductive capacity is embedded in an exchange called *sorolis* that relates parts of the same matrilineal clan of different residence. Other restricted forms of reproductivity are transacted in exchanges called *arademe*, which is a sphere of exchange linking affinal matrilineal clans who have a history of inter-marriage and co-residence.

The imagery embodied in sculptures is reproduced after intervals of twenty to thirty years. The imagery of a sculpture, seen and acquired during the childhood of a deceased person, is reproduced for the final mortuary ceremony of that person. The artist is instructed how to design the object by another elder who shared with the deceased the right over the reproduction of the imagery. This claim over the right to reproduce imagery is proven by the knowledge of the

names carried by every sculpture and by the knowledge of how these names are related to the imagery of the sculpture. As in Eskimo society where the model of masks is derived from the transformation of the shaman's dream into the first mask of its kind, the artist in northern New Ireland is hired and does not know anything about the imagery he is asked to carve (Ray & Blaker 1975: 51). He is told about it in the form of names and is given plant ingredients which are meant to stimulate the appearance of the imagery in his dream. The common source of newly innovated and transmitted imagery in dream-work with its known mechanisms (condensation, displacement, overdetermination) accounts for the general affinity between art works of this kind (cf. Layton 1981: 179).

Changes in what will be referred to in this article as motif composition, however, are not just by-products of the repetition essential to dream-work. These changes are governed by the relation between recall and the grounding of its performance in the context. There is a relation between the recall of an image for transaction in a certain sphere of exchange and the shape given to the sculpture.

The interpretation of a sculpture is based on a recognition of what has been altered in its reproduction. A sculpture thus informs about the relationship between those currently transacting the rights over its reproduction. The production of history and the transmission and transformation of art in the mnemonic process are mutually related and it is on the basis of this relationship that *Malangan*-art attains its political and social significance.

Art and its mode of transmission are central to the social system as can be seen in the present expansion of the ceremonial exchange system over the region of northern New Ireland and beyond. One of the preconditions for the spreading of the *Malangan*-system is the sharing of a common conceptual framework that enables people of different languages and social settings to receive, interpret and transmit the imagery embodied in sculptures. This common framework for interpretation is visible thematically in *Malangan*-art. Sculptures are composed of motifs taken from the animate environment and ranging from representations of birds to shells. Motifs and motif combinations are recurrent and are named. Both motifs and names are standardised and do not vary considerably throughout the region in which the art is produced, nor have they significantly changed since sculptures first reached western institutions.

Representation

It is important, however, to realise that the non-random character of a sculpture does not derive its significance from its stereotypic representation of images taken from the lived-in environment. In the case of *Malangan*-art, representation has to be analysed in relation to the transmission of the imagery. Central to the ability to receive and transmit imagery in transactions of regional character is the sharing of a technique of cultural reproduction that allows sculptures to be interpreted in an informed and interested manner. The organisation and arrangement of motifs in sculptures vary in the history of their transmission and it is this variability of possible motif combinations that is subject to constraints.

It will be argued that these constraints cannot be accounted for with a contextual analysis of the art alone.[6] They are embedded in the operation of a visual mnemonic system.

Malangan-art has been the focus of numerous studies throughout this century.[7] By concentrating on particular sculptures produced at certain times an impression of infinite variability of the imagery was created, each sculpture being apparently singular in its significance and existence. For a sculpture to be recognised, accepted and thus to continue its existence in future reproductions, however, it has to comply with anticipations based on past experiences and on implicit modes of understanding. In need of further exploration is how combinations of motifs can be anticipated and interpreted in socially informative ways.

Visually, sculptures of the kind discussed in this article pay tribute to the thrill derived from discovering and playing with problems of combination (see fig. 1). Carved motifs and painted patterns overlap to leave the eye searching for clues which could uncover a hidden organisation. The instantaneousness of interpretation in the form of names by those familiar with the artistic system can be explained by the culturally elaborated technique that enables the generation of ever new combinations reminiscent of those seen in the past. The emergence of an artificial mnemonic system, of which *Malangan*-art is an example,

FIGURE 1.

facilitates the investigation of the dynamic interplay between cognitive and social processes in the interpretation and production of cultural representations.[8]

The existence and social significance of mnemonic systems is not only a feature of New Ireland society, but has been documented in the now classic study of the Iatmul by Gregory Bateson.[9] Names among the Iatmul in the Sepik river region of mainland New Guinea are remembered in their thousands and are recited in a particular order which led Bateson to suggest that their recall is based on higher mental processes rather than rote memory.[10] The recitation of names involves mnemonic techniques that are the basis of social differentiation and identification:

> Among the Iatmul definite efforts are made to increase the memory endowment of individuals, by means of magical techniques. Soon after birth, a male child is made to inhale smoke from a fire which has been bespelled, in order that the boy shall grow up to be erudite in the totemic names of his clan (1958: 221).

The significance of the naming system is recognised by Bateson not to lie in the facts remembered. Its significance lies in the development of artificial mnemonics, in the culturally specific stimulation of the cognitive machinery (Bateson 1958: 221). The order of reciting names is reproduced in every recitation and it is this order, rather than the names, which is subject to persistent and yet consistent transformation (Bateson 1958: 223). This order is shown by Bateson to correspond to the organisation of social relationships and of ritual activities.

Bateson's analysis of naming among the Iatmul as mnemonic system does make sense and explains why it would be fruitless to attempt an interpretation of each name taken in isolation. When turning to art objects, however, such an approach can only be accepted with difficulty since it contradicts the assumption of the particularity and value of the object on which western art appreciation is based. It will be proposed, however, that *Malangan*-art is generated like a string of names recited by Iatmul men. It is a tool that enables the retention and recall of socially relevant information, but it is not representational in the sense of depicting the information to be remembered. The cultural elaboration of a visual mnemonic system is unusual in Melanesia and must be situated within the historical development of the regional social system characterising present-day New Ireland.[11]

Constancy and variation

Mnemonic techniques are informed by cognitive tools that are specific to a culture and its social history (Neisser 1976: 134). The statement that 'higher mental processes are primarily social phenomena' has only recently been given recognition in psychologically oriented studies (Neisser 1976: 134). It is, however, firmly embedded in the conclusion drawn by Bartlett based on experiments described in his work on 'remembering' (Bartlett 1932). Bateson's study of Iatmul society is heavily influenced by this work, and he reports having taken the volume with him to the field (Bateson 1958: 222). Bateson's book,

moreover, appeared a few years after the first edition of a work by the French scholar Maurice Halbwachs, who became known mainly through this study of 'the collective memory' (Halbwachs [1950] 1980). This is not the place to trace the influences on Bateson's work, but it is interesting that both authors' insights into the cultural elaboration of memory have been largely ignored in anthropology to the present day. This article attempts to resurrect some of these insights and to apply them to the analysis of a cultural system that distinguishes itself from the naming system of the Iatmul in being explicitly concerned with the processing of visual imagery.

Like the order which Bateson isolates in spells, songs and speeches, motifs and their combination in *Malangan*-art undergo a slight, but continual variation every time a sculpture is reproduced (Bateson 1958: 223). Both for the Iatmul and for the people of New Ireland, the totality of names and motifs comprises a stock of knowledge that is the basis of social integration and differentiation. While all aspiring young men know, only the elders can recite names and talk in an informed manner about motifs adhering to sculptures (Bateson 1958: 227). Contrary to oral traditions such as the naming system of the Iatmul, however, the order to be uncovered in *Malangan*-art unfolds diachronically and can be studied on the basis of the ethnographic collections which extend over one hundred years. The order and its transformation, which can be elucidated from the analysis of such collections, thus adds a historical dimension to the synchronic study of naming as undertaken by Bateson among the Iatmul. Like Bateson, however, I shall follow Bartlett's recognition that the order or 'scheme' underlying a succession of reproductions of visual information is 'an important factor in what makes remembering possible' (Bartlett 1932: 81).

Of the thousands of sculptures stored in museums, not one can be said to be a replica of another one. Not one sculpture, however, differs so much from the others that it would prohibit the ease of identifying the sculptures, experienced even by the innocent visitor to an ethnographic collection. Where the outsider sees just a general likeness, the informed can recognise distinctive sets among *Malangan*-sculptures.

To define what constitutes the general likeness and distinctiveness of these sculptures I want to draw on the interpretation of a western artist in a work of modern art. The comparison between a work of modern and of non-western art aims to highlight what appear to be the recurrent structural features of *Malangan*-art and does not imply an affinity between the 'modern' and the 'tribal'. The work chosen for this task is a sculpture made by the surrealist artist Alberto Giacometti, called the *Cage*. The *Cage* was produced by Giacometti in 1932 and might have been informed by his knowledge of *Malangan*-art. It is possible that he was familiar with the art from collections of his surrealist colleagues and from the collection of his patron Joseph Mueller.[12]

Visually, one can discern a relation between the *Cage* and *Malangan*-art. Both are spatially complex and are intricate in their design. In both, this complexity is achieved by surrounding the figurative elements with thin, parallel rods which are connected by short bridges. In Giacometti's work, unrelated shapes are seemingly arbitrarily juxtaposed. This juxtaposition is found in *Malangan*-art in the relation between motifs and painted patterns. The

juxtaposition in both has the effect of denying the three-dimensionality of the sculpture.

Both works, moreover, give the impression of being disjointed, their shapes seemingly being detachable and being thematically independent of the main body of the sculpture. In *Malangan*-art this visual impression is achieved by the technique of making sculptures. Wooden sculptures are composed of a number of motifs that are carved in separate pieces of wood and later joined, together with items taken from the flora and fauna. Moulded or woven sculptures, conversely, have wooden motifs attached to the main body of a work. This compositional character of *Malangan*-art is crucial to its embeddedness in ceremonial exchange. Several social units can have rights over the reproduction of different components of a memorised sculpture as a result of their co-operation in the mortuary exchanges that surround the production and exhibition of sculptures. The knowledge of the relation between the components to a more encompassing image is used in disputes over inter-personal and inter-group relationships. The correspondence between formal properties and social processes of integration and fragmentation in the society producing *Malangan*-art is represented in an abstract sense in the *Cage*, whose shapes could be removed and replaced by others without changing the overall appearance of the sculpture.

Giacometti's interpretation of *Malangan*-art isolates two formal properties persisting in the sculptures to the present day. The name given by Giacometti to his work, the *Cage*, is a pointed characterisation of the tension persisting between the properties of constraint and fragmentation that govern the reproduction of *Malangan*-art. *Malangan*-art can be described as a puzzle whose components can be removed or new ones added within the confines of an all-encompassing image.

The tension between constancy and variation in *Malangan*-art can be understood as a property of the mnemonic process to which sculptures are subjected in the course of successive reproductions:

> In a chain of reproductions obtained from a single individual the general form, the outline, is remarkably persistent, once the first version has been given . . . At the same time, style, rhythm, precise mode of construction . . . are very rarely faithfully reproduced (Bartlett 1932: 93).

The relation between art and memory specific to this material is, however, not merely retrievable through analysis. The tension between constancy and variation which is articulated in Giacometti's interpretation in the sculpture the *Cage* is articulated by those who produce *Malangan*-art. The polysemic term for the generative capacity of *Malangan*-art situates images of reproduction within diverse social experiences and thus creates a notional relation between them. These experiences combine visual and cognitive elements such as pregnancy, smoke and flowing water (cf. Küchler 1985). *Malangan*-art has thus a cognitive efficacy in selecting, ordering and organising experiences in a socially relevant manner.

Every sculpture, either memorised or presently seen, is thought to have been produced out of *wune*, a polysemic term which is translatable as 'source', 'womb' or 'smoke'. Throughout this article I will use the term 'template' to

capture the double character of the indigenous concept, that of generation and structure (cf. Morphy 1977; 1984; see also for alternative terms: 'family' Wilkinson 1978; 'genera' Gunn n.d.). The concept of template was developed by Morphy in his study of Yolngu art where he refers to it 'as a structure of possible relationships between sets of things, which generates both alternative paintings and alternative interpretations of them' (cf. Morphy n.d.).

The imagery, which relates successive reproductions of sculptures, is invented in dreams and is talked about in the form of myths. Nine named types of imagery or 'templates' are currently known throughout the region, but many more are restricted to particular localities. These nine known over an ever increasing area have spread as a result of the ceremonial transactions of the right to reproduce their imagery in sculptures. The mythical themes associated with the templates are articulating issues of social continuity and reproduction. These themes are: 'the relation between fire and culture', 'the relation between brothers and sisters', 'ecology and social differentiation', 'warfare and social migration', 'rain and the productivity of land', 'the relation between people and place', 'mortality and the continuity of the clan', 'the manifestation of power' and 'the process of growth'. Myths pertaining to these themes are not told except with reference to *Malangan*-templates and to the imagery of the art. Every 'template', moreover, is known under a name associated with a particular location where the imagery is believed to have been transformed into sculptural form for the first time. Those who claim the right over the reproduction of a sculpture have to be able to relate the imagery to a mythical theme and to trace a relationship between the location of its innovation and its present reproduction.[13]

The generality of the themes facilitates the ease of fitting new variations into an existing conceptual scheme. It enables, therefore, the continuing boom in the production of sculptures for ceremonial exchange. The generality, however, also leaves its mark in the formal properties of the art. Not only the motifs, but their arrangements in a sculpture are recurrent in sculptures collected over the past century. This standardisation is one of the effects of the mnemonic process as recognised by Bartlett:

> With frequent reproduction the form and items of remembered detail very quickly become stereotyped and thereafter suffer little change (1932: 93).

Every template is known to have a number of motifs reappearing in stereotypic form and combination. The template *Walik* is the most widespread and most easily recognisable in its sculptural forms. Its sculptures have either one of the following two motifs: one called *medane hede*, or the 'eye of the fire', the other *mamaze*, or 'Palolo worm'. Each of these motifs is composed of a number of parts that are either carved into wood or painted over a carved surface. 'The eye of the fire' is a round dotted area with the part of a shell (Turbo petholaurus) in its centre. It also has a raised section comprising two further components, a half moon and a water stopper. The 'Palolo worm' is depicted with minute incisions, with the resulting planes being painted in the colours red, black and white (see fig. 2).

The fire is a metaphor of the life-force and is extinguished immediately after

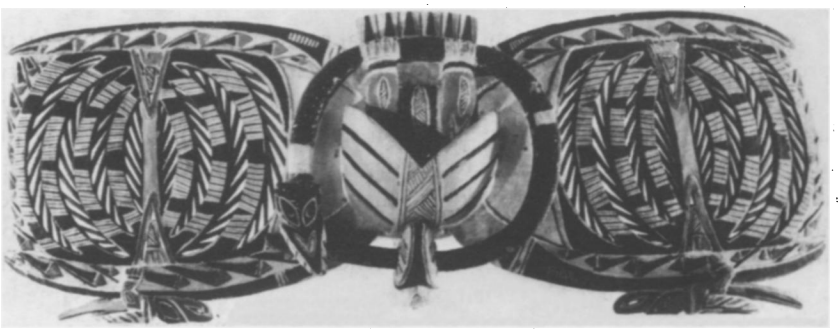

FIGURE 2.

the death of a person. Each stage in the mortuary cycle, which culminates in the performance of the *Malangan*-ceremony, is named after a stage in the process of building up a fire from ashes (*mat*) to glowing heat (*malang*). These stages trace the growth of the life-force until it is absorbed into a sculpture and channelled into the reproductive *Malangan*-system. The Palolo-worm is associated with the growth of the life-force in living beings. Throughout the South Pacific region, the Palolo-worm appears for mating during one night in the year in the lagoon and is fetched in containers. In the early morning after this event, children are taken to the sea and bathed in the water in which the *mamaze* had been mating. The eating of the Palolo-worm and the bathing in the water from which it has been fetched is thought to produce 'heat', which is like the 'heat' generated in the mortuary ceremonies, an expression of a vibrant life-force. The embeddeness of the motifs in common experience enables them to appear together in a single sculpture and to refer to a single template.

For a motif to persist throughout successive reproductions it has to fit these requirements of both generality and simplicity. There are about twenty such named motifs, some of whom are associated with a particular template while others can be shifted from template to template. With every reproduction of a sculpture and its recall from memory, the selection and combination varies in a manner that is conscious and articulated with reference to the practice of ceremonial exchange. Irrespective of whether a motif is replaced by another one or omitted, however, the arrangement of motifs in a sculpture remains constant. The hornbill, for example, is always carved on top of the head of a wooden sculpture, the drongo along its sides and the owl at the bottom. The owl can be replaced by a cornshell, the head of a fish or the head of a pig, while the hornbill

can be replaced by an eagle, a fishhawk or a chicken. The use of certain motifs such as birds, snakes and fish is locality-specific so that the transference of rights over the reproduction of a sculpture between places leads to an alteration of the motifs without changing their combination and arrangement in subsequent reproductions.

Alterations and omissions of motifs undertaken in the process of reproduction express particular kinds of relationships between the present and the future beholder of the sculpture. Omission attests to a relationship of dependency in relation to the use of land, while alteration reflects a dependency between the transacting parties which pertains to the organisation of mortuary ceremonies. The mutual relationship between those sharing the memory of a sculpture is articulated also in the pattern painted over the carved or woven surface of a sculpture. This pattern can only be altered when the right over the reproduction of a sculpture is transacted between parties who do not cultivate the same land and who do not co-operate in each other's mortuary ceremonies.

The relation between the potential range of motifs suggested in a template and their specific selection and arrangement in a sculpture is described as a song whose text differs from place to place, but remains recognisable in its rhythm and melody. Each localised community of two or more sub-clans who share a single cemetery has rights over the reproduction of several named sculptures. Only a few, however, have rights over the generation of variations upon the imagery suggested in a template. In theory such a control over the capacity to produce variations is vested in certain matrilineal clans. In practice, however, such rights change hands every other generation. The extinction of a sub-clan claiming such rights leads to the immediate absorption of the knowledge surrounding the imagery by a co-resident sub-clan and to the forgetting of the relationship between template and clan as it obtained in the past. This process of forgetting and shifting the rights over templates from clan to clan and place to place is an ongoing one. Since the control over a template implies also the control over the cemetery and over the ceremonial activities directed to this place, the scattering of the rights over the template plays a vital part in social processes which impose their character on inter-clan relationships.

The production and processing of memory is thus intimately connected with attainment and maintenance of power and authority. The past is encapsulated in sculptures, but it is an interpreted and constructed past, because of the temporary and reproduced character of sculptures. The mnemonic process and the production of history are thus mutually related processes. Mnemonics, however, is not merely a mental phenomenon that enables the retention and recall of information. The organisation and structure of its operations is conditioned in a learning process and thus open to social and historical influence.

Memory as artifice

Given the social relevance of the production and processing of memory, it should be no surprise that the method of memorising in New Ireland has gone well beyond the untrained capacity to remember. The technique used in remembering visual imagery appears not to be culturally specific, since it is

documented for a number of societies. The effectiveness of this technique seems to lie at least partially in its correspondence to the cognitive requirements and operations of the mnemonic process.[14]

This technique is the 'method of loci', which is known to have been practised by Greek and Roman orators for the memorising of speeches (Yates 1978: 20–1). It is described in a classical text known as 'ad Herennium', compiled by an unknown teacher of rhetoric in Rome between 86–82 B.C. (Yates 1978: 20). The 'method of loci' involves a number of cognitive operations, which relate a word with an image and the image with a particular spatial location:

> The artificial memory is established from places and images, the stock definition of which is repeated forever down the ages. A 'locus' is a place easily grasped by memory, such as a house, an intercolumnar space, a corner, an arch or the like . . . Images are forms, marks or simulacra of what we wish to remember . . . The art of memory is like an inner writing. Those who know the letters of the alphabet can write down what is dictated to them and read out what they have written. Likewise, those who have learned mnemonics can set in places what they have heard and deliver it from memory (Yates 1978: 22).

The 'method of loci' requires the learning of a cognitive map with enough distinct 'loci' (Neisser 1976: 137). It is a mnemonic system whose universal effectiveness is explained by Neisser with its capacity to anticipate information not then available:

> Our image of an object in a particular place is simply a readiness to pick up information specifying the object when we get to the place. Anyone familiar with a particular environment has a cognitive map in which the schemata of many individual loci are embedded and can anticipate what he would see at each of these places in turn. Anyone can change a cognitive map on the basis of verbal information and later give verbal descriptions of what he is ready to see, can use the Method of Loci to organise and recall arbitrary lists (Neisser 1976: 137–8).

The use of spatial patterns in mental processing is thus a particular property of mnemonics. The choice of what Neisser calls the cognitive map, however, is culturally specific. Using the example of *Malangan*-art, I contend that this map is developed in a dynamic relation with social processes and practices that surround the organisation of space and time (cf. Gell 1985: 273).

The concern with the moulding of space and the confounding of time in New Ireland culture is visible in the sculptures and in the settlement pattern. Both are at once of great complexity and yet highly stereotypic in terms of the layout and arrangement of parts within a larger complex. The significance of space appears also in the structuring of inter-generational relationships. The relationship between localised units of a matrilineal clan is apprehended in terms of places and movements of people between places so that genealogies take on the character of a map of the landscape as known to the New Ireland person.

The cognitive map pertaining to intra- and inter-clan relationships and to *Malangan*-art utilises the framework of the house and the tree as 'loci' for the placing of imagery. This common choice of 'loci' reflects the kinship-based organisation of the *Malangan*-system. It enables sculptures to be about relationships without actually representing any particular social unit.

Tree and house are two possible 'loci' for the placing of imagery and are used with varying emphasis in geographically distinct areas of New Ireland, namely

the mainland and the Tabar island to the north-east. Myths claim the innovation of *Malangan*-art on the Tabar islands from where the imagery spread through exchange to the mainland of New Ireland. To the present day, Tabar island uses predominantly the structure of a house for 'loci' in mnemonics, while the mainland population employs the structure of a tree.

Houses are built out of wood, bamboo and sago leaves. While they appear to be fixed and static in character, a study of settlement patterns shows that the movement of house-sites is related to social processes that are initiated with the death of a person. When a person dies, the house he or she had occupied is destroyed, replaced by cooking houses during the *Malangan*-ceremony and thereafter transformed into a part of the secondary forest which edges around each settlement. Years later, a new house is built at the spot where the old one had been by someone who can claim a relationship with those who are remembered in connexion with this location. The house itself is central to the mnemonic process which transmits information about relationships from one generation to the other. It lends itself, therefore, to the active process of fitting which accompanies the recognition of sculptures and their retention in memory.

Imagery, which is carved into sculptures, is both visually and conceptually placed into the structural components of a house. When a dreamt image is first given shape in a sculpture after its innovation, it is given a vertical form and called 'post' (*eikwar*). As a result of the transaction of the imagery in the exchanges and the spreading of rights over the reproduction of memorised sculptures, later manifestations take on a horizontal shape and are called 'beam' (*kobokobor*). Imagery which has been transacted for a considerable time is likely to take on most freqeuntly the shape of a figure, and is identified as 'support'. The transformation of shapes and transference from one 'locus' to the other results from the reproduction of imagery for transaction in the sphere of exchange that links units of the same matrilineal clan, but different residence.

When the finished sculptures are exhibited they are placed in the raw framework of a house erected for this purpose in the cemetery. The shape of these houses can vary between a pig's shelter, caves and trees and house-like structures of extreme height. The placing of the sculpture in such a house accompanies the mental process of fitting which leads to the recognition of a sculpture and to its continuing processing in memory.

The use of the tree as the basis for 'loci' on the mainland is a logical development of this technique, inspired by the social transformations that accompany the spreading of the *Malangan*-system across geographical and linguistic boundaries. The dispersion of the imagery in the course of its reproduction and transaction in the exchanges follows the 'roads of marriage' and thus integrates distinctive linguistic groups into a region. Every clan is capable of recalling a list of place names irrespective of their distance and of reciting how members of the clan came to move from a mythical birth place to all the places inhabited by the clan today. The scattering of the clan is a distinctive mainland phenomenon and it is also only here that political units and sculptures are classified in accordance with the structure of a tree. Contrary to the house, the image of a tree suggests the process of continuing growth and reflects upon the experience of the progressively expanding network of a clan.

Both the clan, in its today merely imaginary unity, and the sculpture, in its complete embodiment of the template, are referred to as 'stem' (*wai*). It is not possible, however, to find on the mainland sculptures of a vertical shape, a fact attesting to the relation between social processes and the transmission of imagery in ceremonial exchange. When a sculpture is recalled for transaction between social units who have a history of ritual co-operation, but are not co-resident, its reproduction is given a horizontal shape and is called 'branch' (*iaiaran*). After its transaction and destruction, the imagery is retained in memory as part of a 'branch' and recalled either as a sculpture corresponding to the same 'loci' or to the subordinate 'loci' called 'leaf' (*bai*). Rights over the reproduction of sculptures of figurative shape integrate less encompassing units which usually do not extend beyond the village.

It is significant that only wooden sculptures are capable of being transformed in the manner just described. Templates, which specify the use of bush material and clay, are used for the production of sculptures only when it is certain that the image will not be transacted between units resident in different places. Their imagery is remembered by means of being placed into a map composed of spirit places (*masalai*) that are represented in the landscape by tall trees, rocks or springs. Spirit places have in common that their outstanding features are not created by people, contrary to settlement-places that are marked by planted trees and other remnants of human productivity. The 'loci' accommodating such imagery are thus unrelated to the social and political organisation of the regional social system.

The complexity of the mnemonic technique surrounding the reproduction of wooden sculptures is crucial to the escalation of ceremonial exchange and the development of regional forms of organisation.[15] Both are governed by a shift of the primarily oral transmission of myth to a visual medium which historically is situated in a period characterised by the break-up of communities through warfare. The interest of traders arriving in the late seventeenth century in land certainly contributed to the increase in the frequency and vehemence of warfare. Traders, however, also introduced iron tools and thus furthered the production of sculptures for peace-making transactions. In northern New Ireland, there is no indication that warfare had to be stopped by the intervention of the colonial administration. Relations between localities, once created through the theft of women in war, were then and are still today retraced in the transactions of sculptures in the context of ceremonial exchange.

While this relation between art and memory is distinctive to the ethnography of northern New Ireland, it nevertheless shares with other Melanesian societies a naming system. It is not the case that one has replaced the other, but that both the visual and the naming system have merged in a manner peculiar to New Ireland culture. It is possible to suppose that the vanishing of the clan as a social unit initiated the change and led to the development of strategies which lend themselves more readily to alternative ways of social integration. By coming to share the memory of a wooden sculpture, the people of New Ireland perceive their relatedness in terms of, and yet independent from, the clan based kinship organisation. Sculptures, unlike names, are 'real' at least for the time in which

they are produced and seen displayed in the cemetery and thus enable the legitimation and manipulation of current interests.

Naming and serial reproduction

A single sculpture is associated with three names, one denoting its template and the place of its innovation, the second its mnemonic position or its stage in the history of its transmission, while the third denotes the selection and combination of motifs. Throughout successive reproductions of imagery, names given to its manifestations accumulate and vary. The third name, the name indicating the particular combination of motifs specific to individual sculptures, varies every time a sculpture is reproduced. The second name, associated with the shape given to the sculpture and its mnemonic position, is only altered when the transmission involves a transference of rights from one localised unit to another within the extended matrilineal clan. The name indicating the relation between a sculpture and a template, however, remains constant throughout the history of its transmission.

The names carried by a sculpture can thus be distinguished in terms of the variability of the imagery to which they refer. I am thus going to talk about first, second and third order names and indicate how this order, articulated visually in the art, corresponds to a pattern of social differentiation.

The third order name given to a sculpture defines the motif combination and selection peculiar to the individual object and is the only name which a sculpture shares with a person. All personal names are names which once had been attached to sculptures and which aid their recall from memory. In theory, a person is capable of making a sculpture which corresponds to the name the person received at birth. In practice, however, only those who receive the name of a sculpture at the time of its ceremonial display and transaction have the right to reproduce and transmit the imagery addressed in the name.

There are various named combinations of motifs that evoke a relationship with a certain named template. Imagery innovated in dreams on Tabar island is associated with motif-names of a distinctive Tabar kind. Names shared by people and *Malangan*-art on Tabar islands are different compared with those found in the northern part of the mainland of New Ireland. Both Tabar island and northern mainland names, in turn, are different from names found in the central and southern area of the island.

The third order names are thus grouped together under the name of a template such as the one known as *Mendis* which is thought to have been dreamt on the northern Tabar island called *Simberi*. This clan is today scattered over the region of northern New Ireland. Individual names associated with this imagery are found at present on the north-west coast of New Ireland, carried both by people and by memorised sculptures. The sharing of the same imagery and name among people of these distant locations institutes a relatedness that is periodically transformed into kinship ties through marriages. Relationships of this kind are analogous to clan-based relationships, but can be turned into affinal

relationships and thus potentially serve to expand the network of ceremonial activity available to a localised community.

The second order name given to a sculpture refers to its mnemonic position. The sharing of the right to reproduce imagery reflecting a particular second order name attests to a politically effective unit based on existing ties of ceremonial cooperation. There are different names for vertical, horizontal and figurative sculptures produced out of the template *Mendis*. One of these positional names is *Mandassonga*, one of several names given to a horizontal manifestation of the template. The sharing of imagery referred to as *Mandassonga* obligates people of distinctive linguistic and geographical localities to co-operate in each other's ceremonial occasions and exchanges.

While the second order name unites people of different localised communities on the basis of co-operation in ceremonial work, third order names are shared by a territorially and politically restricted unit. Both, however, evoke a relatedness analogous to, yet independent of, relationships established through marriage and birth.

The differentiation and relation established between names allows for the integration of a person and community in ever more expanding networks of ceremonial activity. The boom in the production of sculptures for ceremonial exchange during this and the past century is visible in the museum collections. It is also evident in the number of third order names associated with particular motif combinations that are utilised at present for the reproduction of sculptures of specific mnemonic position and template. The capacity for recombination of imagery in the course of its transmission has developed in the context of the dissolution of the clan as an entity whose unity can be experienced. The mnemonic technique and articulation in the naming and visual system constitutes an alternative mode of social integration, which enables the transformation of the process of fragmentation and dissemination into a process of progressive incorporation.

Patterns of social organisation are not just articulated in art, but constructed through it. The alteration of names, for example, effects significant changes in the reproduction of visual imagery from memory which, in turn, evokes complementary changes in social relationships (Bartlett 1932: 185). Because of the embeddedness of art in the memory process, explorations of this dynamic relation between naming, imagery and social relations are possible.

NOTES

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[1] Beaumont 1972.

[2] New Ireland has been the subject of a number of ethnographic studies. *Malangan*-art and ceremonial exchange is recognised by all studies to be a social institution of great centrality. *Malangan*-art is transacted in the last ceremony of the mortuary cycle and is produced specifically for the purpose of being displayed on the grave of a deceased person. The transactions of *Malangan*-art

are carried out predominantly by the population of the northern part, yet researches in central and southern New Ireland indicate the gradual expansion of the ceremonial exchange system (Brouwer 1980). The three areas of the island are nevertheless distinct culturally, ecologically and in terms of social organisation.

[3] The relation between exchange and the production of sculptures is analysed by Lewis in 'the social context of art in northern New Ireland' (1969). The relation between spheres of exchange, kinship and the classification of sculptures is the theme of my Ph.D. thesis based on material collected during fieldwork in north-west New Ireland.

[4] All indigenous terms used in this article are taken from the Kara language spoken in the centre of northern New Ireland. The concepts articulated in these terms do not vary within the region in which *Malangan*-art is produced in the manner described in this article.

[5] Gerbrands 1967; Leenhardt 1979. The use of sculptures as replacements for the body appears to be a phenomenon of Austronesian speaking populations, while the decoration of the body and notions concerning skin seem to be more dominant in non-Austronesian speaking areas (Strathern 1972).

[6] This argument is developed by Sperber 1985.

[7] Kramer 1925; Groves 1933; Lewis 1969; Billings 1972; Lomas 1973. These are only some of the main works produced over the last sixty years on northern New Ireland. In all one can find reference to a number of sculptures which are reported to have been produced at the time of the research. How sculptures are related to social units became an issue in the late 1970's when enough evidence existed for the use of sculptures in land disputes and political processes (Billings 1972; Lomas 1973; 1979; Wilkinson 1978).

[8] See Neisser: 'The higher mental processes are primarily social phenomena, made possible by cognitive tools and characteristic situations that have evolved in the course of history' (1976: 137).

[9] Bateson 1958.

[10] Bateson 1958: 223.

[11] See also Bateson: 'processes of recall and processes of thought seem to have contributed to the maintenance and development of complexity in the Iatmul culture' (1958: 222).

[12] Rubin 1984: 516. For insights into the relation between this work by Giacometti and *Malangan*-art I have to thank Dr A. Grieve of the University of East Anglia.

[13] The use of imagery in political discourse has been discussed recently by Wagner for the Barok of southern New Ireland (1986). The Barok are not participating in the ceremonial exchange of *Malangan*-art, but practise *Tumbuan* which is a masking and dance tradition generic to southern New Ireland and New Britain. In 1983, however, it came to my notice that one village had acquired rights over the reproduction of a *Malangan*-image as a result of a marriage between a woman from the North and a man from Siar.

[14] For the requirement of order in mnemonic processing see Neisser 1967.

[15] The escalation of ceremonial exchange systems appears to have been a widespread phenomenon in post-colonial Papua New Guinea (Gregory 1982). Not in all areas which have experienced such an efflorescence of traditional economy, however, can one trace the development of forms of social organisation which are distinctively regional.

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