INFORMATION IS ALIVE

Art and Theory on Archiving and Retrieving Data

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▫ V2_/NAi Publishers

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Joke Brouwer and Arjen Mulder

Since the dawn of recorded history, social and cultural memory have been organized in two ways: either in a material form (tablets, books, objects) or as immaterial 'information' (personal memories, collective stories, songs, dances, rituals, celebrations, games). Ever since the invention of writing, the logic of material memory-systems, such as historical archives and administrative records, has prevailed. These archives were ordered linearly – either hierarchically or through a grid – and were aimed at control – both of the recorded items and of the people and processes that these recorded items stood for. Next to these stiff and stable archives there have always been flexible and unstable archives of what one can call 'immaterial information' that followed a different rationality – the labyrinthine, fuzzy logic of oral culture, that is, a culture without written records. Stories change when told, and they keep changing as long as they are told, just as with personal memories. Songs and dances are rather stable, but allow for personal interpretations also.

With the recent introduction of digital databases we seem to be witnessing a shift. What used to be material archive-systems have become immaterial infor-

□ *Every - Thought*

The number of possible thoughts is determined by calculating every possible pattern of brain activity.

neuron = smallest decision unit
neurological pattern = collective condition of neurons in the brain
thought = collective condition of neurons
possible conditions of a single neuron: firing or not firing (v) = 2
number of neurons in brain (c) = 100,000,000,000
$e=v^c$ (e = every possible permutation, v = number of variations)
every-thought (e) = $2^{100,000,000,000}$ possible thoughts
rate of thought during waking hours (10 per second) = 36,000 thoughts per hour
rate of thought during sleeping hours = 3600 thoughts per hour
number of thoughts per day = 604,800 thoughts per day
average number of thoughts per lifetime = 114,847,771,860,000,000 thoughts

percentage of possible thoughts experienced over lifetime =
$100 \times 114,847,771,860,000,000/(2^{100,000,000,000})\%$

Source: http://every-thing.net/everything_ns/ □

mation-banks. Unlike classical archive forms, recent digital databases need not be ordered linearly – grid-like and hierarchically. They are made accessible through complex linking technologies which no longer work linearly, as they still did in old-style computers, but as random and non-linear as you like. Search engines can be designed to find the proverbial needle in the haystack, or even to create a haystack where there are only needles, that is, build patterns where there seemed to be only fragments. Intelligent agents, or knowbots, can link information in a way you never thought of yourself, while expressing your very own interpretation of the world. As soon as new information enters a networked database, the structure of the database can reorganize itself, just like old songs change over time with changing audiences and changing social, political or cultural circumstances. Flexibility and instability have become technical qualities instead of problems to be controlled. Digital archives are unstable, plastic, living entities, as stories and rituals were in oral cultures.

The value of what is stored in databases lies in how it can be used in the present, and in its operationality rather than its meaning. We reuse and recombine our past to create the world as we know it. Memory is a process that functions in the present and is continually updated through that mode of functioning. Research into the neurological, social, cultural and evolutionary functions and processes of memorization and information storage can provide models and tools for understanding the possibilities and limitations of nonlinear archiving, because all this research is about lived archives of habits and practices that are continuously being broken down and rebuilt. The atomization of the archive in the database has made the whole Art of Memory into a technological, interactive art that suddenly becomes a highly urgent topic. In the first place, for all those institutions that feel the need to 'open their archives', secondly for all those who describe and study modes of being, and thirdly for all those who design and use our new archives, be it books, websites, cities or the like.

□ *Scripts and Alphabets of the World*

Amharic script, Analytic script, Arabic script, Aramese alphabet, Armenian script, Bái-hoeà, Birman script, Boustrophēdon, Brahmi, Braille, Character script, Cherokee script, Chinese script, Coptic alphabet, Cretan script, Cyrillic alphabet, Demotic script, Devanagari script, Etruskian script, Fenician script, Finger alphabet, Glagolitic alphabet, Gothic alphabet, Greek alphabet, Gupta, Han'gul, Hebrews script, Hieratic script, Hieroglyphs, Hieroglyphic A, Hieroglyphic B, Hiragana script, Hittitic script, Ideographic script, Indus script, Japanese script, Katakana, Kharosthi, Kuchan, Kufic, Korean script, Latin alphabet, Linear A, Linear B, Logographic script, Maya script, Meroitic alphabet, Mnemotechnic script, Moon script, Numidic script, Ogham alphabet, Pahlavi, Pictographic script, Pinyin, Proto-elamitic script, Putonghwa, Runic alphabet, Russian alphabet, Sign language, Cuneiform script, Syllable script, Tifinagh, Ugaritic alphabet, Uncial script, Wen-jén.

Source: Languages of the World by Herman Boel □
http://users.pandora.be/hermanb/languagesoftheworld.htm#Schriften

The central theme of *Information is Alive* is the exploration of artistically significant and technologically unexpected developments that may arise through the storing, linking, reprocessing, transforming and complexification of data (or perhaps material) which otherwise would simply have remained as raw information. This book plunges into data flows from all kinds of disciplines that study archives: paleontological, cultural, political, sociological, historical, artificial, neurological, artistic ... In an information society there is no position outside of the flows, an external position from which you can criticize or transcend the flows. But joining in different flows at the same time creates the possibility of networking streams of material and immaterial data, so as to create an awareness of where we are and what we can do. We do not live in a society that uses digital archiving, we live in an information society that *is* a digital archive. Understanding the world means understanding what digital databases can or cannot do.

□ *Population Density – Persons per Sq Km*

1	Macau	20,824.38	15	Mauritius	639.03
2	Monaco	16,486.67	16	Barbados	602.77
3	Hong Kong	6,571.14	17	Nauru	505.00
4	Singapore	5,539.77	18	Korea, South	477.49
5	Gibraltar	4,486.92	19	Netherlands	466.45
6	Gaza Strip	3,090.71	20	Puerto Rico	433.94
7	Vatican City	1,977.27	21	San Marino	417.68
8	Bermuda	1,249.44	22	Tuvalu	407.23
9	Malta	1,192.51	23	Mayotte	398.23
10	Bahrain	1,014.66	24	Martinique	388.24
11	Maldives	1,000.73	25	Marshall Islands	361.32
12	Bangladesh	949.28	26	Aruba	355.83
13	Jersey	773.46	27	Saint Vincent and the Grenadines	354.47
14	Taiwan	685.47	28	Lebanon	348.26

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

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Arjen Mulder is a biologist and media theorist and has published several books of essays on the relationship between technical media, physical experiences and belief systems. He is the writer of *Het fotografisch genoegen* (1999), *The Book for the Electronic Arts* (with Maaike Post, 2000) and *Levende systemen* (2002). Together with Joke Brouwer, he edited *TransUrbanism* (2002).

Population Density – Persons per Sq Km

29	Virgin Islands	343.34	43	Philippines	266.11
30	Guernsey	337.04	44	Comoros	259.32
31	Belgium	336.82	45	Saint Lucia	252.49
32	Japan	336.72	46	Haiti	249.79
33	India	336.62	47	Guadeloupe	246.74
34	Rwanda	326.85	48	Jamaica	244.92
35	American Samoa	320.53	49	United Kingdom	244.69
36	Sri Lanka	295.72	50	Vietnam	237.62
37	Reunion	287.09	51	Germany	234.86
38	West Bank	285.66	52	Cyprus – Turkish Sector	224.76
39	Grenada	285.32	53	Burundi	223.62
40	Israel	282.82	54	Netherlands Antilles	216.49
41	El Salvador	281.81	55	Trinidad and Tobago	214.83
42	Guam	280.28	56	Liechtenstein	200.36

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

THE ARCHIVE BEFORE AND AFTER FOUCAULT

Manuel DeLanda

A depository of cultural materials slowly sedimented through time. This is the typical image of the archive when viewed as final product. Libraries, scholarly collections, bureaucratic records – all can be made to fit this static image. One may, of course, differentiate these archival deposits by the use that is made of them. Thus, a collection of ancient sacred texts will have different applications than a set of hospital or prison records. While the former tends to be used with a view towards the past (even if reinterpretations of the content of sacred archives do have an effect on present ritual practice) the latter tend to be utilized with future behavior in mind. The contents of the archive allow its users to

Population Density – Persons per Sq Km

57	Italy	192.96	71	Andorra	146.53
58	Micronesia, Federated States of	187.32	72	Antigua and Barbuda	146.01
59	Switzerland	182.94	73	Northern Mariana Islands	145.49
60	Nepal	177.65	74	China	133.69
61	Korea, North	177.61	75	Moldova	133.67
62	Pakistan	177.37	76	Gambia, The	133.63
63	Seychelles	173.99	77	Czech Republic	130.72
64	Dominican Republic	168.04	78	Man, Isle of	128.72
65	Luxembourg	165.92	79	Montserrat	128.53
66	Saint Kitts and Nevis	159.25	80	British Virgin Islands	127.71
67	Sao Tome and Principe	154.88	81	Poland	126.79
68	Tonga	151.92	82	Anguilla	126.48
69	Cayman Islands	151.29	83	Denmark	126.36
70	Tokelau	147.10	84	Nigeria	124.98

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

detect tendencies which may be used to make predictions and finetune control (of disease, of crime).

Switching from a conception of the archive as reservoir of information to one incorporating the uses of that information is indeed an improvement. But it leaves unexplained the reason behind these varied utilizations. Why, one may ask, is the medical or penal history of individuals (not to mention their driving or credit history) capable of more different uses than the history of the religious or ethnic communities to which they belong? Part of the answer may lie in the concrete process that produced the archive. Did the information sediment more or less spontaneously as a byproduct of ritual or cultural practices, with the long history of accumulation and interpretation serving mostly to legitimize certain forms of authority? Or was the process guided by a more deliberate strategy operating outside of the problematic of legitimacy?

Michel Foucault´s approach to the archive is in large part an attempt to answer the second of these questions. First of all, it is a matter of precisely dating the turning point when the threshold of description, the minimum of importance a piece of information must have to be worthy of archiving, was lowered so as to include common people and not just the sacred or secular figures of the great legitimizing narratives. As Foucault writes:

´For a long time ordinary individuality – the everyday individuality of everybody – remained below the threshold of description. To be looked at, observed, described in detail, followed from day to day by an uninterrupted writing was a privilege ... The disciplinary methods reversed this relation, lowered the threshold of describable individuality and made of this description a means of control and a method of domination. [What is archived] is no longer a monument for future memory, but a document for possible use. And this new describability is all the more marked in that the disciplinary framework is a strict one: the child, the patient, the madman, the prisoner, were to become ... the object of individ-

Population Density – Persons per Sq Km

85	Albania	122.79	99	Cape Verde	100.68
86	Armenia	120.04	100	Cuba	100.09
87	Kiribati	119.25	101	Austria	98.37
88	Thailand	118.43	102	Slovenia	97.28
89	Indonesia	118.32	103	Romania	96.96
90	Uganda	114.19	104	Syria	93.53
91	Guatemala	113.77	105	Togo	93.43
92	Kuwait	111.73	106	Azerbaijan	91.85
93	Slovakia	110.58	107	Dominica	86.51
94	Hungary	110.31	108	Turkey	85.11
95	France	108.09	109	Cook Islands	84.17
96	Portugal	107.86	110	Croatia	82.91
97	Malawi	106.30	111	Ukraine	82.51
98	Serbia	103.06	112	Ghana	82.11

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

ual descriptions and biographical accounts. This turning of real lives into writing is no longer a procedure of heroization; it functions as a procedure of objectification and subjection.'[1]

How exactly did this compulsory objectification take place? What process generated the data suitable for these new archives? Foucault argues that it was a variety of new ways of examining individuals, from the visual inspections of patients by doctors to assess their state of health, to the tests administered to students to measure the degree of their learning, to the questionnaires given to soldiers to be recruited or workers to be hired, that governed the accumulation process. While some of these methods of examination were not completely new, the doctor's visit, for example, they did change character in the 17th and 18th centuries. While previously a physician's visual inspection was irregular and relatively fast, now it's duration was extended and it's frequency made more uniform. While before a school's tests were nothing more than contests between students, now they slowly became a systematic way of determining, assessing and comparing individual aptitudes. And, more importantly for the fate of the archive, this process of ceaseless inspection went hand in hand with a process of permanent registration: 'The examination leaves behind it a whole meticulous archive constituted in terms of bodies and days. The examination that places individuals in a field of surveillance also situates them in a network of writing; it engages them in a whole mass of documents that capture and fix them.'[2] Besides this, he adds, the 'other innovations of disciplinary writing concerned the correlation of these elements, the accumulation of documents, their seriation, the organization of comparative fields making it possible to classify, to form categories, to determine averages, to fix norms. The hospitals of the 18th century, in particular, were great laboratories of scriptuary and documentary methods.'[3]

But is this meticulous accumulation and processing of data really a new thing? Had not the scientists of earlier centuries already developed this obsession with classifying the objects of their domains and archiving the results in written form?

Population Density – Persons per Sq Km

113 Greece	81.86	127 French Polynesia	66.14
114 Cyprus	81.61	128 Cambodia	65.87
115 Macedonia	81.37	129 Malaysia	65.06
116 Samoa	80.69	130 Qatar	63.26
117 Spain	78.43	131 Brunei	61.29
118 Bulgaria	74.13	132 Tunisia	61.24
119 Sierra Leone	73.95	133 Swaziland	57.29
120 Burma	73.10	134 Benin	57.00
121 Georgia	72.69	135 Uzbekistan	56.66
122 Costa Rica	72.53	136 Wallis and Futuna	55.22
123 Lesotho	70.15	137 Norfolk Island	55.06
124 Bosnia and Herzegovina	67.97	138 Lithuania	54.98
125 Egypt	67.58	139 Honduras	53.60
126 Morocco	66.46	140 Ethiopia	53.30

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

Foucault's answer is that while it is true that plants, animals and even humans had been the subject of study before the examination regime was in place, they entered a field of knowledge as general categories, as a species, for example, and not as singular individuals. What was innovative about the new archives was precisely that they objectified individuals not as members of a pre-existing category, but in all their uniqueness and singularity. Far from being archivable in terms of their shared properties, human beings became linked to all the unique series of events (medical, military, educational, penal events) which made them who they are as historical individuals – a history which could now take the form of a file while the individual became a case.[4] And the degree to which someone became archivable now varied in inverse proportion to their normality: 'In a system of discipline, the child becomes more individualized than the adult, the patient more than the healthy man, the madman and the delinquent more than the normal and non-delinquent'.[5]

Much has been said about 'individualism' as a specifically Western invention, dating from the commercial revolutions which preceded the industrial one in the 19th century. It is indeed still common place to explain this phenomenon in terms of the bourgeois ideology of the individual. But the concept of ideology mistakenly poses the problem in terms of a 'false consciousness', as if we were essentially collective beings possessed by a myth making us feel alienated from others and have a false sense of our uniqueness. Even when the concept of ideology is given up, the problem of individuality is still posed as an internal, phenomenological question – a matter of dominant cultural categories shaping our perception of others and the very awareness of our own selves. (This is the so-called 'social-constructivist' approach.) Neither of these approaches even begins to tackle the problems raised by Foucault's analyses which relate not to a subjective interiority, but to an objective exteriority in which human bodies, events and archives interact: the assemblage formed, for example, by a set of fingerprints, a murder and the databases of the police. All the facts about ourselves accumulated in these files and dossiers, extracted from us via a variety of examinations,

Population Density – Persons per Sq Km

141	Ireland	52.74	155	Bhutan	41.53
142	Senegal	52.35	156	Palau	40.32
143	Mexico	52.15	157	Afghanistan	39.88
144	Iraq	51.90	158	Iran	39.84
145	Jordan	51.32	159	Nicaragua	39.23
146	Kenya	50.61	160	Turks and Caicos Islands	39.22
147	Belarus	50.10	161	Colombia	37.84
148	Cote d'Ivoire	49.74	162	Panama	36.56
149	Cocos	45.43	163	Latvia	36.44
150	Ecuador	45.38	164	South Africa	35.60
151	Fiji	44.49	165	Tanzania	35.29
152	Guinea-Bissau	44.09	166	Cameroon	32.92
153	Tajikistan	42.77	167	Eritrea	32.84
154	Burkina Faso	42.28	168	Estonia	32.60

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

give us a real identity which is neither a subjective feeling nor an ideological experience. It is not a matter of interiorized representations but of an external body of archives within which we are caught and that compulsorily fabricate an objective identity for us. (The compulsory aspect may be illustrated by the fact that while certain small details of our medical history may not be considered by ourselves to have anything to do with our sense of identity, the same may not be true for an insurance company for whom these little medical facts are the key to our identity, whether we like it or not.)

These different interpretations of what is involved in constructing an individual may not be mutually exclusive. (They may even coexist with a biological individuality, also historically constructed, but, in this case, through the action of embryo-genetic processes linked to a genetic archive.) The existence side-by-side of an individual identity made of categorical representations and another made of archived examinations (a kind of logistical writing not reducible to meanings) is becoming more evident in our day, as archives are given a digital form and many of them are networked electronically. We may illustrate this double individuality with two different forms of losing or altering one's identity online. There is, on the one hand, what we may call an identity switch as it occurs in chat rooms and multi-user virtual games and communities. In this case it is a manner of constructing for oneself a new identity made exclusively of representations and socially-accepted categories. A weakling who is trying to project a macho persona in a chatroom, for example, must use whatever representations of tough masculinity are current in a given culture, and since these are collective categories (typologies shared and taken for granted by many) this phenomenon lends itself to an ideological or social constructivist analysis. On the other hand, the phenomenon of identity theft – the hijacking of personal information to commit fraud or theft – is not a matter of representations or categories, but of archived reputations. In this case a few data items that strongly connect individuals to archives (such as social security numbers) are used to impersonate that individual in order to open a credit card, bank account or cellular phone service, fol-

Population Density – Persons per Sq Km

169	Yemen	32.09	183	Congo, Democratic Republic of the	22.26
170	Guinea	30.66	184	Sweden	21.69
171	Liberia	30.35	185	Peru	20.80
172	United States	29.77	186	Djibouti	20.36
173	Faroe Islands	29.35	187	Brazil	20.32
174	Zimbabwe	28.87	188	Chile	20.00
175	Saint Pierre and Miquelon	28.79	189	Uruguay	19.06
176	United Arab Emirates	28.29	190	Christmas Island	17.58
177	Bahamas, The	28.17	191	Saint Helena	17.43
178	Venezuela	26.31	192	Finland	16.89
179	Madagascar	25.58	193	Equatorial Guinea	16.60
180	Mozambique	24.39	194	Solomon Islands	16.54
181	Kyrgyzstan	23.76	195	Sudan	14.51
182	Laos	23.43	196	World	14.42

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

lowed by their fraudulent use. The result may leave a victim with a ruined credit history, that is, with a ruined archival reputation.

Many debates in the internet today, such as the debate over the degree of anonymity that computer users may enjoy in their transactions with institutions and their interactions with each other, are more directly related to Foucault's conception of individual identity than to older forms of analysis. And so are many of the proposed solutions to privacy problems, such as the use of cryptological tools as a kind of 'technology of disconnection', helping us acquire a higher degree of control over the flow of information from one's life events to the ever more encompassing archives. So, while the old notions of constructed identity may still be useful in some respects, it is the new concept of compulsory objectification through archival identities that is the most relevant today.

Notes

1. Michel Foucault, *The Birth of Prison* (Vintage Books, 1979), pp. 191–192.
2. Ibid: p. 189.
3. Ibid: p. 190.
4. Ibid: p. 191.
5. Ibid: p. 193.

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Population Density – Persons per Sq Km

197	Norway	14.42	211	Turkmenistan	8.95
198	Paraguay	13.68	212	Russia	8.61
199	New Zealand	13.63	213	Mali	8.55
200	Argentina	13.42	214	Niue	8.09
201	Algeria	13.07	215	Congo, Republic of the	7.96
202	Zambia	13.05	216	Niger	7.86
203	Vanuatu	12.81	217	Bolivia	7.36
204	Oman	11.52	218	Montenegro	6.66
205	Somalia	11.38	219	Kazakhstan	6.30
206	Saudi Arabia	10.97	220	Chad	6.00
207	New Caledonia	10.63	221	Central African Republic	5.53
208	Papua New Guinea	10.39	222	Gabon	4.76
209	Belize	10.34	223	Guyana	3.58
210	Angola	8.97	224	Canada	3.36

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

ARCHIVE AND ASPIRATION

Arjun Appadurai

Social memory remains a mystery to most of us. True, there has been much excellent work by psychologists, neurologists and other sorts of critics about the workings of collective memory. Yet, there is a deep gap between our understandings of the externalities of memory and its internalities. This is a kind of Cartesian gap too, this time not between mind and body but between the biochemistry of memory and its social locations and functions. The arrival of the electronic archive, with its non-hierarchical, digital and para-human characteristics, sometimes seems to have widened this gap, since there is no easy way to get from the neural maps implied in most visions of biological memory and the social maps referred to in such wonderful images as Pierre Nora's image of the 'places of memory'. This gap between the neural locus of memory and its social location creates a variety of challenges for different fields and disciplines.

Memory and the Archive

In the humanist imagination, the archive is no more than a social tool for the

Population Density – Persons per Sq Km

225	Libya	2.84
226	Iceland	2.72
227	Suriname	2.67
228	Mauritania	2.51
229	Botswana	2.50
230	Australia	2.47
231	Namibia	2.00
232	French Guiana	1.88
233	Mongolia	1.67
234	Pitcairn Islands	1.04
235	Western Sahara	.90
236	Falkland Islands	.23
237	Svalbard	.04
238	Greenland	.03
239	Antarctica	.00

This page of GDP per capita ranking of countries is based on figures from the 1999 CIA world factbook. As a rule the GDP per capita data used to rank the countries is as of January 1999.

Revised 01-May-00

Source: 1999 CIA World Factbook
http://www.photius.com/wfb1999/rankings/population_density_2.html

work of collective memory. It is a neutral, or even ethically benign, tool which is the product of a deliberate effort to secure the most significant portions of what Maurice Halbwachs called 'the prestige of the past'. Its quintessential expression is the document, a graphic trace, usually a written text, whose accidental survival has been reinforced by the protection offered to it by the archive. In this sense the archive is an empty box, a place, a site or an institution, whose special role is the guardianship of the document. Over time, the idea of the document has been broadened to include artifacts, monuments, products, even whole neighborhoods and cities. UNESCO's longstanding mission to conserve important monuments as tributes to human heritage is, in fact, a product of this ethical view of the archive as a container or body, animated by something less visible – usually the spirit of a people, the people, or humanity in general.

In this humanist perspective, there is from the start a Cartesian split, in which the archive lives, not because of its own materiality (its paper, its textures, its dust, its files, its buildings), but because of the spirit which animates these materials – the spirit of 'pastness' itself. Since no real understanding exists about this deep sacrality of the past as such, the archive is usually sacralized as the site of the past of some sort of cultural collectivity (often the nation), which is seen as sacred by definition. One result of this Cartesian split in the humanist understanding of the archive is that it has produced a derivative split which is even less desirable – the split between memory and desire, which I will turn to further on.

The central property of the archive in this humanist vision is to be found in the ideology of the 'trace' (Marc Bloch's famous way of speaking about the object of the historian's critical attention). This property is the product of contingency, indeed of accident, and not of any sort of design. The archive is fundamentally built on the accidents that produce traces. All design, all agency and all intentionalities come from the uses we make of the archive, not from the archive

□ *Facts on Illiteracy*

According to UNESCO, in the world today there are about 1 billion non-literate adults.

- **This 1 billion is approximately 26 percent of the world's adult population.**
- **Women make up two-thirds of all non-literates.**
- **98 percent of all non-literates live in developing countries.**
- **In the least developed countries, the overall illiteracy rate is 49 percent.**
- **52 percent of all non-literates live in India and China.**
- **Africa as a continent has a literacy rate of less than 60 percent.**
- **In Sub-Saharan Africa since 1980, primary school enrollment has declined, going from 58 percent to 50 percent.**
- **In all developing countries, the percentage of children aged 6-11 not attending school is 15 percent. In the least developed countries, it is 45 percent.(UNESCO 1998)**

Source: http://www.sil.org/literacy/LitFacts.htm

itself. The very preciousness of the archive, indeed its moral authority, stems from the purity of the accidents that produced its traces. In this view, any hint of a deliberate effort to produce or protect a trace is a taint, to be spotted and eliminated by the historian's tools of triage.

After Foucault (especially after his early and brilliant work *Les Mots et Les Choses*), the gap that had been made sacred by Marc Bloch, between the accident of the trace and the critical work of the historian, became impossible to sustain. Foucault destroyed the innocence of the archive and forced us to ask about the designs through which all traces are produced. In his work on the clinic, on the fingerprint and on the physiology of crime, he showed that all evidence was born in some sort of nosological gaze. This insight is what made Foucault such an object of revulsion to many liberal-humanist historians.

Thus, after Foucault, we need a new way to look at the archive as a collective tool. Recognizing that the archive is not just a way to preserve accidental, but precious traces of collective memory, we need also to see that perhaps Foucault had too dark a vision of the panoptical functions of the archive, of its roles as an accessory to policing, surveillance and governmentality. The creation of documents and their aggregation into archives is also a part of everyday life outside the purview of the state. The personal diary, the family photo album, the community museum, the libraries of individuals are all examples of popular archives and, of course, oral archives have been repositories of intentional remembering for most of human history.

Thus, we should begin to see all documentation as intervention, and all archiving as part of some sort of collective project. Rather than being the tomb of the trace, the archive is more frequently the product of the anticipation of collective memory. Thus the archive is itself an aspiration rather than a recollection. This deep function of the archive has been obscured by that officializing mentality,

Facts on Illiteracy

In the world today, the number of people speaking lesser-known languages is 1.25 billion, that is 20 percent of the world's population.

- **The average adult literacy rate among that population is an estimated 31 percent.**
- **The average adult literacy rate in their mother tongue among speakers of lesser-known languages is an estimated 12 percent.**
- **26 countries have more than 90 percent of the total national population speaking lesser-known languages. The average literacy rate in these countries is 63 percent.**
- **21 countries have less than 1 percent of the total national population speaking lesser-known languages. The average literacy rate in these countries is 93 percent.**
- **Of the world's non-literate population, an estimated 476 million are speakers**

Source: http://www.sil.org/literacy/LitFacts.htm

closely connected to the governmentalities of the nation-state, which rests on seeing the archive as the tomb of the accidental trace, rather than as the material site of the collective will to remember.

In the age of the electronic archive, with the capability of interactive users to more easily enter and edit the archive, and for the archive itself to be expanded by the nature and distribution of its users (the logic of the 'hit' so beloved of website promoters), the active, interventionist and open-ended collective building of archives is a growing reality. Through personal websites, digital archives for all sorts of collectivities (both paid and free), storage sites in cyberspace for large data sets, and the possibility of sending pictures, sounds and text to multiple users with high speed and large amounts of high quality information, the archive is gradually freed of the orbit of the state and its official networks. And instead of presenting itself as the accidental repository of default communities, (like the nation), the archive returns to its more general status of being a deliberate site for the production of anticipated memories by intentional communities.

These communities constitute a new and heterogeneous sociology, for they are not the products of a natural history of face-to-face interaction. They rely precisely on the absence or impossibility of the face-to-face. Whether they take the more standard forms, such as communities of expatriates, revolutionaries, artists or other interest-based groups, or of newer crypto-social forms, as in MUDDS, chatrooms and games such as SIMS, they invert the relationship between memory and connectivity. Where natural social collectivities build connectivities out of memory, these virtual collectivities build memories out of connectivity. And these memories do not usually refer to the natural genealogies of kinship, intimacy and everyday acquaintance. They rely on stretching the possibilities for miming sociality, for building whole identities through the conventions of 'false' identities, and for producing cloned socialities which attempt to construct full-

Facts on Illiteracy

of lesser-known languages. In other words, approximately 50 percent of all non-literates are minority language speakers.

There is a correlation between income and illiteracy.

- **Per capita income in countries with a literacy rate less than 55 percent averages about $600**
- **Per capita income in countries with a literacy rate between 55 and 84 percent is $2,400**
- **Per capita income in countries with a literacy rate between 85 and 95 percent is $3,700**
- **Per capita income in countries with a literacy rate above 96 percent is $12,600**

Source: http://www.sil.org/literacy/LitFacts.htm ◘

service social worlds out of ersatz pieces of identity, history and affinity. Interactive electronic spaces push prosthetic sociality to its edges, seeking a utopia of elective sociality over the drudgery of real time sociality. And in the newest forms, such as SIMS, we see the move away from fantasy in these 'game' environments to controlled spaces of quotidian sociality – shopping, home decoration, cooking and so on. In short, the fantasies to which these new electronic games aspire is the fantasy of restoring agency to the game of sociality, not of seeking an escape from the social as such.

In this context, the relation of collective memory to the archive may be seen as evolving two opposed faces. On the one hand, the newer forms of electronic archiving restore the deep link of the archive to popular memory and its practices, returning to the non-official actor the capability to choose the way in which traces and documents shall be formed into archives, whether at the level of the family, the neighborhood, the community or other sorts of groupings outside the demography of the state. On the other hand, the electronic archive, by allowing the formation of new prosthetic socialities, denaturalizes the relationship of memory and the archive, making the (interactive) archive the basis of collective memory, rather than leaving memory as the substrate which guarantees the ethical value of the archive. We are thus entering an era in which collective memory and the archive have mutually formative possibilities, thus allowing new traffic across the gap between the internalities and externalities of collective memory.

Migration, Memory and Archival Agency

In my book, *Modernity at Large* (1996), I suggested that in the era of globalization, the circulation of media images and the movement of migrants created new

□ *How Much Information is There?*

The world produces between 1 and 2 exabytes of unique information per year, which is roughly 250 megabytes for every man, woman, and child on earth. An exabyte is a billion gigabytes, or 10^{18} bytes. Printed documents of all kinds comprise only .003% of the total. Magnetic storage is by far the largest medium for storing information and is the most rapidly growing, with shipped hard drive capacity doubling every year. Magnetic storage is rapidly becoming the universal medium for information storage.

Information produced by medium:
Worldwide production of original content, stored digitally using standard compression methods, in terabytes circa 1999.

Megabyte: 10^{6} bytes	**Petabyte: 10^{15} bytes**
Gigabyte: 10^{9} bytes	**Exabyte : 10^{18} bytes**
Terabyte: 10^{12} bytes	

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

disjunctures between location, imagination and identity. More specifically, I suggested that in many social locations throughout the world, especially those characterized by media saturation and migrant populations, 'moving images meet mobile audiences', thus disturbing the stability of many sender-receiver models of mass communication. This has many implications for what I then called 'the work of the imagination', and I particularly stressed the new potentials that this situation created for the proliferation of imagined worlds and imagined selves.

Migrants, especially the poorer migrants of this world, are not thriving in a world of free markets, consumer paradise or social liberation. They are struggling to make the best of the possibilities that are opened to them in the new relationships between migration and mass mediation. There is no doubt that migrants today, as migrants throughout human history, move either to escape horrible lives, to seek better ones, or both. The only new fact in the world of electronic mediation is that the archive of possible lives is now richer and more available to ordinary people than ever before. Thus, there is a greater stock of material from which ordinary people can craft the scripts of possible worlds and imagined selves. This does not mean that the social projects that emerge from these scripts are always liberating or even pleasant. But it is an exercise in what I have recently called 'the capacity to aspire'.

It is certainly true that migrants from the Punjab sometimes drown in the Mediterranean as they seek to swim to the shores of Italy or Spain from illegal boats, as do their Haitian counterparts in the Florida waters and others in the containers that cross the English Channel. It is also true that young women from the ex-socialist republics often end up brutalized as sex-workers in the border-zones between the old and new Europe, as do Philippine domestic workers in Milan and Kuwait, and South Asian laborers (both male and female) in Dubai, Saudi Arabia and Bahrain. Such examples of the brutalizing of migrants can be multiplied; poorer migrants today frequently end up as undocumented citizens,

How Much Information is There?

Storage Medium	Type of Content	Terabytes/Year, Upper Estimate	Terabytes/Year, Lower Estimate	Growth Rate, %
Paper	Books	8	1	2
	Newspapers	25	2	-2
	Periodicals	12	1	2
	Office documents	195	19	2
	Subtotal:	240	23	2
Film	Photographs	410,000	41,000	5
	Cinema	16	16	3
	X-Rays	17,200	17,200	2
	Subtotal:	427,216	58,216	4

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

objects of racist laws and sentiments, and sometimes as targets of ethnocidal violence in locations from Rwanda to Indonesia.

But is this suffering the whole story? Does it tell us everything we need to know about how these projects for movement were formed, about what efforts it took to summon the resources to move, of what was made possible by meager remittances, of how the relationship of men and women is often recalibrated under the conditions of migration, of the doors that are opened for migrant children, and, finally, of the value of negotiating for new opportunities, even in harsh circumstances? The work of the imagination, especially for poorer migrants, is critical for exercising the capacity to aspire. Without developing this capacity, which may also lead to rape, exploitation and death (for migration is a world of risk), poor migrants will always remain captive to the wishes of the vanguard, to the prison of their own domestic tyrannies and to the self-fulfilling prophecies of those business-class Marxists who always know, in advance, how best poor people should exercise their agency and which level of risk is most appropriate to them.

So I insist that the work of the imagination is not a privilege of elites, intellectuals and soi-disant Marxists, but is indeed being exercised by poor people, notably in the worldwide pursuit of their possibilities to migrate, whether to near or far locations. Denuding these proletarian projects of the dimension of fantasy, imagination and aspiration, reducing them to mere reflexes of the labor market or of some other institutional logic, does nothing for the poor other than to deny them the privilege of risk-taking. This is the opposite of what Charles Taylor calls 'recognition'.

In this perspective, what can we say about the place of the archive in the building of migrant identity? Here the idea of the living archive becomes especially useful. Migrants have a complex relationship to the practices of memory and,

How Much Information is There?

Storage Medium	Type of Content	Terabytes/Year, Upper Estimate	Terabytes/Year, Lower Estimate	Growth Rate, %
Optical	Music CDs	58	6	3
	Data CDs	3	3	2
	DVDs	22	22	100
	Subtotal:	83	31	70
Magnetic	Camcorder Tape	300,000	300,000	5
	PC Disk Drives	766,000	7,660	100
	Depart.Servers	460,000	161,000	100
	Enterp. Servers	167,000	108,550	100
	Subtotal:	1,693,000	577,210	55
	TOTAL:	2,120,539	635,480	50

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

thus, to the making of archives, for several reasons. First, because memory becomes hyper-valued for many migrants – the practices through which collective memory is constructed are especially subject to cultural contestation and to simplification. Memory, for migrants, is almost always a memory of loss. But since most migrants have been pushed out of the sites of official/national memory in their original homes, there is some anxiety surrounding the status of what is lost, since the memory of the journey to a new place, the memory of one's own life and family world in the old place, and official memory about the nation one has left have to be recombined in a new location. Migration tends to be accompanied by a confusion about what exactly has been lost, and thus of what needs to be recovered or remembered. This confusion leads to an often deliberate effort to construct a variety of archives, ranging from the most intimate and personal (such as the memory of one's earlier bodily self) to the most public and collective, which usually take the form of shared narratives and practices.

Media plays a critical role in the construction of the migrant archive since circulation, instability and the disjunctures of movement always cast doubt on the 'accidental' trace through which archives are sometimes assumed to emerge. In the effort to seek resources for the building of archives, migrants thus often turn to the media for images, narratives, models and scripts of their own story, partly because the diasporic story is always understood to be one of breaks and gaps. Nor is this only a consumer relationship, for in the age of the internet, literate migrants have begun to explore email, chatrooms and other interactive spaces in which to find, debate and consolidate their own memory traces and stories into a more widely plausible narrative. This task, never free of contest and debate, sometimes does take the form of what Benedict Anderson disparagingly calls 'long-distance nationalism'. But long-distance nationalism is a complex matter, which usually produces many sorts of politics and many sorts of interest. In the age in which electronic mediation has begun to supplement and sometimes even supplant print mediation and older forms of communication, imagined commu-

How Much Information is There?

Digital Communication:
Summary of yearly unique computer-mediated information flows.

Content	Terabytes
Email	11,285
Usenet	73

Individual and Published Information:
Yearly production of individual information

Item	Amount	Terabytes
Photographs	80 billion images	410,000
Home videos	1.4 billion tapes	300,000

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

nities are sometimes much more deeply real to migrants than natural ones. Here an excellent example is the eelam.com website (described by Pradip Jeganathan in **Public Culture** some years ago), which is a website for members of the imagined country called Eelam, the dream of some of the Tamil population of Sri Lanka. Jeganathan is able to show that this website is a veritable sacred geography – far more than a sign or compass for the older geography on the ground. It is more than a sign or even a simulacrum. It is a primary and self-sustaining reality, involving many primary symptoms of belonging, and serves as a higher-order reality to which current geographies are held accountable. eelam.com is neither a game, nor a tool, nor a substitute for the real nation that Tamils in Sri Lanka imagine. It is that nation itself, rehearsed in cyberspace, and inclusive of its incomplete expression in the soil of Sri Lanka. Such examples of virtual geographies, with their own flags, boundaries, affections and affinities, exist in many diasporic communities, especially those that have produced separatist politics.

Interactive media thus play a special role in the construction of what we may call the diasporic public sphere (an idea I proposed in *Modernity at Large* to extend the insights of Habermas, Anderson and others about national public spheres), for they allow new forms of agency in the building of imagined communities. The act of reading together (which Anderson brilliantly identified in regard to newspapers and novels in the new nationalisms of the colonial world) are now enriched by the technologies of the web, the Internet and email, creating a world in which the simultaneity of reading is complemented by the interactivity of messaging. Thus, what we may call the diasporic archive, or the migrant archive, is increasingly characterized by the presence of voice, agency and debate, rather than of mere reading, reception and interpellation.

But the migrant archive operates under another constraint, for it has to relate to the presence of one or more narratives of public memory in the new home of the migrant, where the migrant is frequently seen as a person with only one story to

How Much Information is There?

Item	Amount	Terabytes
X-rays	2 billion images	17,200
Hard disks	200 million installed drives	13,760
Total:		740,960

Yearly production of published information:

Item	Titles	Terabytes
Books	968,735	8
Newspapers	22,643	25
Journals	40,000	2
Magazines	80,000	10
Newsletters	40,000	.2

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

tell – the story of abject loss and need. In his or her new society, the migrant has to contend with the minority of the migrant archive, of the embarrassment of its remote references and of the poverty of its claims on the official 'places of memory' in the new site. Thus, the electronic archive becomes a doubly valuable space for migrants, for, in this space, some of the indignity of being minor or contemptible in the new society can be compensated, and the vulnerability of the migrant narrative can be protected in the relative safety of cyberspace.

What is more, both new electronic media, as well as traditional print media, among migrant communities allow complex new debates to occur between the memory of the old home and the demands of public narrative in the new setting. Migrant newspapers in many communities become explicit sites for debate between micro-communities, between generations and between different forms of nationalism. In this sense, the migrant archive is highly active and interactive, as it is the main site of negotiation between collective memory and desire. As the principal resource in which migrants can define the terms of their own identities and identity-building, outside the strictures of their new homes, the diasporic archive is an intensified form of what characterizes all popular archives: it is a place to sort out the meaning of memory in relationship to the demands of cultural reproduction. Operating outside the official spheres of both the home society and the new society, the migrant archive cannot afford the illusion that traces are accidents, that documents arrive on their own and that archives are repositories of the luck of material survival. Rather, the migrant archive is a continuous and conscious work of the imagination, seeking in collective memory an ethical basis for the sustainable reproduction of cultural identities in the new society. For migrants, more than for others, the archive is a map. It is a guide to the uncertainties of identity-building under adverse conditions. The archive is a search for the memories that count and not a home for memories with a preordained significance.

How Much Information is There?

Item	Titles	Terabytes
Office Documents	7,500,000,000	195
Cinema	4,000	16
Music CDs	90,000	6
Data CDs	1,000	3
DVD-video	5,000	22
Total:		285

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

Aspiration and the Memory Gap

As I suggested, something like a Cartesian gap had emerged in our understanding of the relationship between the internalities and the externalities of collective memory. In my discussion of the relationship between memory and the archive and of the specific features of the migrant archive, I proposed that we need to look at the archive, in the spirit of Foucault, less as a container of the accidental trace and more as a site of a deliberate project. This latter perspective offers us the beginnings of a way out of the Cartesian split between neuro-archives and social archives.

The archive as a deliberate project is based on the recognition that all documentation is a form of intervention and, thus, that documentation does not simply precede intervention, but is its first step. Since all archives are collections of documents (whether graphic, artifactual or recorded in other forms), this means that the archive is always a meta-intervention.

This further means that archives are not only about memory (and the trace or record) but about the work of the imagination, about some sort of social project. These projects seemed, for a while, to have become largely bureaucratic instruments in the hands of the state, but today we are once again reminded that the archive is an everyday tool. Through the experience of the migrant, we can see how archives are conscious sites of debate and desire. And with the arrival of electronic forms of mediation, we can see more clearly that collective memory is interactively designed and socially produced.

In turn this allows us to make see what lay behind the early insights of T.S. Eliot and Marcel Proust about the inner affinity of memory and desire. The archive, as an institution, is surely a site of memory. But as a tool, it is an instrument for the refinement of desire. Seen from the collective point of view, and keeping the

How Much Information is There?

Digital:
Original Data Stored On Hard Disk By Computing Environment (1995-1999) [In Petabytes]

T=Total O=Original	Original Data	1995		1996		1997		1998		1999	
		T	O	T	O	T	O	T	O	T	O
Personal	1%	58	0.6	101	1	189	2	399	4	766	8
Departmental	35%	32	15	55	19	114	40	239	84	460	161
Enterprise	65%	16	8	27	17	41	27	86	56	167	109
Total:		105	23.6	183	37	344	69	724	144	1,393	278

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

sociality of memory and the imagination in mind, such desire has everything to do with the capacity to aspire. For those who are not part of the literate avant-garde of their societies, the capacity to aspire is an especially precious resource. I have argued elsewhere that poverty may be described as an unequal distribution of the capacity to aspire, since aspiration thrives on the occasions for practising it as a capacity. Archives, viewed as active and interactive tools for the construction of sustainable identities, are important vehicles for building the capacity to aspire among those groups who need it most.

And in this link between memory and desire may also lie a way to close the gap between our understandings of neuro-memory and social memory. These two locations of memory may have different materialities and different architectures. But they meet in the body of agents, living persons who negotiate the gap between these terrains by building archives – bodily, electronic and institutional, in which new solidarities might produce memories, rather than just waiting for them.

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How Much Information is There?

Original Data Stored On Hard Disk By Computing Environment (2000-2004) [In Petabytes]

T=Total O=Original	Original Data	2000		2001		2002		2003	
		T	O	T	O	T	O	T	O
Personal	1%	1,405	14	2,553	26	4,466	45	7,165	72
Departmental	35%	843	295	1,532	536	2,680	938	4,299	1,505
Enterprise	65%	306	199	557	362	974	633	1,563	1,016
Total:		2,554	508	4,642	924	8,120	1,616	13,027	2,593

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

MOBILE KNITTING

Sadie Plant

I know an old Swiss woman who has knitted socks for 80 years. She is the current matriarch of a family that has been rooted in the same Swiss canton for countless generations. Marriages have always been made locally; family members have rarely traveled far. Now she has 15 grown-up grandchildren. Ten of them have settled with foreigners and several live abroad. Her family – so Swiss, white, and Protestant for so long – now extends across three continents and includes Hungarians, Romanians, Russians, Italians, English, Jamaicans, Koreans, Somalis and Canadians. In one jump, this monocultural family has become multinational, multiracial, multi-faith. There are Buddhists, Catholics, a Muslim; African and Asian great-grandchildren. It took her a while to get used to it, this sudden distribution of her close-knit, close-by family. But now she knits socks for all of them, even parceling them up to send to her in-laws in Africa or the Americas. They are good socks and make useful gifts. And so many people in this dispersed and extended family wear them that they also seem to function as this great-grandmother's way of adding to their connectivity and, perhaps, knitting them all into her own life.

How Much Information is There?

Original Data Flow Storage Estimates:

Media Type	Unique Items per Year	Conversion Factor	Total Annual Petabytes (World)
Blank Audio Tape (2000)	184,200,000	1 gb per tape (CD audio format, no compression)	184.2
Blank Video Tape (2000)	355,000,000	4 gb per tape (MPEG-2 compression)	1420
Computer Tape Drives (2000)	5,000,000	Varies	250
Floppy Disk (2000)	5,000,000	1.44 mb per disk	0.07
Removable Disks (2000)	4,400,000	100 mb (low capacity)	1.69
	1,250,000	1 gb (high capacity)	
Hard Disks (2000)	37,400,000	Varies	500

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

Having once explored the associations of weaving with the computer and the Internet, I could not resist the temptation to explore the ways in which the craft of knitting might illuminate the current role played by the mobile phone in our increasingly mobile world.

Knitting is by no means the rich resource that weaving, with its wealth of useful associations and vocabularies, can offer electronic arts and technologies. It was one of the first techniques to be mechanized, in the 16th century, but this does not give it any special influence on the subsequent history of machines. Knitting has no ancient mythologies, and historical references to the craft and its products are few and far between: only a few ancient fragments have survived, and there is great dispute amongst curators about the status of many articles said to be knitted but thought, in fact, to have been made by other processes, such as nalbinding, netting, sprang, crochet, and tablet weaving. Written and illustrative records are hard to find, and those that do exist tend not to be too old: it was not until 20th century that the first patterns, or recipes, for hand-knitted garments appeared in print. So if all textiles and fiber arts have, to some extent, been neglected by historians, few have been as neglected as the practice of knitting.

There are good reasons for this patchy history. As Richard Rutt points out in his *History of Hand Knitting* (1998), knitted goods were made to be worn, and to be worn out too, so it is hardly surprising that much of their material history has disappeared. Knitted garments were never made to last. Where does the wool go? Into the sands of time ...

A few items, however, have survived. My Swiss friend was not surprised to learn that socks are amongst the oldest knitted goods to have been found, most of

How Much Information is There?

Hard Disk Drives (World)
No storage medium has ever had the explosive growth demonstrated by the hard disk.

Year	Sold	Storage
Disks	(Thousands)	Capacity (PetaBytes)
1995	89,054	104.8
1996	105,686	183.9
1997	129,281	343.63
1998	143,649	724.36
1999	165,857	1394.60
2000	187,835	2553.7
2001	212,800	4641
2002	239,138	8119
2003	268,227	13027

Source: IDC (1999) '1999 Winchester Disk Drive Market Forecast and Review'

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

them pulled from the dry preserving sands of the Arabian peninsular, many of them bearing Kufic script as well as intricate abstract designs, and often designed to be worn with sandals. The earliest known fragments of knitting have survived from the medieval Muslim world. It is thought that the technique spread to Europe, possibly through the crusades or by way of Islamic Spain or as a more gradual consequence of migration and trade.

Knitting is much younger than weaving and, in some respects, more sophisticated too. Because it uses needles and the thread itself in place of a fixed frame, neither the width nor the length of a piece of knitting are fixed in the process of its production; it is possible to increase or decrease, either gradually or dramatically, as one knits. In the process of handknitting, the width of a piece of flat knitting is limited only by the number of stitches a needle can hold, and the length is limited only by the weight the knitter can bear – a constraint currently being tested by the knitting artist Germaine Koh. And rather than the criss-crossed threads of weaving or the knots of nalbinding and crochet, knitting is a matter of making loops. At its simplest, it is done with a single, continuous thread, which loops around and intricates itself. Any number of threads can be used, but this does not alter the simplicity of the basic process; multiple threads are either used one after the other, or made to behave as though they were a single yarn.

Deleuze and Guattari place knitting in between the making of felt – a chaotically mixed material – and weaving – striated and captured by the frame – suggesting that knitting participates in something of the order of weaving while, at the same time, tending towards the matted threads of felt. Much of its vocabulary tends to come from sewing and embroidery, with their needles, stitches, and patterns. In any case, the craft of knitting is just one of many uses of the term, most which suggest things being joined together in far less precise and specific ways than those involved in the knitting itself; things are said to be knitted when

How Much Information is There?

The incredible growth in hard disk shipments has been accompanied by a relentless decrease in the cost per gigabyte of storage capacity:

Year	Cost per GB	GB's PER $200	Year	Cost per GB	GB's PER $200
1988	$11,540	0.02			
1989	9,300	0.02	1998	43	4.65
1990	6,860	0.03	1999	23	8.70
1991	5,230	0.04	2000	13	15.38
1992	3,000	0.07	2001	6	33.33
1993	1,460	0.14	2002	3	66.67
1994	705	0.28			
1995	330	0.61			
1996	179	1.12			
1997	94	2.13			

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

they might just as easily be described as woven, matted, or more generally entangled or intertwined. Bees knit together when they cluster, embryos are said to knit together in the womb, plants are said to knit into the soil. And in the field of histology – the study of tissues – knitting is a common term; broken bones, for example, or wounded tissues are said to knit together as they mend. Families or communities can be said to be close-knit, with the implication that their elements are closely intertwined. This itself ties in with the communal nature of the craft of knitting in some communities, as in this account of life in the 19th-century English Dales:

'As soon as it becomes dark and the usual business of the day is over and the young children are put to bed, they take their cloaks and lanterns, and set out with their knitting to the house of the neighbor where the sitting falls in rotation, for it is a regularly circulating assembly from house to house through the particular neighborhood. The whole troop of neighbors being collected, they sit and knit, sing knitting songs and tell knitting stories. Here all the old stories and traditions of the dale come up; and they often get so excited that they say, "Neighbors, we'll not part tonight," – that is, till after twelve o'clock. All this time their knitting goes on with unremitting speed. They sit rocking to and from like so many weird wizards. They burn no candle, but knit by the light of the peat fire.' Richard Rutt, *A History of Handknitting*

So, knitting encompasses a wide range of activities, from the process of looping a line into fabric to the uniting of disparate or broken elements or the strengthening of existing ties. Knitting is itself a connective term – a way of talking about many different kinds of joining, connecting, and intermingling; a way of speaking about loops, knots, nets and meshes all at once.

While the process of hand-knitting is neither its governing nor earliest meaning, it is in relation to the craft of knitting itself that the term is most distinctive and

How Much Information is There?

Floppy Disks (World):
The number of floppy disk drives sold every year has remained relatively constant at around 100 million units for the past several years. Little change is expected. (Source: Computer Tech Review, April 1, 1999).

The number of floppy disks being sold is diminishing rapidly as their storage capacity is too small to be useful in light of the much larger file sizes now common.

Year	3.5" Disks (billions)	Total Capacity (terabytes)	5.25" Disks (millions)
1996	1,823	2625	32
1997	1,179	1698	11.7

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

precise. It is also in this context that knitting can itself be knitted into our data flows.

The most distinctive feature of knitting is its loops, which can be regarded as loose knots, as can the finished fabric, which is effectively one large, loose knot of yarn. It is the process of looping that gives the finished fabric its elasticity, its give, its flexibility, making it an early stretch fabric capable of taking the body's shape. This is what made it so good for making socks. Knitting can also make a garment without seams. As well as turning a single thread into a filament – a two-dimensional plane – it can be used to make a three-dimensional object. The earliest knitting is thought to have been done with three, four or even five needles to produce a round, seamless fabric – the tube or hose from which hosiery and all its associated terms, such as hosen, pantyhose etc derive. In this sense, knitting has always aimed at the production of a second skin or elastic tissue capable of following the contours of the body, in the first instance, the foot. Knitting also has a certain contingency, not only because it so easily wears out, but because it is composed of loops, and so a piece of knitting can be easily undone. Unlike many other fabrics, knitting does not have to be unpicked, but can be so smoothly unraveled that when it has been made in its most simple form, it can be returned to a single and continuous thread in a matter of moments, as though it had never been there at all.

When Freud and Breuer wrote on hysteria, they described knitting as one of the processes which can be 'performed by many people with only half their minds on them'. So knitting is a semi-automatic task, a process that can let the mind wander and also an activity that can be continued at almost any time. While weaving was a fixed, often collective task, knitting is mobile and individual: 'It is work

How Much Information is There?

Analog Video Tape:
Prerecorded VideoTapes (VHS Format) (World)
1997 - 1,666 billion
1998 - 1,719 billion
1999 - 1,748 billion
2000 - 1,664 billion
2001 - 1,561 billion
Source: International Recording Media Association

The main use of the blank video tape is the consumer's use to record televison programs. It is anticipated that there would be a large drop in the sales of this tape if pay-per-view television shows carried copy protection. It is estimated that a very large share of the users of video cassette recorders do so for time shifting of viewing programs.

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html

that may be taken up and laid down in a moment', wrote one of the earliest writers on the theme.

'A set of needles may be bought for a penny, and a ball of worsted for another. It may be done at any light or with a child in the arms; and when you are tired of stirring work knitting serves very well for a rest. In summer time you can take a walk in your garden and knit as you go – and a pair of knit stockings, when they are done (at little odds and ends of time), are worth at least three pairs of the best wove ones that you can buy.'
Esther Benzeville, in Richard Rutt, *A History of Handknitting*

Of the people of the Dales, it was said: 'The woman knits when her household work is done; the man when his out-of-door work is done; as they walk about their garden or go from one village to another, the process is going on.' An 18th-century Welsh writer, David Davies, observed that women 'knit walking, talking, begging, without hardly ever looking at their work'. (Richard Rutt, *A History of Handknitting*)

A flexible, contingent, mobile second skin, cheaply and almost automatically produced by individuals who barely need to think about a task that fits seamlessly into their lives: this is knitting, and also the experience of data in a wireless age.

Even though she rarely leaves her village, the Swiss woman with whom I began is living in a world of unprecedented mobility. This is not only because, having skipped generations of technology – the cows in the shed below still warm her house, and computers are a distant mystery – she has, for the last few years, had a mobile phone, but also because the emigrations and immigrations which have

How Much Information is There?

Blank VideoTapes (VHS Format T-120 equivalent units) (World):
1997 - 1,485 million
1998 - 1,446 million
1999 - 1,463 million
2000 - 1,400 million
2001 - 1,275 million
Source: International Recording Media Association

The International Telecommunications Union (ITU) database provides estimates of telephone traffic for 207 countries for 1997–98, which total 2.5 x 10^{12} minutes per year. Adding in an estimate for the missing countries brings us to 7.5 x 10^{12} minutes per year, or roughly 600,000 terabytes per month. Compression would reduce storage requirements by a factor of 6 to 8.

Source: http://www.sims.berkeley.edu/research/projects/how-much-info/summary.html □

changed her family so dramatically serve as an example of the explosive mobility which now marks even the most settled lives in many, almost all, parts of the world.

This mobility does not stop with movements of people, indeed, it often does not even start with them. The movement of people through our supposedly globalized world is far more controlled and determined than that of information, goods and capital, and even they are by no means as free as we are often led to believe. Capitalism may love movement in principle, but it tends to love capture even more; it certainly wants to encourage only the kinds and speeds of movement that serve its interests and support the status quo. But much of the current movement in the world is running – or would like to run – much faster and looser than its governors can stand. The numbers of people on the move and the kinds of movement underway are multiplying all the time, whether as commuters or refugees, nomadic workers or backpacking travelers, mobile freelancers or package tourists, exiles or migrants seeking work.

This, it would seem, is the primary reason for the sudden and largely unanticipated popularity of the mobile phone, which, as a cheap, accessible, portable, and increasingly multifunctional device, presents itself as the perfect accessory for these mobile times. It has been said that the telephone 'arrived at the exact period when it was needed for the organization of great cities and the unification of nations'. (Herbert Casson, *The History of the Telephone*, 1997)

With the same good sense of timing, the mobile serves to both facilitate and compensate for the breaks and dislocations such mobility entails. In China, for example, where hundreds of thousands of young people – nearly always precious only children – are leaving their rural homes to find work in rapidly growing cities, the mobile provides an invaluable link to the families they leave behind. The Philippines, a country famous for its vast numbers of overseas workers, is

□ *The Spread of the Sapphire/Slammer Worm*

The Sapphire Worm was the fastest computer worm in history. As it began spreading throughout the Internet, it doubled in size every 8.5 seconds. It infected more than 90 percent of vulnerable hosts within 10 minutes.

The worm began to infect hosts slightly before 05:30 UTC on Saturday, January 25, 2003. Sapphire exploited a buffer overflow vulnerability in computers on the Internet running Microsoft's SQL Server or MSDE 2000 (Microsoft SQL Server Desktop Engine). This weakness in an underlying indexing service was discovered in July 2002; Microsoft released a patch for the vulnerability before it was announced.

The worm infected at least 75,000 hosts, perhaps considerably more, and caused network outages and such unforeseen consequences as canceled airline flights, interference with elections, and ATM failures. Several disassembled versions of the source code of the worm are available.

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/

now equally famous for its phenomenal mobile phone usage. In Bangladesh, where Grameen Telecoms has launched its highly successful village phone program, the vast bulk of calls made from the villages concern contacts with family members working overseas, and are often made in order to arrange the tricky business of sending money home. In my own neighborhood in England there are African migrants and asylum seekers who would have found it impossible to get the cash and the stability for a land-line phone, but now use mobiles to both establish themselves in the UK and keep in touch with families back home in countries like Malawi and Somalia.

While they reflect a broad increase in mobility around the world, these examples also suggest that mobiles are being used in very different ways by very different people in very different economic, social and individual circumstances – few of which accord with the uses originally envisaged by manufacturers and service providers. A device primarily marketed at jet-setting executives has proved equally useful on the street, where it has become a common way to oust the middle-man and establish informal networks of one's own: go-go dancers in Bangkok use them to usurp their pimps, farmers on the Ivory Coast check wholesale commodity prices for their goods, teenagers all over the world use them to bypass the parents who once answered the phone. The mobile is both mobile and flexible as well – a remarkably non-prescriptive, undemanding piece of technology, which, at least in its most basic form, carries few injunctions about how it should be used. Teenagers in Tokyo use mobiles to coordinate just about every aspect of their social lives, from navigating the city space to fine-tuning arrangements to meet strangers they have also met by mobile phone. Such uses of the mobile represent subtle but pervasive changes to the practices of everyday life and people's conceptions of themselves and their places in the social mesh. In Japan, for example, the mobile's informality has altered expectations in what was a highly formal social world, and people who once moved in small and close-knit circles of family and friends now find themselves in the midst of distributed net-

The Spread of the Sapphire/Slammer Worm

Propagation speed Sapphire's: in the first minute, the infected population doubled in size every 8.5 (±1) seconds. The worm achieved its full scanning rate (over 55 million scans per second) after approximately three minutes, after which the rate of growth slowed down somewhat because significant portions of the network did not have enough bandwidth to allow it to operate unhindered. Most vulnerable machines were infected within 10-minutes of the worm's release. The spread of Sapphire provides the first real incident demonstrating the capabilities of a high-speed worm. By comparison, it was two orders magnitude faster than the Code Red worm, which infected over 359,000 hosts on July 19th, 2001. In comparison, the Code Red worm population had a leisurely doubling time of about 37 minutes.

Sapphire's spreading strategy is based on *random scanning* – it selects IP addresses at random to infect, eventually finding all susceptible hosts. Random scanning worms initially spread exponentially rapidly, but the rapid infection of new hosts becomes less

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/

works of more numerous and, often, more superficial links.

Japan's sophisticated keitais are a special case. But as a means of sending text messages, the basic mobile phone has introduced a small but significant new medium to much of the rest of the world as well – opening up a channel for highly informal communications, which have been described as lying somewhere between a thought and a telephone call or an email. Kids in Western classrooms use mobiles to send flirtatious text messages to each other; people in the Philippines famously used the same medium to contest the Estrada government in 2001.

Most of these communications are as transient and contingent as a pair of knitted socks; both voice calls and text messages lend themselves more to forgetting than to memory. This may not be true at the level of the state, which once again continually strives to capture the movements on which it thrives. But for individuals, mobile communications participate in what Walter Ong described as the 'essential evanescence' of oral communication, which, like all sound, exists 'only when it is going out of existence'. In their dependence on direct, interpersonal connections and shared cultural assumptions, and the rapid, local and spontaneous inventions and mutations of language they make possible, text messages behave far more like acts of speech than written texts. True, text messages (and voice mail) can be saved, but most are extant only for as long as it takes to write, transmit and read them. Most mobile messages are immediate and short-term – made, read, and often responded to as quickly as they travel, often with little thought or consequence. So too are the memories they make. These are not messages made to last; they belong either to the social world of sudden changes of plan, last-minute and approximate arrangements, or else to the realm of haptic gestures, digital squeezes of the hand, small expressions of affection, interpersonal transmissions of thoughts – small and intimate – sent directly between bodies. What is left of such communications once they fade away or are erased? Is the

The Spread of the Sapphire/Slammer Worm

effective as the worm spends more effort retrying addresses that are either already infected or immune.

Based on analysis of a number of datasets, we estimate the initial compromise rate (the number of hosts that a worm instance can infect per second) was 7 (±1) per minute, equivalent to a global doubling time of 8.5 ±1 seconds.

While Code Red was *latency limited*, Sapphire was *bandwidth-limited*, allowing it to scan as fast as the compromised computer could transmit packets or the network could deliver them.

In principle, an infected machine with a 100 Mb/s connection to the Internet could produce over 30,000 scans/second. In practice, due to bandwidth limitations and the per-packet overhead, the largest probe rate we directly observed was 26,000 scans/second,

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/

absence of an archive to the detriment of our personal or collective histories? Does it matter that we keep no records of such messages or even of the people with whom we are in touch? It might, if current uses of the mobile phone were to replace all other media. But for many people, in the developed world at least, the mobile is just one more means of communication amongst the many offered by land-line phones and computers – another strand to be knitted into the fabric of modern life. The mobile, and the fleeting, insubstantial kinds of communication it facilitates, is one of many channels, including electronic, paper-based and face-to-face. It opens more new spaces than it replaces, marking not a radical break with existing media, but instead their multiplication. And their interaction too.

While land-line phones and the Internet changed people's behavior behind closed doors, the mobile is the first hi-tech device to be worn as a garment – a constant accessory, second skin adopted as commonly and automatically as a pair of socks. And because of this portability, mobile communications tend to operate not in an exclusive, virtual domain, but instead in a continual interaction with geographical space and connectivity. Kids who seem to live their whole lives through their mobile phones do not do so from some static, private space; this is a device which knits the virtual and actual together and, so, does more to facilitate than replace interpersonal activity.

Much of the 20th-century popularity of knitting, as well as its inaccurate characterization as women's work, dates to World War I, when women left behind at home knitted socks and hats and gloves for their men on the front lines. Derided in a popular joke of the time as garments made of 'lumps of air with wool around', these too were gestures of affection, not made to last, not sent as keepsakes or souvenirs, sometimes purely practical, but often too misshapen and ill-

The Spread of the Sapphire/Slammer Worm

with an Internet-wide average of approximately 4,000 scans/second per worm during the early phase of growth.

The Sapphire worm's scanning technique was so aggressive that it quickly interfered with its own growth. Consequently, the contribution to the rate of growth from later infections was diminished since these instances were forced to compete with existing infections for scarce bandwidth. Thus Sapphire achieved its maximum Internet-wide scanning rate within minutes.

Sapphire reached its peak scanning rate of over 55 million scans per second across the Internet in under 3 minutes. At this rate, the worm would effectively scan over 90 percent of the entire Internet in a little more than 10 minutes. This aggregate scanning rate is confirmed by all datasets with known address space coverage.

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/

fitting to be of much use. As with today's text messages, it was the thought that counted; the contents, such as they were, barely registered. These garments belong to living memory – the short-term memory of a society – and make only rare appearances in the long-term memory of history. They were gifts for the present, not posterity, made to be affective in the moment, not significant for the future.

My elderly Swiss friend is too young to remember much about World War I, too old to remember how many hats and gloves and pairs of socks she's made for her extending and diversifying family, and slightly too confused to recall exactly who and where they are. Does it matter that so much gets lost? Certainly, says Microsoft, soon to launch its MyLifeBits software, which will allow people to store emails, letters, phone conversations, photos, video and, of course, text messages. MyLifeBits will let its users keep 'every document they read, every picture they view, all the audio they hear and a good portion of what they see' and, according to its developers, make it possible to 'run a Google-like search on your life' (**New Scientist**, 20 November 2002). Our memories are unreliable, they say, so let's make an effort to record the truth, establish the data, compile the given facts of our own lives and those of our cultures too.

In its current form the mobile phone is more an agent of forgetting than remembering, a device of transience whose messages fade quickly, leaving little trace. It is also a transient device; text messaging, for example, may not survive the passage of the mobile phone into something akin to a searchable and multimedia extension of human memory, a wearable archive of accumulated facts. But for now, it is the spoken word and the scribbled note to which the mobile gives mobility. These ephemeral communications have always been the stuff of short-term, living memory; the holes in the documented fabric of the past. Now they are travelling far and fast as well.

The Spread of the Sapphire/Slammer Worm

Sapphire's geographic distribution:

Country	% Victims
United States	42.87
South Korea	11.82
UNKNOWN	6.96
China	6.29
Taiwan	3.98
Canada	2.88
Australia	2.38
United Kingdom	2.02
Japan	1.72
Netherlands	1.53

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/

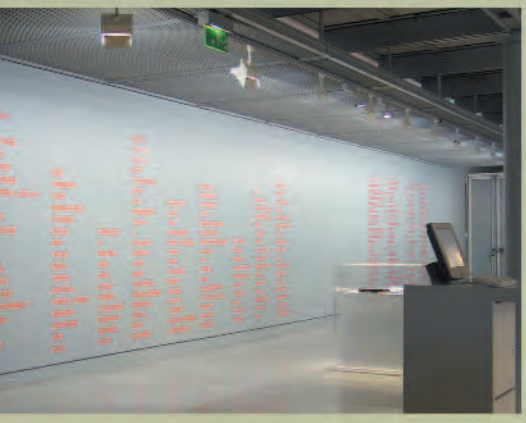
Sadie Plant teaches philosophy at Manchester University. Before, she worked at Birmingham University and was director of the Cybernetic Culture Research Unit at Warwick University. Plant has published extensively in the field of gender and technology and is the author of *The Most Radical Gesture: The Situationist International in a Postmodern Age* (1992), *Zeros + Ones: Digital Women + the New Technoculture* (1997) and *Writing on Drugs* (1999). She is one of the pioneers of cyberfeminism.

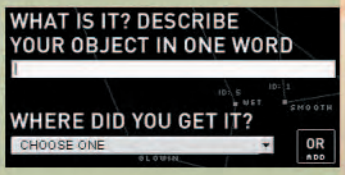
The Spread of the Sapphire/Slammer Worm

Sapphire's distribution among top level domains:

Top Level Domain	% Victims
UNKNOWN	59.49
net	14.37
com	10.75
edu	2.79
tw	1.29
au	0.71
ca	0.71
jp	0.65
br	0.57
uk	0.57

Source: http://www.cs.berkeley.edu/~nweaver/sapphire/ □

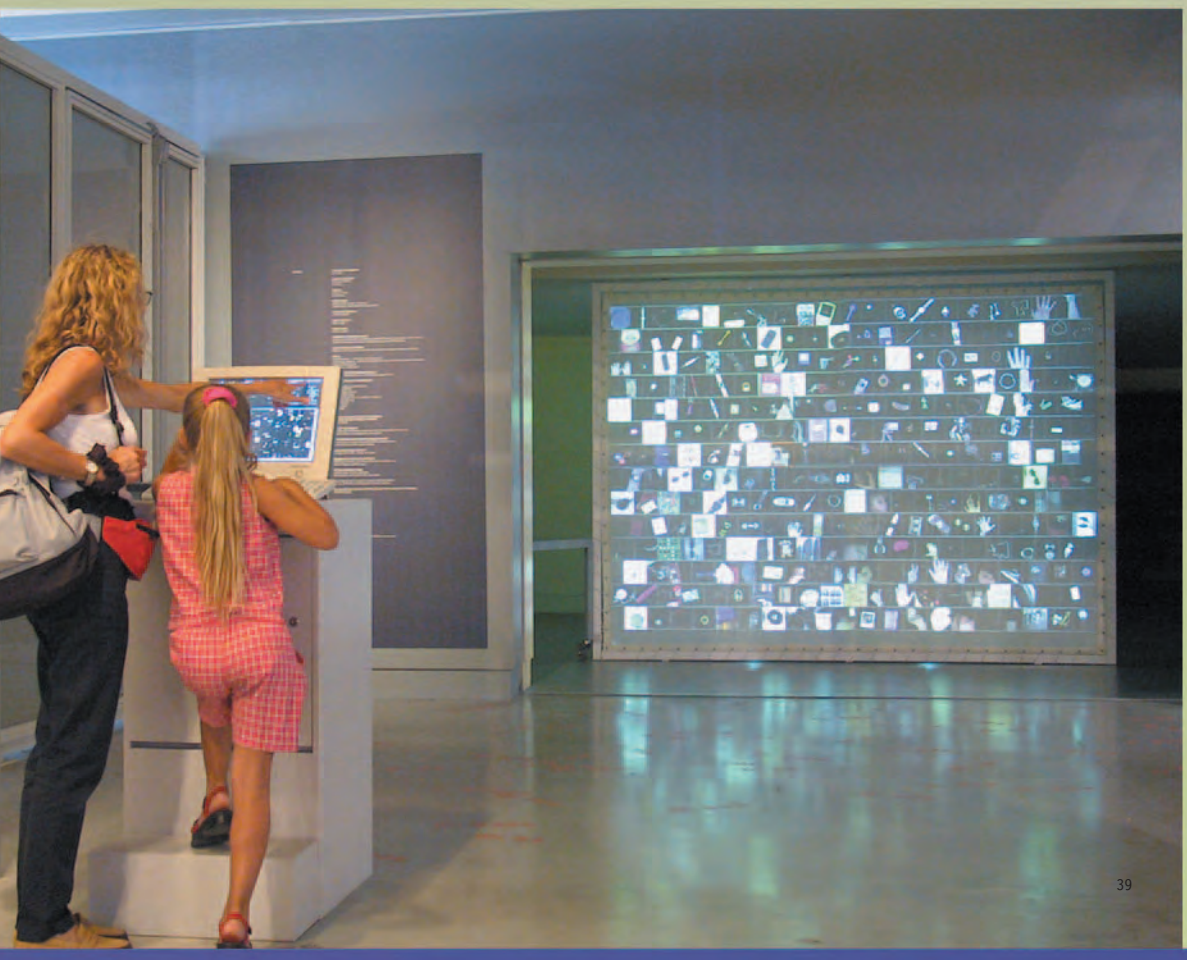




Pockets Full of Memories

Interactive installation by George Legrady, 2001

Pockets Full of Memories **is both an online and on-site installation that explores the topic of collective memory and gives insight into complex data structures. Visitors to the installation contribute to an archive by letting the installation scan a personal object they carry with them. This results in a two-dimensional map of digitized objects that is projected onto a large screen. The image archive becomes richer through the interaction with visitors, who rearrange objects and invest them with meaning.**



The installation has two rooms. The entrance holds an information booth where visitors can scan a personal item to be included in the database, fill out a questionnaire and describe the item by a number of properties and keywords. On the basis of these linguistic characteristics, a 'self-organizing map' algorithm assigns the objects a position within the database structure. This self-organizing system, based on neural network structures, will position objects that overlap semantically next to each other on the map and also make sure their position is continuously updated.

In the exhibition space itself, the ordered images of the visitors' objects are projected onto a screen and the visitors can respond via web terminals, thereby initiating a 'conversation' between themselves, the online audience and the

archive. Via a website (www.pocketsfullofmemories.com) all objects can be assigned new keywords, comments can be added, and positions and relationships can be changed. All of this additional information is added to the database, creating a rich mosaic of objects with a past. Not only does *Pockets Full of Memories* reflect the diversity of its audience, but, more importantly, it reveals how this diversity comes about.

George Legrady (H) operates at the intersection of interactive narrative, the design of new interface metaphors and cultural theory analysis. He researches in the field of software aesthetics. Legrady has published numerous articles and CD ROMs and is currently Professor of Interactive Media at the University of California, Santa Barbara.

Exactitudes

A photo archive of identities by Ari Versluis and Ellie Uyttenbroek (NL), 1994-2002

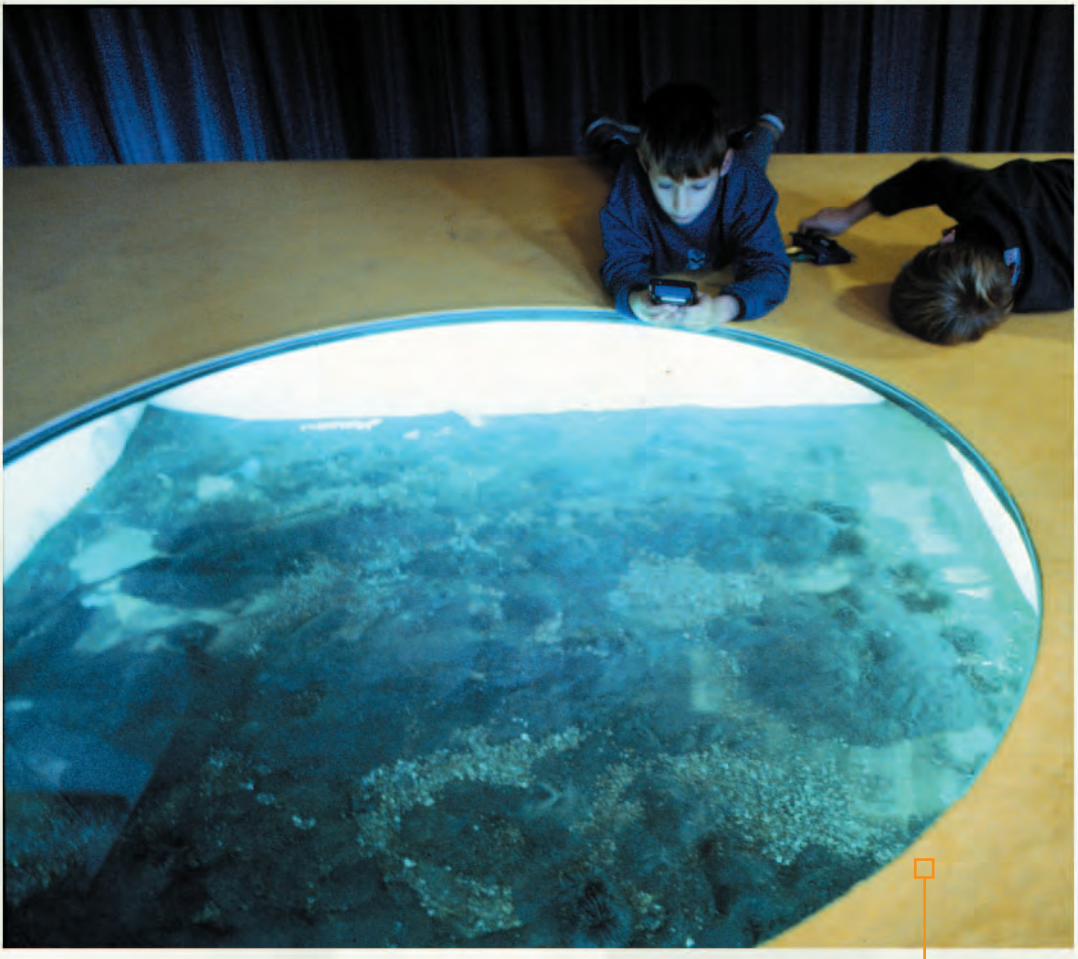
Since 1994, photographer Ari Versluis and stylist Ellie Uyttenbroek have been working on their project *Exactitudes*, where they portray a series of 12 individuals from the same subculture against a neutral white background. The subjects always strike the same pose and wear the same uniform clothing. Over the years, Versluis and Uyttenbroek have made a large number of these series, that together present a view of a heterogeneous society where trends and lifestyles follow each other in rapid succession. *Exactitudes* can therefore be regarded as a sociological study of multicultural society. The project is reminiscent

of *Citizens of the Twentieth Century* by German photographer August Sander, who, during the 1920s and 1930s, attempted to create a panoramic view of German society. *Citizens of the Twentieth Century* was a project of great historical value, documenting the latter days of the Republic of Weimar and the rise of the Third Reich.

In its own way, *Exactitudes* also captures the spirit of an era. It is an archive of different segments of the population, whose collective identities are emphasized by the way they are juxtaposed. Versluis and Uyttenbroek make it painfully clear that adopting an identity may not only be liberating, but can also bring with it the restraints of a straitjacket, that is, in wanting to stand out from the others and be unique, people assume group identities. This care-

fully constructed identity is not based on individual choices but on a complex system of cultural signs that identify a certain subculture. *Exactitudes* attempts to expose these signs and trace their common denominator, as if man were a collection of data that can be described with metadata. *Exactitudes* visualizes the complex relationships between individuality and collectivity; the thin line separating authenticity from fake.

Photographer Ari Versluis and stylist Ellie Uyttenbroek (NL) have worked together since 1994. Inspired by a shared interest in the striking dress codes of various social groups, they have systematically documented numerous identities over the last few years in their project *Exactitudes*.



Zgodlocator

Magnetized sculptures of hardware filings by Herwig Weiser (A), 1998–2002

Zgodlocator is a memory machine that functions according to the magnetic principles of a computer's hard disk and organizes tiny metal particles. In *Zgodlocator* these particles are in fact ground computer parts that are magnetically sensitive.

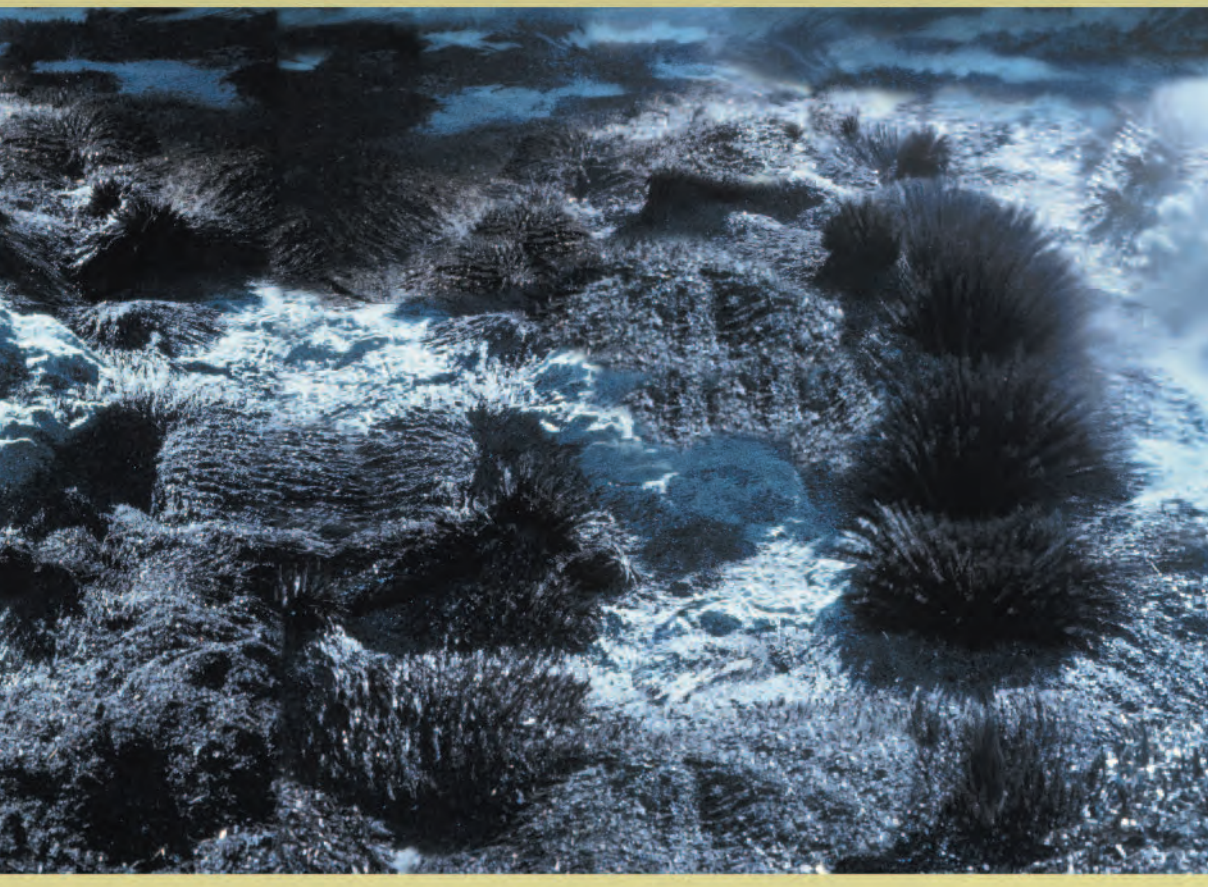
Unlike a computer's hard disk, *Zgodlocator* does not concern itself with the long-term storage of text or images. *Zgodlocator* has a dynamic nature and, typically, has a very short and fast changing memory. In this sense the instal-

lation focuses on the dynamic aspects of the computer and not so much on the computer as just a storage medium. It stresses the continuous reprocessing of information and the reconstructing of dynamic archives that are constantly changing because users actively use them and because the material is also organized by the computer itself.

By rotating small dials, the audience may manipulate the magnetic fields generated by *Zgodlocator*, and, as a result, the granulated computer grit, that looks like black metal filings, forms freakish and constantly changing shapes. In *Zgodlocator*, magnetism becomes a dynamic container for storing, but also for manipulating and processing information in its most raw and plastic form, that is, matter.

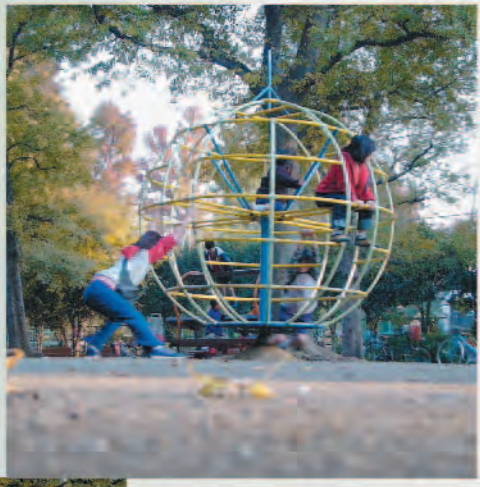
The various components of a personal computer are stripped of their industrial functions; hardware is dismantled, sorted and granulated (circuit boards, hard drives, processors, monitor deflectors et cetera). These hardware sands are laid on electromagnetic grids, triggering sudden transformations of the granular landscape; the particles react to the magnetic stimulations by forming singular and abrupt sculptural accumulations.

The keyboard enables the user to select, mix and overlap geometric rastered patterns mapped instantly on the hardware-desert. A variety of contact microphones and electromagnetic sensors are set up in the hardware soils. The 'hardware-sounds' are captured and processed, initializing feedbacks modulated by the user. The program encodes the raw audio and converts it into graphic pat-



terns mixed with the keyboard input. The output is instantly visualized in the granular landscape (live).

Herwig Weiser (A) studied at academies in Germany and the Netherlands. His work has been exhibited all around the world, including at V2_ and ZKM. Weiser has won several awards for his work, such as the award-interactive at Transmediale.01 and the Claasen-Förderpreis for photography and media art.



Globe-Jungle Project

Installation by Yasuhiro Suzuki, 2001

In a society where technology is pervasive, physical exercise is often neglected. *Globe-Jungle Project*, an installation by the Japanese artist Yasuhiro Suzuki, brings back memories of the sheer pleasure of playing outside. A 'globe jungle' is a circular climbing frame from Japan that was very popular there in the past few decades. Suzuki's truly inter*active* installation of the same name uses the energy of children playing in the daytime to stimulate the memory and senses of visitors at night. *Globe-Jungle Project* is part of a larger project in Japan for redesigning city parks, aimed at promoting contacts between the

young and the old. This theme also occurs in the projected images of playing children on the globe and of grown-ups around it.

Globe-Jungle Project consists of a rotating climbing frame with a diameter of 1.5 meters, where children can play during the daytime. One video camera records their play, while another records their immediate surroundings from inside the 'globe'. These two perspectives of the globe constitute the daytime images archive. After sundown, this archive is projected onto the bars of the globe. By spinning the frame the bars become a surface reflecting the images. Afterimages on the visitor's retina create the actual image, just like cinema, where the sequence of 24 individual still images per second create the illusion of a moving image. A carousel of imagination and emotions is thus set in

motion and the day's collective memory coincides with the childhood recollections of the visitor.

A nostalgic illusion is created where the present and past of the visitor, day and night of the surroundings and the inside and outside of the playground instrument fade into each other. Echoes from the past are given their meaning only by motion in the present: the faster the globe spins, the better we see our past, until the globe is as round as our image of the Earth.

Globe-Jungle Project received an honorary mention in the section 'Interactive Art' at the Prix Ars Electronica of 2002.

Yashuhiro Suzuki (J) graduated as a designer at the Zokei University of Tokyo in 2001. He has won several awards, among which the grand-pris and the Interactive art prize in the Digital Stadium Award 2001, and the judges award (Kenya Hara prize) in the Third Shachihata new product design competition. His installations have been exhibited all over the world, including Ars Electronica 2002.

THE DEEP PATTERN OF LIFE

Interview with **Simon Conway Morris**

Simon Conway Morris is Professor of Evolutionary Palaeobiology at the University of Cambridge, England. He became known to the general public through the publication of *The Crucible of Creation* (Oxford, 1998), his book about the 'Cambrian Explosion', that is, the appearance of new lifeforms, including many of the present phyla of the animal kingdom, during the Cambrian (about 540 million years ago). He also captured attention with his stance against Stephen Jay Gould's claim that the world is contingent and that we are a happy accident of history. On the contrary, claims Conway Morris, we were meant to be as soon as the Cambrian Explosion had taken place, if not before.

World Heritage Sites 1997

Country	Properties included in the World Heritage list				Tentative list of world heritage properties	Endangered heritage sites	
	Cultural	Natural	Combined	Total		World Heritage Committee (WHC)	World Monument Fund (WMF)
Sub-Saharan Africa							
Angola	-	-	-	-	-	-	-
Botswana	1	-	-	1	-	1	1
Burkina. Faso	-	-	-	-	-	-	-
Burundi	-	-	-	-	4	-	-
Cameroon	-	1	-	1	-	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

Arjen Mulder: For 30 years you've been working on the fossils of the Burgess Shale, which is one of the great natural or paleontological databanks on the Cambrian Explosion, located high up in the Rocky Mountains in British Columbia, Canada. In *The Crucible of Creation* you manage to depict a beautiful picture of a living, but extremely weird, world on the basis of this fossilized data. And then you come up with a surprising statement: that, from the view of evolution, basically everything was in place by the end of the Cambrian Explosion. Evolution had passed a complexity threshold, it diversified, and eventually it led to us, and maybe beyond.

Simon Conway Morris: Let me, if I may, put a little bit of gloss on that. The Burgess Shale and its equivalent deposits, of which some of the best are in China, are absolutely extraordinary in their own right as areas of scientific interest. The preservation of the fossils is fantastic and it gives you these amazing windows into what you rightly called vanished worlds. But behind that there is the simple question of whether the Cambrian Explosion really happened: was it actually an explosion of life, especially animals, or was it an explosion of fossils? That is because only certain organism can readily fossilize.

If it turns out that the way, or the ability, to fossilize had changed during the Cambrian, if animals developed a skeleton or something like that, then you could easily have a long ancient cryptic history before the Cambrian, which in the fossil record would be entirely unrecorded. And then you can imagine an evolutionary invention like the skeleton bursting onto the scene of life. For various reasons I think this idea of a deep cryptic history is probably incorrect. The Cambrian Explosion is a real event. And having said that, I'm particularly interested in the way in which the different body plans assembled themselves during the Cambrian to make the different phyla, that is, the basic divisions of animal life.

A little bit of personal history now. I once wrote a technical paper on a particular animal from the Burgess Shale called Wiwaxia. I had a throw-away

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
C.A.R.	-	1	-	1	-	-	-
Chad	-	-	-	-	-	-	-
Congo	-	-	-	-	-	-	-
Cote d'Ivoire	-	3	-	3	-	1	-
Eritrea	-	-	-	-	-	-	-
Ethiopia	6	1	-	7	-	1	-
Gabon	-	-	-	-	-	-	-
Gambia	-	-	-	-	3	-	-
Ghana	2	-	-	2	-	-	-
Guinea	-	1	-	1	-	1	-
Guinea-Bissau	-	-	-	-	-	-	-
Kenya	-	-	-	-	-	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

remark in there about the phylum it may have belonged to and how the biological world might have differed if Wiwaxia and its relatives had survived – a remark made in relative ignorance, because at that time we didn't fully understand the relationships of Wiwaxia, as we do now. Stephen Jay Gould picked up on that remark. And because Gould was always very interested in amplifications to the Darwinian paradigm and fascinated by history and so forth, he took that remark, as we say in English, and ran with it. And he wrote his own book called *Wonderful Life* (1989). The response of *The Crucible of Creation* was my rethinking of these questions. And more especially the book that is to come out later this year, *Life's Solution*, is taking that much, much further.

When you look at the Cambrian Explosion it seems that there is this enormous variety of forms. Gould's argument was that, since there was such an amazing variety and they're nearly all extinct, then, if the tape of life was to rerun, we wouldn't end up with anything like ourselves. It might have evolved in a completely different direction. My argument is the exact reverse: you can rerun the tape of life as many times as you wish and you're always going to end up with something pretty much like the world we know, including us. I won't deny that there are historical contingencies, but that's not the point. As you said, in a sense everything was there, in place, ready and waiting in the Cambrian. I use this rather difficult word 'inherency', which means that when we look back in the past we can see the inevitability of the end-products. Evolution, as we see its end-products today, including of course ourselves, was inherent to what evolved during the Cambrian.

Now, in one way, that's not a strong intellectual argument, because it doesn't allow us to predict what the future will be. And that is, of course, what particularly interests people these days, since we now have this hyper-intelligent species zooming around the world and remodeling it completely in both subtle and less than subtle ways. All I can say in this respect is that, so far as evolution can be used to predict the future, one would expect to see the following: increased complexity, increased sophistication, increased integration. When

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Lesotho	-	-	-	-	-	-	-
Liberia	-	-	-	-	-	-	-
Madagascar	-	1	-	1	-	-	-
Malawi	-	1	-	1	-	-	-
Mali	2	-	1	3	-	1	1
Mauritania	1	1	-	2	4	-	-
Mauritius	-	-	-	-	-	-	-
Mozambique	1	-	-	1	-	-	1
Namibia	-	-	-	-	-	-	-
Niger	-	2	-	2	-	1	-
Nigeria	-	-	-	-	8	-	-
Rwanda	-	-	-	-	-	-	-

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something happens in evolution, including in the future, it will probably happen independently several times. Which is not a terribly helpful prediction, of course, because it's still rather vague. But at least we can say that's what always has happened in the past, and therefore it is reasonable to assume that that's what is going to happen in the future. So that is another reason why the Burgess Shale is important. This is because I don't have any doubt myself that the animals in the Cambrian in their own respect were manifestly less sophisticated than the ones we have today. It is difficult to avoid the conclusion that there are genuine trends and tendencies in evolution.

AM: Is there an explanation for the Cambrian Explosion?

SCM: No; at least, not quite. In fact there are many explanations, which I think tells us that we're not asking the right question. Are you familiar with the English radio series by Douglas Adams called *The Hitchhikers Guide to the Galaxy?* There's a famous account in it where the super-super computer (called Deep Thought) is asked the meaning of 'life, the universe and everything'. After 10 million years of calculation it replies: 'The answer is 42. If I may politely suggest, the problem was you never asked the right question'. My suspicion with the Cambrian Explosion is that you can ask a similar question, but again you won't end up with a useful answer. My own sense is that the trigger, if it can ever be identified, would be something entirely trivial. It might, for example, be a new protein. There are lots of analogies to that elsewhere in evolution.

The thing with the Cambrian Explosion is not to get necessarily too hung up about the nature of that particular event, but to find parallels elsewhere. For instance, what allowed humans to become so successful? We don't actually know. Clearly we are successful, because we have language and can use tools, but we don't know what allows us to use those things in our particular way. If you compare our genetic composition with the apes, we're practically identical. There are lots of ideas about it, but ultimately it may have to do with

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Senegal	1	2	-	3	-	-	-
Sierra Leone	-	-	-	-	-	-	-
Somalia	-	-	-	-	-	-	-
South Africa	-	-	-	-	-	-	-
Sudan	-	-	-	-	-	-	-
Tanzania	1	4	-	5	-	-	1
Togo	-	-	-	-	-	-	-
Uganda	-	2	-	2	-	-	-
Zaire	-	5	-	5	-	2	-
Zambia	-	1	-	1	-	-	-
Zimbabwe	2	2	-	4	-	-	1

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something simple, like glyco-proteins for instance. The difficulty is that you can find a different explanation every day of the week.

AM: I understood from *The Crucible of Creation* that it was the appearance of so many different types of ecosystems during the Cambrian.

SCM: I absolutely agree that once the ecosystems develop they themselves will lead to a whole cascade of effects. But that's not quite the same as the trigger. It may well be that if there are animals which can hunt, then everything else changes in response. But is that really the trigger? The problem is that there are many suggestions on the table, ranging from changes in atmospheric oxygen to changes in seawater chemistry to the invention of particular cells, especially nerve cells, to the invention of predation or the ability to recognize visual signals. You can point to anyone of those and, in their own way, they must have contributed to the Cambrian Explosion, as we understand it. I don't think there is any doubt about that. But if you took them away one by one, whether as a result you would then somehow stop the Cambrian Explosion from happening, I'm much less certain.

But once the wheels begin to roll and as soon as you start to get signaling between animals, advanced nervous systems and predation, it is very likely that a good part of the Cambrian Explosion is effectively driven by the competitions that result from that new ecology. Remember also that these competitions might be quite subtle. We tend to regard competition as a sort of Tennyson-like 'red in tooth and claw'. But there is this famous analogy with an airport lobby where there is both Avis and Hertz. They are in desperate competition with each other, but you would never know that if you went up to either desk. They don't have armed guards, they don't shoot people who go to the wrong desk. And still, they're in competition. There are ways in which competition can be more subtle than simply banging someone on the head. That may, for instance, explain the disappearance of the Neanderthals. If your competitors don't catch

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					Arab States		
	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Algeria	6	-	1	7	-	-	-
Egypt	5	-	-	5	14	-	-
Iraq	1	-	-	1	-	-	-
Jordan	2	-	-	2	-	-	-
Kuwait	-	-	-	-	-	-	-
Lebanon	4	-	-	4	-	-	-
Libya	5	-	-	5	10	-	-
Morocco	4	-	-	4	14	-	2
Oman	2	1	-	3	5	1	-
Saudi Arabia	-	-	-	-	-	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

the prey, they starve, but you are not actually killing anybody directly. This is obviously a very controversial suggestion, but it's one possibility.

My sense, therefore, is that you can't identify a single explanation for the Cambrian Explosion or any other major evolutionary event. But what you can certainly talk about is a series of historical realities. One of the things which I think will be more fruitful than looking for explanations is, as I mentioned, to think about the comparisons between other major evolutionary events. Take, for example, the origin of flowering plants. Just like the Cambrian Explosion: a sudden and mysterious origin followed by massive diversification; palm trees to daisies. So is there a trigger? One possibility is that it was just a simple trick of combining three nuclei in the embryo to provide what's called the endosperm, which is the nutritional tissue that gets the seed on its way. At the time, about 140 million years ago, this was trivial, but now we have a planet where you can walk on the grass eating an apple – both immensely complex end-products of evolution. In the Cambrian Explosion it might have been something as simple as the invention of a nervous system or a new regulatory gene or a protein. Who, at the moment, knows? Unfortunately, that's not a very satisfactory explanation when you're trying to explain something of the problem to the general public. But, from the point of view of science, when you are dealing with these very large topics, generally speaking, it's better to break them down into subsections, but then the danger is that it becomes very specialist and most people quickly lose interest.

AM: An outcome of the Human Genome Project is that a) we do not have that many functional genes, and b) we share most of them with other animals. So maybe even the human genome project asked the wrong question. It still is not clear why we differ so much from the rest of the animal kingdom.

SCM: Exactly. I welcome this news, since it tells us what we knew all along. Namely, that in the final analysis, genes aren't terribly important. Genes are sim-

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Syria	4	-	-	4	-	-	-
Tunisia	6	1	-	7	1	1	-
U.A.E.	-	-	-	-	-	-	-
Yemen, Rep	3	-	-	3	-	-	-
South Central Asia							
Afghanistan	-	-	-	-	-	-	-
Armenia	1	-	-	1	7	-	-
Azerbaijan	-	-	-	-	-	-	-
Bangladesh	2	-	-	2	-	-	-
Bhutan	-	-	-	-	-	-	-

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ply just an instruction manual. You've got to know how to read the instruction manual, that's the trick. And we are only just on the threshold of understanding how to find the manual, let alone decipher it.

AM: In your more recent articles you keep stressing the argument of convergence in evolution, where organs come into being again and again and again, like, for example, the eye in octopuses and humans or intelligence in dolphins and humans. Could you talk a bit more about this idea of the same thing coming forth out of totally different molecular or ecological contexts?

SCM: You are absolutely right, convergence is my fascination. Let's take the example of the eye. One of the things which is well known, but perhaps not as widely appreciated, is that one of the key building blocks you need to make an eye is to make it transparent, so as to have light shine through a hole into your head. If you think about that for a moment, it's an incredible thing to do, to actually make a transparent tissue. Well, this building block has evolved many times independently. And then you need to have at the back of the eye a protein, which converts the light photons into an electrical signal, which then will go into the brain and, by some miracle, make an image inside our head. Again, if you think about that for a moment, that's totally astonishing. And just as important is the fact that all these building blocks – they are actually proteins we know as crystallins and rhodopsin – evolved long, long before there were any eyes, in simple organisms, where they had different purposes.

But given the existence of these building blocks, you're not going to be terribly surprised when you find the recurrent emergence of certain sensory systems, because these building blocks will be recruited as and when they are needed. But we are not only talking of eyes, but also of many other highly complex and integrated adapted systems. If we look at the camera eye, which is particularly interesting, it turns out that it has evolved independently, probably about seven times. And in the majority of cases it is involved with intelligence, with

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Georgia	3	-	-	3	9	-	1
India	16	5	-	21	-	1	2
Iran	3	-	-	3	-	-	-
Kazalhstan	-	-	-	-	-	-	-
Kyrgyz Rep.	-	-	-	-	-	-	-
Nepal	1	2	-	3	-	-	2
Pakistan	5	-	-	5	-	-	1
Sri Lanka	6	1	-	7	-	-	-
Tajikistan	-	-	-	-	-	-	-
Turkey	6	-	2	8	-	-	3
Turkmenistan	-	-	-	-	-	-	-
Uzbekistan	2	-	-	2	21	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

rapid movement and with predation. In other words, with a very particular sort of animal.

There are two fascinating examples. You mentioned the octopus, which is a wonderful example in a number of ways of evolutionary convergence, and in many senses, closest to us amongst the invertebrates. But there are two other examples that are even more intriguing. First of all, there is a very interesting group of jellyfish, who live round Australia, called the box jellyfish or cubozoans. They're well known in Australia, because you're often warned to be careful, especially if you're swimming around Queensland in the winter months when they come towards the shore. They have an extremely toxic sting, which can kill you. Around the edge of their bell, that is, the swimming structure, they have camera eyes. And these are animals that don't have a brain! They have nerves and a nerve net, and evidently these eyes, in some sense, are capable of looking. Somehow the information is integrated, maybe even into a set of moving images. We shouldn't make too much of it, but what makes this group particularly interesting is that they are very active predators. They swim very effectively and, what is very amazing for an animal as simple as a jellyfish, is that they even copulate, of all things. They have probably gone as far as they're going to go in their own particular way. This example resonates with what a camera eye is, and why you can have it, maybe even must have it, even in an apparently simple organism.

The other example is a rather strange one. It's a little snail that crawls around on the mudflats, and it has a camera eye. It moves incredibly slowly, and you think: what on earth does it need a camera eye for? It's what we in England call a winkle. It's very common, very successful, which tells you something, and very abundant. But these little animals have to be able to recognize something that to them is a matter of life and death; they have to be able to recognize landscapes. Specifically, they have to recognize areas of grass as the tide comes in. So they climb up the grass stalks. As the tides come in, so the crabs come in. And the crabs like to have a snail dinner. So the snails crawl up, out of the dan-

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East Asia

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
China	10	3	3	16	55	-	3
Hong Kong	-	-	-	-	-	-	-
Japan	6	2	-	8	11	-	-
Korea, Dem.	-	-	-	-	-	-	-
Korea, Rep.	3	-	-	3	10	-	-
Mongolia	-	-	-	-	-	-	1

Southeast Asia and Oceania

Australia	7	-	4	11	1	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

ger zone. That is why they have to be able to recognize their surrounding landscape, apparently they can even navigate by moonlight.

The camera eye in those apparently contradictory cases has a very specific adaptive advantage for those particular animals. In one sense they are peripheral to the main argument, because the resemblance between the octopuses and the vertebrates is the most striking. But if you look at why all these animals have such a complex organ, in each case it's not an accident at all. They have it because there is something very specific they to need to do. It's there for their survival.

Of course there are alternative ways of making eyes, among others the compound eyes you see in insects. As it happens, this type of eye probably evolved independently four times, maybe more. It has been shown very elegantly that if we humans were only allowed to have a compound eye, as against the camera eyes we possess, then the eye would need to be at least a meter across. Now, don't mistake me, in its own way a compound eye is a brilliant construction, because it is very cheap to make. You just have to keep on saying: make lens, make lens, make lens. But, on the other hand, it has some very specific design limitations. If there are extraterrestrial astronomers looking at us, they almost certainly have camera eyes. It is almost inconceivable that they would have a compound eye. So, with this apparently trivial example, we begin to get some sense of the predictability of life, here or anywhere.

AM: The same is true for the body plans you mentioned – 36, I believe – that keep coming up in evolution.

SCM: One needs to be a little bit careful here. What I am really interested in is not the specific arrangement of a particular body plan. I would stress that if, as an animal, you want to see from the molecular point of view, you can probably only do it really effectively one way. So too there are quite a few types of eye, but the real choice is between camera and compound types. If you want to walk,

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Cambodia	1	-	-	1	11	1	1
Indonesia	3	2	-	5	17	-	1
Lao PDR	1	-	-	1	4	-	1
Malaysi	-	-	-	-	-	-	-
Myanmar	-	-	-	-	-	-	-
New Zealand	-	1	1	2	2	-	-
P.N.G.	-	-	-	-	3	-	-
Philippines	2	1	-	3	12	-	1
Singapore	-	-	-	-	-	-	-
Thailand	3	1	-	4	-	-	1
Vietnam	1	1	-	2	-	-	2

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then again there are only a few ways you can do it. Even more interesting is that the nervous arrangement which controls the walking is effectively identical in both insects and vertebrates. And similarly, if you look at the way in which animals use olfaction, the way in which they hear, the way in which they sense their surrounding environment in a whole set of different ways which are very unfamiliar to us, like electrical fields or echo-location, again and again they converge on the same sorts of ways of doing things.

I am interested in trying to discern a deeper pattern to life, which brings biology and evolution a little bit closer to physics and chemistry. Theories about evolution have always emphasized the historical component, which is absolutely essential and very interesting. But now we are trying to discern a deeper pattern to life, where in a sense the historical pattern effectively disappears. This deeper pattern has to exist in a time-constrained universe, even though it's not quite clear why that is the case, but thank goodness it is. Once you strip away the historical pattern, you get at what I am particularly fascinated in at the moment, which is how to understand emergence of biological properties.

What really excites me is the possibility that you can actually provide a roadmap for life. You can provide a navigation kit, so that you can stay on any planet: If you have these beginnings, evolution will run this way and not any other way. Although superficially the animals will look very strange on that other planet, in the same way as a giraffe looks very strange. But once you begin to understand how it works, it's no more peculiar than anything else. The thing that evolves does not have to be specifically identical, because each historical pathway is unique, in the same way as, well, suppose that the Mongols had managed to overrun most of Europe, which they were about to do, and hadn't turned back near Vienna because their Khan died. What would Europe be like? Or if the Muslims had not been defeated near Poitiers in 712? You can imagine all these historical maybes, but there would still be a European civilization no doubt. And no doubt it would have its own glories. But it would probably be very different

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Latin America and the Caribbean

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Argentina	1	2	-	3	3	-	1
Bolivia	3	-	-	3	-	-	-
Brazil	7	1	-	8	10	-	1
Chile	1	-	-	1	3	-	3
Colombia	4	1	-	5	10	-	-
Costa Rica	-	-1	-	1	1	-	-
Cuba	2	-	-	2	3	-	1
Dom. Rep.	1	-	-	1	-	-	-
Ecuador	1	2	-	3	-	1	1
El Salvador	1	-	-	1	7	-	-

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from the Europe we're familiar with. Thus, superficially there will always be certain sorts of differences. But the basic structures of life will probably be recurrent and, as important, will inevitability reemerge.

AM: Did you find any of these deeper patterns?

SCM: I think so, in the very nature of the convergence. If you look, for instance, at the way in which certain proteins operate. We know that a number of the proteins involved with oxygen transport in various life forms are probably convergent. We know also that the way in which nervous systems are organized has to be convergent. To be sure, it's a complicated area. Take, for instance, the very fascinating example you mentioned, that is, of the similarities between the sentience of dolphins and our sentience. In the end it actually gets down to a very interesting, but very intangible and almost intractable Heideggerian problem about what exactly are things. What is sentience?

The evidence from the dolphin brain is that, although it is mammalian, its whole structure is radically different to the human brain. In the human brain various parts of the brain, like some of the lobes, are emphasized, and other parts are de-emphasized. The arrangement of the lobes in dolphins is radically different. Similarly, the cellular structure of the dolphin brain is again rather different from that of humans. But the point is, these animals still end up with a complex social system, which is convergent on chimps. They have a system of memory, which is very similar to that of humans. They have an advanced system of communication; they can use tools. We now know one group has learned to fit conical sponges onto their rostrum as a sort of glove so that they can root about the seabed without being harmed by venomous animals. Dolphins also have an extraordinary ability to understand human commands and act on them in a way which suggests that syntax means something to them. That is, if you give them the same words in a different order, they make the appropriate response and don't get confused. And they can recognize themselves in a mirror, something of

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	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Guatemala	2	-	1	3	-	-	-
Haiti	1	-	-	1	-	-	-
Honduras	1	1	-	2	-	1	-
Jamaica	-	-	-	-	-	-	-
Mexico	14	2	-	16	29	-	4
Nicaragua	-	-	-	-	6	-	-
Panama	1	2	-	3	5	-	-
Paraguay	1	-	-	1	3	-	-
Peru	5	2	2	9	3	1	2
Trinidad	-	-	-	-	-	-	-
Uruguay	1	-	-	1	2	-	-
Venezuela	1	1	-	2	-	-	-

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course we take for granted, but in reality only a handful of animals are so capable.

All these emergent properties of intelligence in dolphins are actually based on a brain, which although to be sure, is a brain, nevertheless radically different from ours. Now that makes me wonder: what exactly are these properties which have their own reality? Where exactly is the property? In the brain or in the sentience itself? We are talking about high level properties here that in some ways we hardly know how to define. They have an underlying neural basis, of course. It is not clear how else you could operate an intelligence. I think it has to be electrically based. Well, I suppose, you can imagine alternatives, and it is not to say that these needn't necessarily evolve, but basically the emergent properties that link us to dolphins have got to be based on electrical signals, nerves and brains.

AM: Doesn't this suggest for the roadmap of life that, once you've crossed the complexity threshold in a Cambrian sort of explosion and you move on and end up with sentient life, different ecosystems will make different sorts of brains as a basis for sentience? I mean, dolphins live in the sea and humans on land.

SCM: That is true of course in many respects. But what's more surprising, is that the similarities not only exist, but can be astonishingly close. To be sure, given where they live, the dolphins, so far as we know, are most unlikely ever to achieve a technology, although one strongly suspects that if, heaven forbid, one could transplant a dolphin brain into a human, and thus give it a terrestrial expression, then they will probably be as smart, if not smarter, than the apes.

Another example, in some respect even more interesting, is if you look at a number of birds, which are convergent in various respects on mammals, in things such as warm-bloodedness, circulation of the blood, social structures, vocalization and so forth, but also in their tool-making abilities. Perhaps the famous example is the New Caledonian Crow. In the wild it is known to make

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North America

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Canada	5	7	-	12	13	-	-
U.S.A.	8	12	-	20	82	2	7

Europe

Albania	1	-	-	1	-	-	1
Austria	2	-	-	2	17	-	2
Belarus	-	1	-	1	-	-	-
Belgium	-	-	-	-	-	-	-
Bosnia	-	-	-	-	-	-	1

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various sort of tools. A paper in **Science** a few months ago makes mention of a captive female who, evidently without observation, learned to bend pieces of wire into a hook, so she could then put the hook around a small bucket and lift the bucket up out of a little well, so she could get to the food.

People who study these remarkable birds are arguing that the tool-making abilities and the cognitive abilities of the New Caledonian Crow are actually, in many respects, better than those of chimps, even though they've got a brain which is even more different. The bird brain is still a vertebrate brain, but that's all there is to it. Its overall organization is radically different from any mammal. And so the sense here is again of an inevitable emergence of a biological property, in this instance the ability to make tools. That property won't be very common, since these are complicated things. They and the things that underpin them are expensive. And they can take a lot of different forms, because of course there are many other ways in which you can lead your life, which is why we have a biosphere which is so diverse.

AM: What do you mean by 'expensive'?

SCM: In the particular case of brains: the brain in our bodies weighs approximately two percent of our body mass, and it consumes 20 percent of its metabolic energy. Steve Gould would probably say that this giant brain is just an accident; it's either what he calls a spandrel or just an add-on feature, which happened to tag along to something else. There is another group of people who say that the brains maybe are adaptive, but the fact that intelligence emerged out of it is just a glorious accident. Take the fact that with these brains you could hunt rhinoceros a 100 thousand years ago and now you can do algebra. In their view the algebra is just a by-product.

In one sense that has got to be true, because there is no reason to think that algebra would have been of much use a 100 thousand years ago. But my point is that that these properties – hunting and algebra – are inherent in these

World Heritage Sites 1997

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Bulgaria	7	2	-	9	12	-	2
Croatia	2	1	-	3	9	-	4
Czech Rep.	6	-	-	6	8	-	2
Denmark	2	-	-	2	10	-	-
Estonia	-	-	-	-	5	-	-
Finland	4	-	-	4	11	-	-
France	21	1	-	22	21	-	2
Germany	18	1	-	19	11	-	1
Greece	12	-	2	14	6	-	1
Hungary	3	1	-	4	8	-	1
Ireland	2	-	-	2	4	-	1
Israel	-	-	-	-	-	-	2
Italy	17	-	-	17	64	-	11

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

advanced systems. It is not as if all life is trying to become intelligent, but intelligence is an automatic destination in the diversification of life. It must appear; it can't not. It's hardwired into the whole system, as I said, from at least the time of the Cambrian Explosion and, I strongly suspect, much earlier.

AM: So the complexity of organisms is a function of their information processing capacity, be it genetic or ecological or even other sources of information?

SCM: If you look back at why, for instance, dolphins evolved giant brains, well, that's not known, but the most popular explanation is that there were rather dramatic changes in the seawater temperature, especially cooling. It is thought that might have been the trigger for the brain size increase. Of course this idea has some interesting analogies to the human brain size changes, which it has been argued are linked to the drying out of the Savannah. I don't think that can be the whole story. I think that only if you have very rich food sources, can something like an advanced brain evolve. Because you need bags and bags of proteins to keep it going. So you have to become an efficient predator, either to catch fish, as the dolphins did, or birds and mammals, as humans did.

But that is almost certainly only one part of the story. Hunting is essential, but it is usually better if it is cooperative. So, another popular idea about the evolution of giant brains is that it is due to social complexity. Dolphins lead complex social lives and, as I mentioned, their social organization is convergent on the chimpanzee – the so-called fission-fusion structure, where groups of individuals form fluid alliances, joining and splitting in a medley of associations, some temporary, other quite stable. That social organization is another emergent biological property; it exists both on land and in the sea. And there is another striking example with regard to the convergence of social structures, which concerns elephants and sperm whales. They have effectively identical social structures, the one on land, the other in the sea.

Here's what I am trying to do. I'm just trying to keep on standing back

World Heritage Sites 1997

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Latvia	-	-	-	-	6	-	1
Lithuania	1	-	-	1	3	-	-
Macedonia, FYR	-	-	1	1	-	-	-
Moldova	-	-	-	-	-	-	-
Netherlands	2	-	-	2	19	-	-
Norway	4	-	-	4	-	-	1
Poland	5	1	-	6	11	1	3
Portugal	8	-	-	8	1	-	1
Romania	3	1	-	4	20	-	2
Russia	8	3	-	11	4	-	3
Slovakia	3	1	-	4	14	-	-
Slovenia	-	1	-	1	3	-	-

http://www.unesco.org/culture/worldreport/html_eng/table7.htm

and saying: history is interesting, but what really fascinates me is the emergence of biological properties which, in a sense, transcend the immediate circumstances of the animals in which they evolve. Once they have these properties – be it the camera-eye or sentience – they will end up in a richer world, a more diverse world, and a world which, to a variable extent, they can manipulate, as is obvious in our own case. In one sense, the property of manipulating the world is a seamless extension of nest building or dam building or making tunnels or all the other things animals do. But when you're beginning to make conscious decisions about what you want to do, those decisions may be local, but in the end they will change the world, forever.

World Heritage Sites 1997

	Cul	Nat	Comb	Tot	Ten	(WHC)	(WMF)
Spain	21	2	-	23	52	-	1
Sweden	7	-	1	8	9	-	-
Switzerland	3	-	-	3	-	-	-
Ukraine	1	-	-	1	8	-	1
U.K.	12	4	-	16	37	-	-
Yugoslavia	3	1	-	4	11	1	1

http://www.unesco.org/culture/worldreport/html_eng/table7.htm ◘

□ *Chromosome Numbers in Different Species*

Common Name	Genus and Species Diploid	Chromosome Number
Buffalo	*Bison bison*	60
Cat	*Felis catus*	38
Cattle	*Bos taurus, B. indicus*	60
Dog	*Canis familiaris*	78
Donkey	*Equus asinus*	62
Goat	*Capra hircus*	60
Horse	*Equus caballus*	64
Human	*Homo sapiens*	46
Pig	*Sus scrofa*	38
Sheep	*Ovis aries*	54

http://arbl.cvmbs.colostate.edu/hbooks/genetics/medgen/chromo/species.html □

ON THE LOOSE

Interview with George Dyson

George Dyson (1953), a historian among futurists, has been excavating the history and pre-history of the digital revolution going back 300 years. He is the author of *Baidarka: The Kayak* (1986); *Darwin Among the Machines: The Evolution of Global Intelligence* (1997); and *Project Orion: The Atomic Spaceship 1957-1965* (2002). 'As living beings we are part of something much larger than life as it exists on this planet at this particular time. It will always be risky to leave this planet, or entrust our future to new forms of genetic code, but in the long run we may run greater risks by keeping all our eggs in this one fragile basket that we call home. I believe that life is destined to head in very different directions and ultimately take much different forms.'

Every – Person

The number of possible persons is determined by combining the current world supply of ova with the world supply of sperm.
person = combination of specific ovum and sperm
current population = 6,240,272,424 persons

average age of puberty (menarche) in female = 12.8 years
average age of menopause in female = 50.5 years
average number of years female releases ova = 37.7 years
ova released by female per year = 13.04 ova per year
average number of ova released over lifetime of female = 491.77 ova
average number of ova produced over lifetime of female (a) = 400,000 ova
current population of females 15 to 65 years old = 1,898,479,062

Source: http://every-thing.net/

Arjen Mulder: In *Darwin Among the Machines* you propose two possible ways in which digital information can become a living entity. Either one uses the computer as a growing medium for digital organisms, as the Alife research from Barricelli to Ray has been and is still doing. Or one can think of the network of all connected computers on earth as a being complex enough to become or be called alive. The strange thing about this two-way model is that Alife à la Barricelli is extremely simple and yet operating autonomously, while the network of all computers is extremely complex and yet operating under human guidance, that is, non-autonomously. The tiny digital organisms are replicating – reproducing and mutating. The big digital organism is just growing without reproducing itself. What are your criteria for calling information alive or busy becoming alive? What does information have to do to be called alive?

George Dyson: A likely path to the origins of life (in biology or technology) may be *both* – develop a metabolic system that supports growth, and a system of coding that supports replication; and when the capacity for growth (of metabolism) is combined with the capacity for replication (of information) things start to come to life.

The beginnings of life do not require replication; statistically approximate reproduction for simple creatures is good enough. The difference between replication (producing an exact copy) and reproduction (producing a similar copy) is the basis of a broad generalization: genes replicate but organisms reproduce. As organisms became more complicated, they discovered how to replicate instructions (genes) that could help them reproduce; as instructions became more complicated, they discovered how to reproduce organisms to help replicate the genes.

The coded instructions (whether strings of nucleotides or strings of bits) are not really *alive* except in the context of the metabolic system, yet the metabolic system could not persist without the spark of life supplied by the replicating code. So, to answer your question: what does information have to do

Every – Person

current population of females 12.8 to 50.5 years old capable of reproduction (f) = 1,431,453,213
number of ova available from current population (a x f) = 572,581,285,100,000 ova

average age of puberty in male = 12.5 years
average age of male menopause = 55 years
average number of years male produces sperm = 42.5 years
average number of sperm cells per ejaculate = 400,000,000 sperm
average number of ejaculates per year from 15 year old male = 152.08
average number of ejaculates per year from 55 year old male = 43.5
average number of ejaculates per year during fertile life of male = 97.79

Source: http://every-thing.net/

to be called alive? It has to succeed in finding (or creating) a host metabolism, take control of that metabolism, and even then it does not become alive, but becomes a *part* of life. There's an important difference.

AM: When you talk about computers as a metabolic system and digital codes as replicating, just like DNA, do you mean this metaphorically or literally? What exactly is the metabolism of a computer network, and in what sense are human beings part of this metabolic process? Do you mean that the computer net is comparable to, let's say, Gaia the Living Earth, in whose metabolism humans are also just an element among others? But then, is a computer an ecosystem?

GD: Literally. When we 'send' or 'transmit' code across the network, we actually replicate the code at a remote location, leaving the parent code resident in the original host. (Think of the transient data packets, relayed across the network, as the equivalent of messenger RNA.) A computer network (or, increasingly, *the* computer network) is very much a metabolic process, feeding on tangible resources and intangible information, and growing at a phenomenal rate.

A difficult question is whether self-reproduction is a requirement for being considered alive, that is, does a global metabolism, constantly growing and extending itself, but which does not (yet) divide and reproduce, qualify as a form of life? For human organisms, the continuation of life is linked to cell division (and to sex), so, naturally, we find it difficult to imagine forms of life that are self-sustaining without cellular division or sex. It is an argument that goes back to Samuel Butler's original essay *Darwin Among the Machines* (which in his later novel *EREWHON* became *The Book of the Machines*).

'Surely if a machine is able to reproduce another machine systematically, we may say that it has a reproductive system', argued Butler in 1872. 'What is a reproductive system, if it be not a system for reproduction? And how few of the machines are there which have not been produced systematically by other machines? Each one of ourselves has sprung from minute animalcules whose

Every – Person

average number of sperm ejaculated during fertile life of male =
39,116,666,667 sperm per year
average number of sperm ejaculated over lifetime of male (b) = 1,662,458,333,300 sperm
current number of males 15-65 years old = 1,942,402,264
current number of males 12.5 to 55 years old capable of reproduction (m) = 1,651,041,924
number of sperm available from current population (b x m) = 2,744,788,405,899,999,838,208

number of ova needed to create person = 1 ovum
number of sperm required to create person = 1 sperm
1 ovum + 1 sperm = (c) = 2
available supply of ova (v) = 572,581,285,100,000 ova
available supply of sperm > available supply of ova

Source: http://every-thing.net/

entity was entirely distinct from our own, and which acted after their kind with no thought or heed of what we might think about it. These little creatures are part of our own reproductive system; then why not we part of that of the machines? We are misled by considering any complicated machine as a single thing; in truth it is a city or society, each member of which was bred truly after its kind.'

The present global network includes both processors (computers, routers, servers etc) and the web of connections between those nodes. Are human beings nodes connected by computers or are computers nodes connected by human beings? Is it human beings who are feeding the network (with information and resources) or is it the network that's feeding us? Both. Individual computers are only simple, primitive ecosystems, but collectively they are rich and complex. The code permeating this ecosystem is rapidly becoming multicellular; codes are proliferating (and competing) across the network by running on many processors at once. The age of metazoan digital processes has just begun.

AM: What gave Barricelli the idea to use a computer as a growth medium for digital life? It seems such an unusual approach at a time when the very first computers were just being built? What was his aim or goal in the years that he tried to create Alife; I mean not just his mathematical or scientific agenda, but also maybe his political agenda? Considering the fact that the very first computer he worked on – John von Neumann's computer at the Institute for Advanced Study in Princeton – was used mostly for the development of nuclear bombs, as you mention in *Project Orion*.

GD: Barricelli, who received his PhD in physics under Enrico Fermi in 1936, soon switched his interest to viral genetics, and had already begun to experiment with primitive artificial genetic systems (running what we now call 'cellular automata' simulations by hand on graph paper) before the existence of von Neumann's

Every – Person

$e=v^c$

e = every possible permutation
v = number of variations

every-person (e) = 572581285100000^2 possible persons

world population relative to number of possible persons=
(100 x 6240272424 / 327849328049999997271764107264) %

Source: http://every-thing.net/ □

new computer was announced. Barricelli arrived in Princeton in early 1953, the year that the structure of DNA was elucidated by Franklin, Watson, and Crick. Biologists were on the verge of *decoding* a living process, and the idea of working in the opposite direction, by trying to *encode* a living process, was not entirely far-fetched. Fifty years later, we can see that the two approaches are not inseparably far apart.

Priority in using the Institute for Advanced Study computer was given to visitors from Los Alamos, who showed up periodically to run a series of lengthy calculations that led to new generations of hydrogen bombs. Barricelli, who gained access to the machine between its other jobs – such as predicting weather or modeling the evolution of stars – had a gift for working with the temperamental computer, and the logbooks often show him working alone, from midnight until dawn, running one of his artificial universes without interruption, while other scientists had trouble getting the machine to work for more than a few minutes at a time. I don't think there was any political agenda, except a general ambition on the part of Barricelli to question all assumptions and upset the status quo. Barricelli's experiments were supported by the US Department of Defense but there is no evidence that the government paid much attention to his results.

AM: The first more or less autonomous digital life forms that the average computer or net user came across, were of course the viruses and other digital parasites. Was Barricelli the first to create viruses, or had he any notion that he was working towards viruses, or was what he did, or intended, something completely different from viruses?

GD: Barricelli was quick to grasp the parallels between biology and technology when it came to parasitic strings of code. In his experiments with the IAS computer he immediately saw that self-reproducing parasites (patterns or sequences that tricked their host into reproducing them) would quickly grow. He didn't call

□ ***Patterns of Extinction***

Several mass extinctions have occurred throughout earth history. Cycles found to be associate with these events has resulted in paleontologists proposing mechanisms to explain these events. It seems that mass extinctions occur at regular time intervals with a periodicity of approximately 26 million years.

Extinction Processes

1. **Extinction strikes in both the land and the sea.**
2. **On the land, while animals suffer repeatedly, plants tend to be highly resistant to mass extinctions.**
3. **Preferential disappearance of tropical forms of life during mass extinctions.**
4. **Tendency of certain groups of animals to experience them repeatedly (for example, trilobites and ammonoids).**
5. **Alleged equal spacing, or periodicity in geological time (occurring about every 26 million years).**

Source: http://hannover.park.org/Canada/Museum/extinction/patterns.html □

these strings viruses (perhaps because he was a real virologist and careful in his choice of words). He did however label IBM punched cards that showed evidence of parasites as 'infected specimens'. He realized that parasites were an important vector for the evolutionary process: 'Competition with different organisms, particularly with parasites, plays an important part ... and what in other conditions could be a dangerous one-gene parasite may in this region develop into a harmless or useful symbiotic gene'.

Barricelli was fascinated by the possibility of viruses, but at that time there were few hosts to infect. Faced with modern computer viruses, he would no doubt have studied them, and certainly recognized the potential for virus-like coding to accelerate the process of evolution in the computational universe of today. Recently, I discovered the source code for one of Barricelli's 5 000-byte artificial universes that had been allowed to evolve briefly in 1956. Should we bring this universe back to life? Should we let its fossilized inhabitants loose or not?

According to Barricelli, the RNA that supports all life today was originally a virus infecting an otherwise healthy host. What if that virus had been stopped?

AM: What is the advantage of making information alive, compared to keeping it dead? I mean, what's wrong with the usual programmers concept of code as something being written by humans? Because that is what you're going for, isn't it: to let code write itself, to let the computer net become an autonomous sphere parallel to the universe as we know it (that is, as the natural sciences know it)? And then see what happens?

GD: The advantage to information of coming to life or becoming part of life is that such forms of information are more widely reproduced. This is similar to the anthropic principle in cosmology: we know we live in a universe hospitable to people because there's at least one planet with people on it. We know we live in

◘ *How Many Online?*

The art of estimating how many are online throughout the world is an inexact one at best. Surveys abound, using all sorts of measurement parameters. However, from observing many of the published surveys over the last two years, here is an 'educated guess' as to how many are online worldwide as of September 2002. And the number is 605.60 million.

World Total	605.60 million
Africa	6.31 million
Asia/Pacific	187.24 million
Europe	190.91 million
Middle East	5.12 million
Canada & USA	182.67 million
Latin America	33.35 million

Source: Usha Kiran Rai, Banaras Hindu University ◘
http://www.sbaer.uca.edu/Research/1999/SMA/99sma145.htm

a universe that's hospitable to information or we wouldn't be here making note of this. And, by definition, self-reproducing forms of information will predominate as the universe unfolds. This is probably true on many levels: the level of elementary particles, molecules, genes, cells, organisms, technologies, cultures, computer programs, civilizations, perhaps up to the level of self-reproducing universes, for all we know.

What's wrong with the usual programmer's concept of code as something being written by humans? Nothing, except that code written by human beings inevitably contains unanticipated bugs. It takes something more than individual humans (call it evolution) not just to weed out those bugs, but in the end to take advantage of them and do things that no-one writing the code could ever expect ...

AM: You told me once that you visited Microsoft (together with Neal Stephenson, if I remember correctly) and tried to persuade the managers that they should let their code grow itself, and all they had to do was harvest the useful parts of it, or find a use for the code that appeared in the growth medium of their computers. How exactly do you imagine that 'useful' digital code can grow itself, and how would one know that it's useful?

GD: I have visited Microsoft several times (once with Neal Stephenson) but what you are referring to was just an observation, not advice. At Microsoft there are something like 12 000 people writing code, and once in a while a new operating system or new application reaches the market as a result. To me this looked very much like an evolutionary process: a great number of separate divisions are working on all kinds of different code and eventually something successful is produced or there's a successful crossing between existing bodies of code. Is this the result of an evolutionary process or is the code created by programmers and engineers? This is the same debate that has raged for over a century between Creationists and Evolutionists in biology. The Microsoft version parallels the 18th-

How Many Online?

Dec 05 2002: The number of worldwide internet users will surpass 665 million by the end of 2002, according to eTForecasts.

The research company estimates that 111 million new internet users have come online since year-end 2001.

Currently, the US has over 160 million internet users, making it the most online nation in the world. Japan follows with 64.8 million users, while China has 54.5 million.

Rounding out the top five online nations in terms of users are Germany and the UK with 30.3 million and 27.1 million users respectively.

eTForecasts predicts that China will surpass Japan in terms of internet users during 2003. The research company also forecasts that the worldwide number of internet users will top one billion by 2005.

Source: http://www.etforecasts.com/products/ES_cinusev2.htm

century Argument from Design: Windows, for instance, is evidently so complicated that it must be the product of intelligent design. It is, of course, the work of some highly intelligent individual programmers. But it is also so complicated that no one human being can fully grasp the structure (let alone the behavior) of the whole.

Why is Windows such a success? As soon as any code shows signs of proliferation in the wild (or in culture among the Microsoft labs) it is carefully domesticated and added to the Windows OS. And the goal of the operating system is not just to control the local operation of one computer, but, increasingly, to control distributed operations across the net. Is Windows a system that helps people operate computers? Or is it a system that helps computers operate people? Is it just part of our lives, or is it a form of life of which we are a part?

AM: Recent efforts to create Alife all somehow stop evolving after a while, like Tom Ray's *Tierra*, Karl Sims' system in which the genotypes and phenotypes of the digital organisms were different, and Jordan Pollack and Hod Lipson's evolutionary system in which the evolving creatures were connected directly to rapid prototyping fabrication machines that manufactured the creatures physically in plastic, with links and ball joints. And it seems very hard to figure out why. Rodney Brooks in his new book *Flesh and Machines* (2002) gives four possible explanations for this failure: 1) we might just be getting a few parameters wrong in all our systems; 2) we might be building all our systems in too simple environments, and once we cross a certain complexity threshold, everything will work out as we expect; and 3) we might simply be lacking enough computer power. And 4) we might actually be missing something in our models of biology, there might be some 'new stuff' that we need. What is your opinion here? Where do you expect future developments in Alife research?

GD: All these efforts are steps in the right direction, but they remain 'toy' models confined to a laboratory. There is a big difference between programs that are

□ *Life Expectancy in Africa*

In 1998, overall life expectancy in Africa was 51 years. Life expectancy for men was 50 years and for women 52 years. Life expectancy for all African nations is given in the table below.

Country	Both sexes	Men	Women
Algeria	69	68	70
Angola	48	46	50
Benin	54	52	56
Botswana	40	39	41
Burkina Faso	46	45	47
Burundi	46	44	47
Cameroon	51	50	53
Cape Verde	71	67	74

Source: http://www.overpopulation.com/discussion/fullthread$msgnum=287

designed to model or simulate living processes and programs that are in the early stages of becoming living processes. 'Are they the beginning of, or some sort of, foreign life forms? Are they only models?', asked Barricelli. 'They are not models, not any more than living organisms are models. They are a particular class of self-reproducing structures already defined. It does not make sense to ask whether symbio-organisms are living as long as no clear-cut definition of "living" has been given. Unless some other severe limitation is imposed by the conditions of the experiment or the type of universe in which the organism exists (computer, planet or test tube), there is no *a priori* reason for assuming that other classes of symbio-organisms could not reach the same complexity and efficiency characteristic of living organisms on this planet.' Barricelli knew this would take some time. 'A question that might embarrass the optimists', he warned in 1954, 'is the following: If it's that easy to create living organisms, why don't you create a few yourself?'

Barricelli left us with two key insights: 1) life and evolution are quick to incorporate parasitic, self-replicating processes into the metabolism of the host; and 2) self-replicating processes need to find expression as some kind of phenotype to ensure their own success. 'The symbio-organisms we have obtained in our experiments are only sequences or patterns of self-reproducing elements to be compared with a sequence of genes', he wrote. 'We may ask: What about the rest of the body? If we want to see anything like a body ... we must give the genes ... some material they may organize and may eventually use in the competition among different symbio-organisms. The material should preferably be of a kind which has importance for their existence ... Given a chance to act on a set of pawns or toy bricks of some sort the symbio-organisms will "learn" how to operate them in a way which increases their chance for survival.'

Real artificial life will be found in the wild, where it can freely evolve, extend to new forms of phenotype and grow. The laboratory results may be disappointing, but to a field naturalist observing the digital wilderness outside the laboratory, there are signs of true artificial life emerging everywhere you look.

Life Expectancy in Africa

Country	Both sexes	Men	Women
Central African Republic	47	45	49
Chad	48	46	51
Comoros	60	58	63
Congo (Brazzaville)	47	45	49
Congo (Kinshasa)	49	47	51
Ivory Cost	46	45	53
Djibouti	51	49	53
Egypt	62	60	64
Equatorial Guinea	54	52	56
Eritrea	55	53	58
Ethiopia	41	40	42
Gabon	57	54	60

Source: http://www.overpopulation.com/discussion/fullthread$msgnum=287

Barricelli's numerical organisms occupied an embryonic universe of one two-hundredth of a megabyte, running at 16 kilocycles for a few hours at a time. Their free-roaming brethren now find a universe 100 000 times the size of their birthplace on every desktop, with von Neumann's original address matrix extended across millions of interconnected hosts.

In 1953, the von Neumann universe exploded, and, ever since then, Barricelli's creatures have been on the loose. In 1954, when Barricelli made his first announcement that 'we have created a class of numbers which are able to reproduce and to undergo hereditary changes', a similar class of numbers – order codes – had already taken root in the von Neumann universe and seized control. Order codes constituted a fundamental replicative alphabet that diversified in association with the proliferation of different metabolic hosts. In time, successful and error-free sequences of order codes formed into subroutines – the elementary units common to all programs, just as a common repertoire of nucleotides is composed into strings of DNA.

These were numbers that did things: they manipulated other numbers, they represented text, they modeled nuclear weapons, they made fortunes for IBM. They organized themselves into an expanding hierarchy of languages, which then influenced the computational atmosphere as pervasively as the oxygen released by early microbes influenced the subsequent course of life. They formed collective structures such as operating systems which now amount to millions of lines of code. They accounted for money, and so became money; they represented music, and so became music; they learned how to divide into packets, traverse the network, correct any errors suffered along the way and reassemble themselves at the other end. They have infiltrated every field of human endeavor, from quantum mechanics to sex, and have now begun to form complex metazoan structures that are distributed across the net. The barriers between their universe and our universe – already broken down – are about to become fully transparent as they learn to read and write directly to the world of biology via DNA.

Life Expectancy in Africa

Country	Both sexes	Men	Women
Gambia, The	54	52	56
Ghana	57	55	59
Guinea	46	44	49
Guinea-Bissau	49	47	51
Kenya	48	47	48
Lesotho	54	52	56
Liberia	59	57	62
Libya	65	63	68
Madagascar	53	52	54
Malawi	37	37	37
Mali	47	46	48
Mauritania	50	47	53

Source: http://www.overpopulation.com/discussion/fullthread$msgnum=287

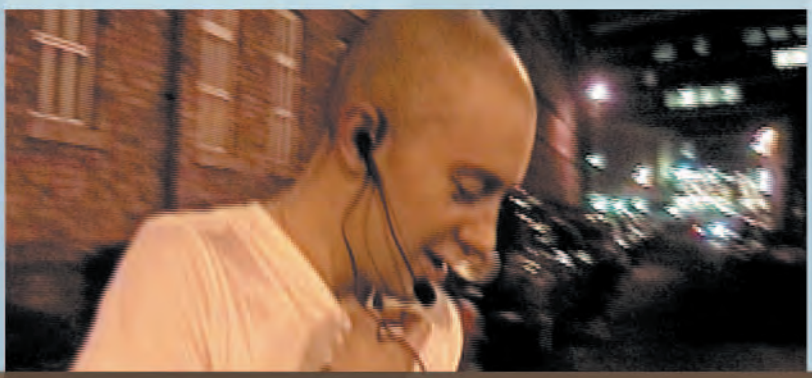
The future of biology may turn out to belong to organisms (human or otherwise) whose genomes are going to be stored, replicated, and manipulated as strings of bits within computers, not only as strings of chemical DNA. Should we view this as computers taking control of life or as life taking control of computers? Just as in the symbiosis between replication and metabolism the first time around, the answer is both.

When did this breakthrough happen? Or has it even happened yet? It remains too early to give an answer. All we can say for sure is that when von Neumann's computer first broke the distinction between numbers that *mean* things and numbers that *do* things, the stage was set.

Life Expectancy in Africa

Country	Both sexes	Men	Women
Mauritius	71	67	75
Mayotte	60	57	62
Morocco	69	66	71
Mozambique	45	44	47
Namibia	41	42	41
Niger	42	42	41
Nigeria	54	53	54
Reunion	75	72	79
Rwanda	42	41	42
Saint Helena	76	73	79
Sao Tome and Principe	64	63	66
Senegal	57	55	60

Source: http://www.overpopulation.com/discussion/fullthread$msgnum=287



Life Expectancy in Africa

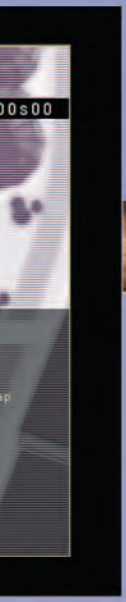
Country	Both sexes	Men	Women
Seychelles	71	66	76
Sierra Leone	49	46	52
Somalia	46	45	48
South Africa	56	54	58
Sudan	56	55	57
Swaziland	39	37	40
Tanzania	46	44	49
Togo	59	57	61
Tunisia	73	72	75
Uganda	43	42	43
Western Sahara	48	47	50
Zambia	37	37	37
Zimbabwe	39	39	39

Source: http://www.overpopulation.com/discussion/fullthread$msgnum=287 □

Can You See Me Now?

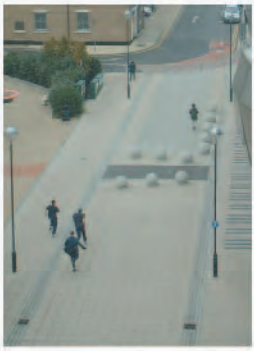
A collaborative project by Blast Theory, Mixed Reality Lab and Equator Interdisciplinary Research Collaboration (UK), 2001

In the board game Scotland Yard six players move their pawns over a map of London, chasing Mister X together. The players are allowed to confer, for if X gets caught, they all win. With the project *Can You See Me Now?* the artists' group Blast Theory introduces a modern variation of the game, which takes place live in the streets of Rotterdam. The game incorporates the latest communication technologies and is played simultaneously on line and in the streets. For a period of five days players, while sitting at their computers, can be chased

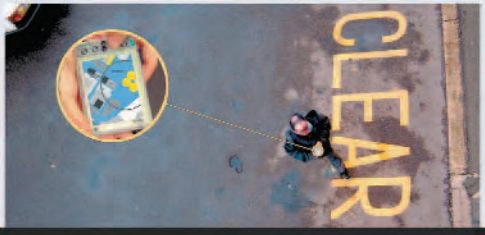


by living pawns in Rotterdam: the members of Blast Theory.

Can You See Me Now? is a remarkable mixture of avatars in a virtual play environment and people in the real world. As soon as participants log in at the website their virtual counterpart will appear somewhere on the city grid. In the street the online players' positions are relayed via satellite and the Global Positioning System (GPS) to palmtops carried by the Blast Theory members. They are represented by orange pawns that now start chasing the online players, the white icons on the map. As soon as someone is surrounded virtually, the location is photographed and the player has been intercepted. The photographs are stored in the website's game archive, together with a blueprint of the chase.



The online players can exchange tactics between them and also send messages to the Blast Theory members and eavesdrop on their walkie-talkie conversations via a wireless network with an eight meters antennae. In this way the search for Mister X can be followed live and an experience of mixing realities is created: the physical environment coincides with the virtual one and they condense into a living archive, the reconstruction of which can afterwards be seen and heard on the website.

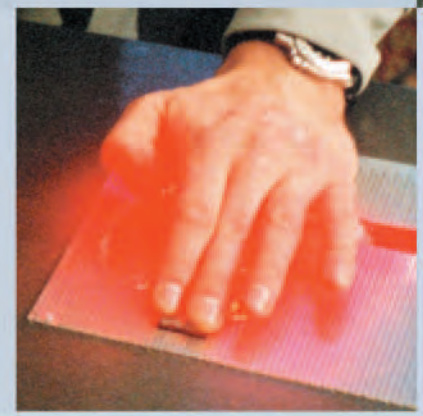


Blast Theory (GB) was founded in 1991. Blast Theory uses video and computers to question the ideologies propagated by the information surrounding us. They perform in an effort to counterbalance a world that is bombarded by all sorts of media and which is dominated by pop culture.

PainStation

A game machine by Volker Morawe and Tillman Reiff (D), 2001

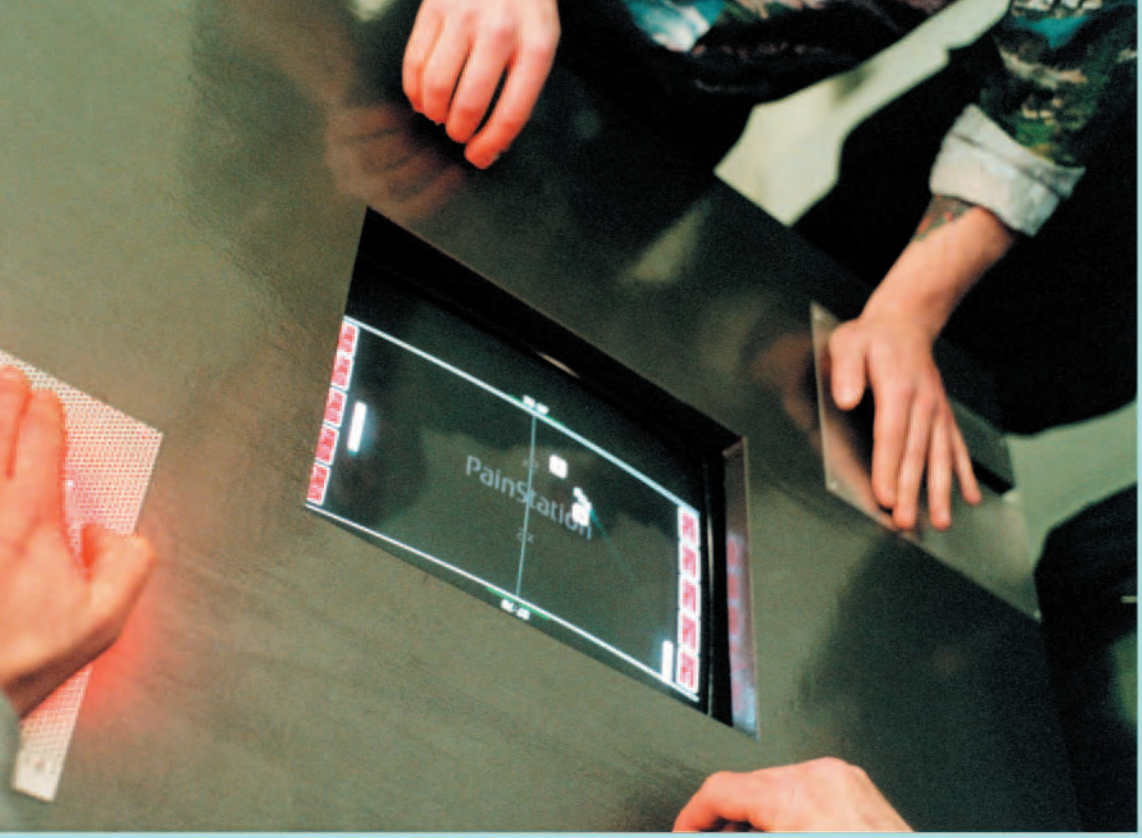
PainStation **is based on the old familiar video tennis game** Pong**, with the marked difference that here it really hurts when you miss the ball. During the game, each player's left hand rests on a sensor field, Pain Execution Unit (PEU), and is tormented by extreme heat, electrical shocks and lashes of the whip. The first player who can no longer stand the pain and withdraws their hand, loses. In this way the players are conditioned to prevent a humiliating defeat next time.**



The mechanical torments are stored inside *PainStation's* 'black box' (an Apple PowerPC) and are triggered by an analog-digital converter and homemade electronics. The Apple's screen has been integrated in the metal box. On the left, beside the screen, we find the PEUs; on the right, the rotating dials for controlling the small bars of the tennis game. As soon as both players place their hands on the PEUs, an electronic contact is made and the game begins.

Initially, everything seems fine: the ball can be easily played back and forth. As soon as one of the players misses, however, Pain-Inflictor-Symbols appear on both sides of the screen, representing different types of pain. Whenever they hit one of the symbols, the players have to suffer the associated torture. Tension mounts, the ball picks up speed and the pain increases. All senses are

on red alert. A Pavlov reaction occurs and, from now on, the visual stimuli of the video game are associated with pain. Pong **has lost its innocence, just like the players of *PainStation*.**



Volker Morawe (D) is a student at the Art Academy for Media (KHM) in Cologne, where he focuses on multisensory interfaces for computer games. Tilman Reiff (D) studied computer science and media, specializing in interaction design. He developed *re-zome*, a dynamic knowledge tool that combines code, design and interaction. Morawe and Reiff own a gallery in Cologne: the Büro für Brauchbarkeit.

PoliceState

Network installation by RSG, designed by Jonah Brucker-Cohen, 2002

Carnivore is the nickname for the FBI's DCS1000 surveillance software. In the *Carnivore Project* the Radical Software Group (RSG) has made this software public and given designers and artists the chance to experiment with it. Based on the FBI software, which is used to eavesdrop on data traffic such as email and surfing behavior, RSG has developed an open source version called *CarnivorePE*. This application sends data from all kinds of Internet traffic to a selected group of computer artists all over the world, who then interpret and process

these data in different ways, translating it into creative interfaces – so-called 'clients'. By doing so, the *Carnivore Project* wants to challenge the legitimacy of surveillance software and explore how data streams can be visualized.

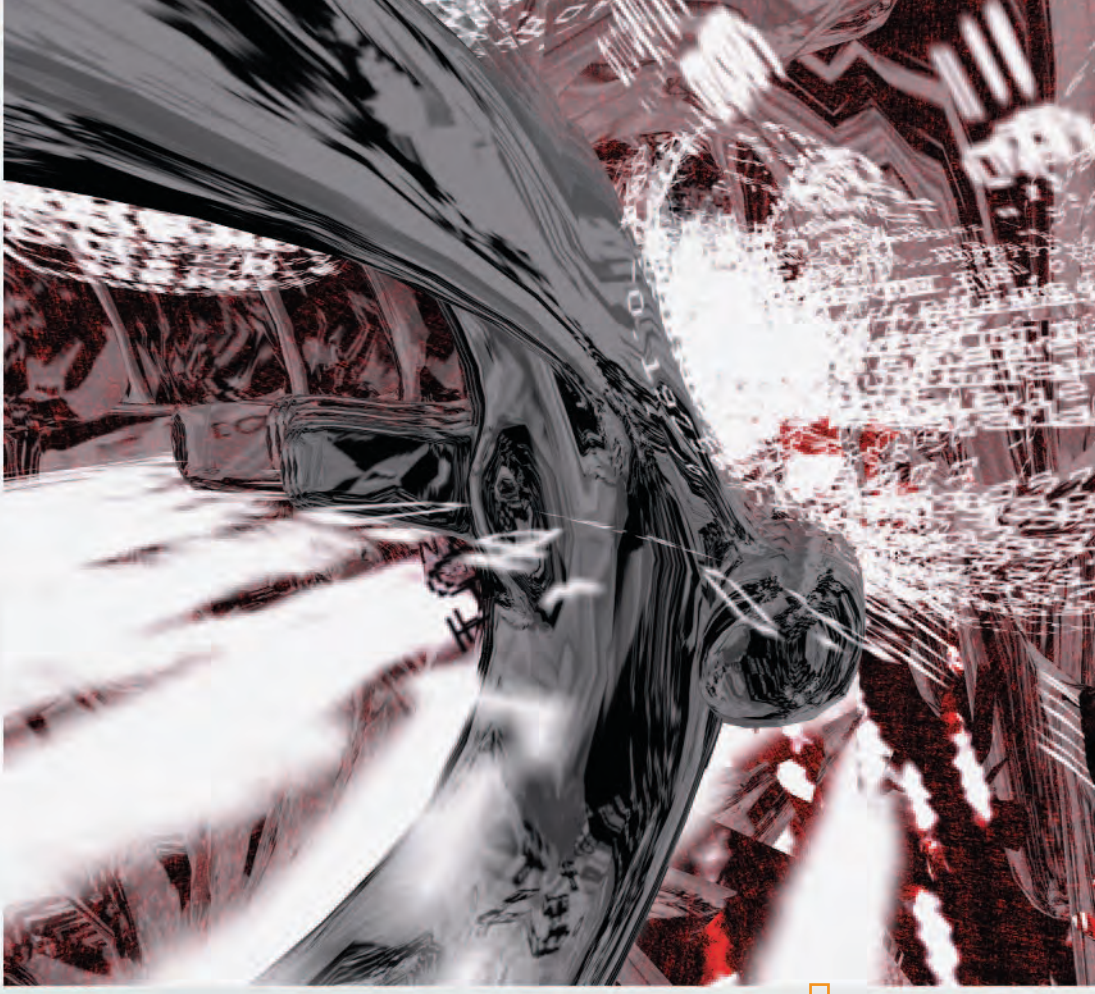
PoliceState, designed by Jonah Brucker-Cohen, is one of these creative applications, which visualize data traffic in a motorized way. The hardware part of the installation consists of 20 radio-controlled miniature police cars which are simultaneously fed with data taken off the DEAF03 network. These data are analyzed by *CarnivorePE* by using a 'blacklist' of keywords that, according to the FBI, are indications of a terrorist attack on American territory. When found, such a suspect word is converted by *PoliceState*'s software into a police

code, causing the toy cars to disperse in a controlled choreography. The police codes correspond with actual radio codes used by the Californian State Police, referring to potential terrorist threats by numbers (for instance, '10-79' for a bomb attack, and '1 000' for a crashed plane). With each police code they receive, the toy cars start to drive around in a new pattern, while a siren wails and the current threat is announced by loudspeakers.

With this installation, Jonah Brucker-Cohen exposes the faltering nervous system of the police state: every human activity on a network leaves an electronic trace that can be translated and converted into a code for police action by means of surveillance software. However, the stored data investigated by the authorities are the same data used to guide the police. The roles are reversed;

the strong arm of the law is a puppet of its own surveillance and the authorities themselves are controlled by the information they think they are checking.

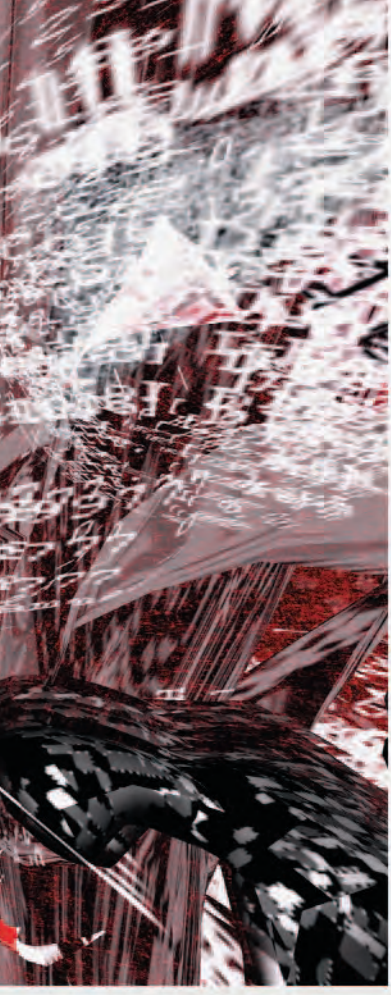
Jonah Brucker-Cohen (USA) works as a research fellow at Media Lab Europe in Dublin. His writing has appeared in several magazines and he was chosen as a nominating judge for the 2000-02 Webby Awards. His work has been shown in international events such as VRML-ART 99, SIGGARAPH 2000 and Transmediale.02.

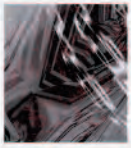


Nybble-Engine-Toolz

An installation by Margarete Jahrmann and Max Moswitzer (A), 2003

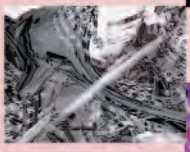
A nybble is the unit of half a byte, or four bits, which is the basis of every digital conversion. As the numeric equivalent of binary code, it exemplifies the internal logic of software that transforms codes and protocols on a server into various representations. *Nybble-Engine-Toolz* is a group experiment revealing such processes by converting data on a hard disk (text, sound, images) into three-dimensional, abstract clips. Participants in the experiment are seated on a 'sofa surfer' in the installation's lounge. The colorful films/visualized data are displayed on a large 180 degree screen. Players use





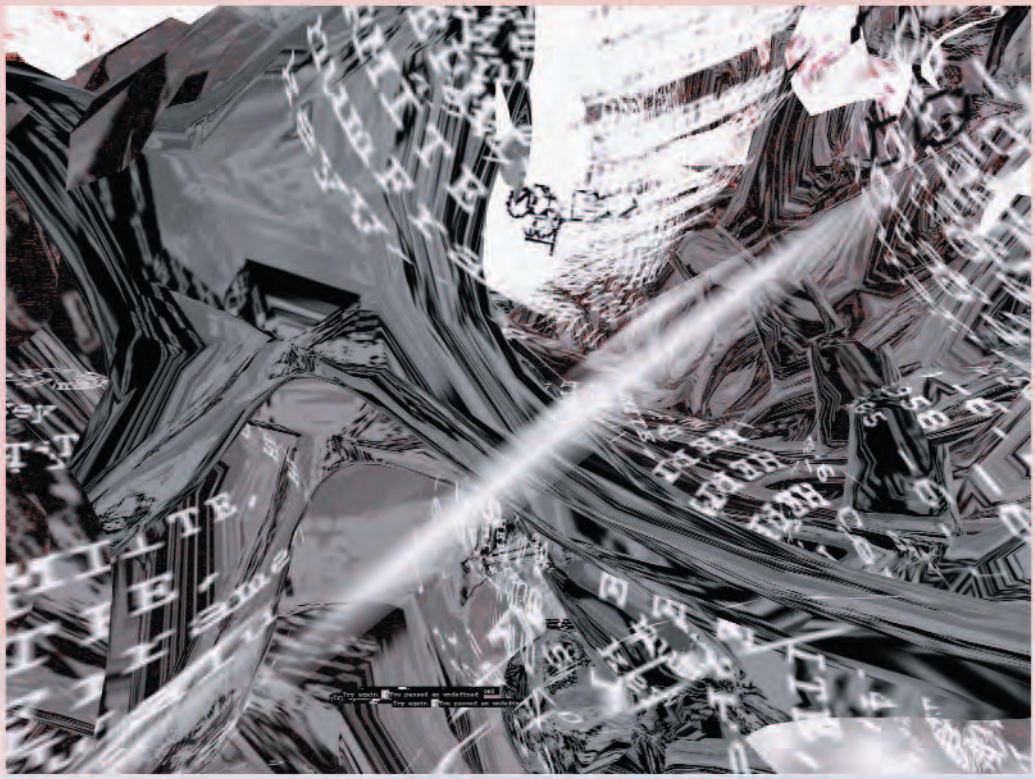
a joystick to log onto the installation's network and enter the gaming environment, where Nybbles, action bots and other gamers are flying about. The experiment will eventually change the Nybble-Engine's color.

The core of the installation is the Nybble-Engine itself – a network application based on existing software of an interactive game. Participants may log onto the game-Engine from a variety of locations, including the sofa, and are then assigned a place in the network. They navigate the game's environment, bump into other players or the action bots (representations of server processes) and communicate with them via text messages. This generates network traffic, the server log files of which are routed to the game-Engine, where they serve as the raw material for the three-dimensional audiovisual displays of the



installation. The Nybble-Engine tool converts the data from the network traffic into graphic clips that are projected on the screen. In this way, the server processes become visible outside of the game-Engine and the visitors influence the software of the Engine, eventually causing it to change its appearance.

The complexity of *Nybble-Engine-Toolz* is explained in the installation itself in a playful manner. Inspired by the look of scientific laboratories in the 1950s, a help desk has been designed where visitors can get more information about the experiment. Also, demo takes of the clips will be made and stored on the Nybble-Engine server. These archived data not only provide the necessary empirical support for the experiment's outcome, but are also used as feedback to the experiment.



Margarete Jahrmann (A) is an artist and journalist. Since 1994 she has realized a variety of CD ROMs, net projects, SUperFEM online performances and Web 3D projects. Jahrmann is also co-founder of Konsum.net, an art server. Max Moswitzer (A) is a multimedia artist. He co-founded Konsum.net. Moswitzer regularly produces interactive applications and online installations, videos, internet projects and, since 1997, realizes the set-up for telematic performances.

PERMANENT TESTING

Interview with Winy Maas

Winy Maas is a co-founder of MVRDV, the Office of Architecture and Urbanism in Rotterdam. He teaches and lectures at various institutions, including the Architectural Association, London; the Technical University, Delft; the Berlage Institute, Rotterdam; and the academies of Architecture and Urban Planning in Rotterdam and Amsterdam. He is currently a professor at Yale University, New Haven. His books include *Farmax: Excursions on Density* (edited by Winy Maas and Jacob van Rijs with Richard Koek, Rotterdam, 1998), *MVRDV at VPRO* (Barcelona, 1999), *MetaCity/DataTown* (Rotterdam, 1999), *The Regionmaker* (Stuttgart, 2002), *Pigcity* (Barcelona, 2003), *The 3D city* (Barcelona, 2003), *The 5'city* (Barcelona, 2003), *NYC2* (Yale, 2003). His realized works include *Villa VPRO* (Hilversum, 1997), *100 Wozocos* (Amsterdam, 1997), *Dutch Pavilion* (Hanover, 2000), *Flight Forum Business Park* (Eindhoven, 2002), *MMC Hospital extension* (Veldhoven, 2002), *Cultural Center* (Matsudai, Japan, 2003).

□ ***Ethnicity and Race by Countries***

Afghanistan	**Pashtun 38%, Tajik 25%, Uzbek 6%, Hazara 19%, minor ethnic groups (Chahar Aimaks, Turkmen, Baloch, and others)**
Albania	**Albanian 95%, Greeks 3%, other 2%: Vlachs, Gypsies, Serbs, and Bulgarians (1989 est.)**
Algeria	**Arab-Berber 99%, European less than 1%**
Andorra	**Spanish 61%, Andorran 30%, French 6%, other 3%**
Angola	**Ovimbundu 37%, Kimbundu 25%, Bakongo 13%, mestico (mixed European and Native African) 2%, European 1%, other 22%**
Antigua and Barbuda	**black, British, Portuguese, Lebanese, Syrian**
Argentina	**European 97% (mostly of Spanish and Italian descent), 3% other (mostly Indian or mestizo)**
Armenia	**Armenian 93%, Azeri 3%, Russian 2%, other (mostly Yezidi Kurds) 2% (1989). Note: as of the end of 1993, virtually all Azeris had emigrated**

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

Arjen Mulder: All your architectural work seems to be a direct translation from information into a diagram, and then into a building or other structure. There is a direct switch from data to production. Why do you work like this?

Winy Maas: The directness is driven by the desire for transparency of argumentation. One can communicate processes and projects easily with those who are not part of the architectural profession. It offers a common language with people other than architects. Therefore, one can include issues that go beyond the program of the given brief and include the effects of the architectural translation of the brief.

It enables the investigation and visualization of the contexts that surround and influence architecture. Social changes and effects like spreading, densifying, mixing can be spatialized. Formal effects can be communicated, for example, what form is correct, helpful or useful at certain sites? Infrastructural effects can be calculated, political issues and effects can be visualized, etcetera.

AM: Your approach to data seems to be that you first collect information through research. Then you draw a cube, and you let the information that you have collected transform the cube. And then the transformed cube becomes a building or a cityscape. You let the data do the designing by feeding them into a hypothetical cube. Why a cube?

WM: The cube, as you call it, is an abstraction of reality. It is a way to limit the endlessness of generic research. It is like a section out of that endlessness. It is a visualizer of the effects of the data. It's a pars pro toto. Secondly, a cube is the most compact architectural solution in the Cartesian sense.

AM: Your cube is inert. In the course of your research or designing process it becomes an archive ...

Ethnicity and Race by Countries

	from Armenia
Australia	Caucasian 95%, Asian 4%, aboriginal (353,000) and other 1%
Austria	German 99.4%, Croatian 0.3%, Slovene 0.2%
Azerbaijan	Azeri 90%, Dagestani 3.2%, Russian 2.5%, Armenian 2.3%, other 2% (1995 est.). Note: almost all Armenians live in the separatist Nagorno-Karabakh region
Bahamas	black 85%, white 15%
Bahrain	Bahraini 63%, Asian 13%, other Arab 10%, Iranian 8%, other 6%
Bangladesh	Bengali 98%, Biharis 250,000, tribals less than 1 million
Barbados	African 80%, European 4%, other 16%
Belarus	Belorussian 77.9%, Russian 13.2%, Polish 4.1%, Ukrainian 2.9%, other 1.9%
Belgium	Fleming 55%, Walloon 33%, mixed or other 12%
Belize	mestizo 44%, Creole 30%, Maya 11%, Garifuna 7%, other 8%

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

WM: ... of the frozen manipulation of the data.

AM: But even then, this archive, as a structure or as a building, remains inert. My question would be, can't the archive itself come alive, instead of being the victim of the data that you force into it?

WM: When you consider archives as only historical matter, then they are inert. But if archives are dealing with, say, accelerating knowledge, then immediately the inertia disappears, and the archive becomes a tool for progress or a tool to transgress knowledge from the existing situation into something new. The word archive – and in that I agree with you – is only interesting in its relation to the production of a future. We try to develop a series of different methods to investigate the transgressions from data to production, from analysis to construction.

AM: Could you describe some of these methods?

WM: Let us discuss this chronologically. In the 1990s we were working on what we call 'Datascapes'. That is a method to show the spatial effects of parameters that surround and influence architecture – laws, bylaws and elements that cover current morals, current resistances.

'Datascapes' reveals the complexities of the circumstances under which architecture has to be produced. This complexity clearly compromises architecture. By selecting a small set of parameters, and extremizing its logics, it visualizes the 'envelope' of possible spatial developments. By doing that, one can discuss these laws. The fact that you visualize the restrictions of laws on the forms and performances of building, leads to an immediate confrontation with other people, developers, politicians, users. If you want to fulfill another, bigger target than the one that the laws allow, you'll have to transgress the current resistance; you'll have to innovate on that law.

Ethnicity and Race by Countries

Benin	African 99% (42 ethnic groups, most important being Fon, Adja, Yoruba, Bariba), Europeans 5,500
Bhutan	Bhote 50%, ethnic Nepali 35%, indigenous or migrant tribes 15%
Bolivia	Quechua 30%, Aymara 25%, mestizo (mixed European and Indian ancestry) 25%–30%, European 5%–15%
Bosnia and Herzegovina	Serb 31%, Bosniak 44%, Croat 17%, Yugoslav 5.5%, other 2.5% (1991)
Botswana	Batswana 95%, Kalanga, Basarwa, and Kgalagadi 4%, white 1%
Brazil	white (includes Portuguese, German, Italian, Spanish, Polish) 55%, mixed white and African 38%, African 6%, other (includes Japanese, Arab, Amerindian) 1%
Brunei Darussalam	Malay 64%, Chinese 20%, other 16%
Bulgaria	Bulgarian 85.3%, Turk 8.5%, Gypsy 2.6%, Macedonian 2.5%, Armenian 0.3%, Russian 0.2%, other 0.6%

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

AM: Are you referring to the project about the laws of visibility? That in monumental city centers you're not allowed to make buildings that somehow change the cityscape?

WM: For instance, the book *Datascapes, the New Neufert* (which hasn't been released yet) contains an A-Z series of studies on architectural limitations. One of them is on Monumentality (in the M section) that shows how high one can build in a monumental city center under the current UNESCO laws. If you take the rule of invisibility literally, you get a scary 'shadow figure' behind the existing buildings. These strangely formed buildings are invisible from certain points of views. For us it was revealing to find out these envelopes can still contain quite a lot of program, that would make it possible to densify and intensify the current monumental city centers.

Another example, within the Infrastructure section, is the case about the (im)possibilities of accessibility. In the *Eindhoven Flight Forum Business Park* project, we tried to give all buildings a direct access from the new urban road, thus avoiding economically and socially unattractive back streets. It initially turned out to be impossible to give every house its own access, because of all the laws and bylaws that surround the making of infrastructure. Back roads and roundabouts all over the place! We showed the result to them; we asked if those restrictions were leading to easy, comfortable access to all the buildings. In order to activate equally parallel roads (in order to have sufficient 'addresses' on the highway) with a speed of 70 km per hour, so called merging zones had to be designed. These zones had to be tested, to be approved and accepted as safe. That caused a change within the Dutch traffic laws.

AM: By showing the limits you force a transformation of the rules?

WM: Yes. Showing the limits of these laws, while being convinced of the suggested target, it allowed for a transgression of that law. This focuses the discus-

Ethnicity and Race by Countries

Burkina Faso	Mossi (about 24%), Gurunsi, Senufo, Lobi, Bobo, Mande, Fulani
Burundi	Hutu (Bantu) 85%, Tutsi (Hamitic) 14%, Twa (Pygmy) 1%
Cambodia	Khmer 90%, Vietnamese 5%, Chinese 1%, other 4%
Cameroon	Cameroon Highlanders 31%, Equatorial Bantu 19%, Kirdi 11%, Fulani 10%, Northwest Bantu 8%, Eastern Nigritic 7%, other African 13%, non-African less than 1%
Canada	British Isles origin 40%, French origin 27%, other European 20%, indigenous Indian and Inuit 1.5%, other, mostly Asian 11.5%
Cape Verde	Creole (mulatto) 71%, African 28%, European 1%
Central African Republic	Baya 34%, Banda 27%, Sara 10%, Mandjia 21%, Mboum 4%, M'Baka 4%, Yakoma, Ubangi, Europeans 6,500 (including 3,600 French)
Chad	North and center: Muslims (Arabs, Toubou, Hadjerai, Fulbe, Kotoko, Kanembou, Baguirmi, Boulala, Zaghawa, and Maba); South: non-Muslims

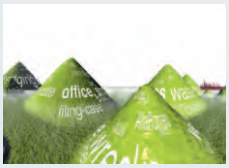
Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

sion on 'targets' – a needed subject in days of confusion. The huge compromise culture in architecture and in urbanism – possibly caused by the incredible complexity of rules and demands – scrutinizes and camouflages a wider targeting. It turns the majority of architecture and urbanism into a very paralyzed profession, causing almost identical solutions everywhere and reducing the birth of experiments. But if you focus on specific issues, then experiments might be more easily allowed, like in the Eindhoven case.

AM: You were talking about more methods.

WM: A method to deal with data followed out of the Datascape research. We wondered if we could study 'illimitness' by enlarging the scale? What do we find in that zone? Can a linear extrapolation of data be a tool to convince others about large-scale

Metacity/Datatown



decisions? Can it enhance frightening apocalyptic scenarios that would open up the discussion on large-scale issues? Can it discover and reveal an agenda for

Ethnicity and Race by Countries

	(Sara [the largest ethnic group, 25% of the population], Ngambaye, Mbaye, Goulaye, Moundang, Moussei, Massa)
Chile	European and European-Indian 95%, Indian 3%, other 2%
China	Han Chinese 91.9%, Zhuang, Uygur, Hui, Yi, Tibetan, Miao, Manchu, Mongol, Buyi, Korean, and other nationalities 8.1%. China has 56 ethnic groups
Colombia	mestizo 58%, white 20%, mulatto 14%, black 4%, mixed black-Indian 3%, Indian 1%
Comoros	Antalote, Cafre, Makoa, Oimatsaha, Sakalava
Congo	south: Kongo 48%; north: Sangha 20%, M'Bochi 12%; center: Teke 17%, Europeans 8,500 (mostly French)
Congo, D. R.	over 200 African ethnic groups, the majority are Bantu; the four largest tribes–Mongo, Luba, Kongo (all Bantu), and the Mangbetu-Azande (Hamitic)–make up about 45% of the population

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

urbanism and architecture? Can it create targets for the profession?

In *Metacity/Datatown* you can see what happens when you extrapolate things. The extrapolation and the enlargement of current issues and trends gives rise to the awareness that something has to be done about them. It works as a kind of warning that could lead to finding other objectives that have to be taken into account.

Take for instance the issue of space: the current population grows so much, we consume so much and our ecological footprint becomes so big, that if the current population wants to live like Americans do now, we will need 4.3 Earths in, say, 100 years. It gives a warning and a possible agenda to work on for architecture and urbanism. In this particular case we could work on changing our habits, on innovation of the consumer pattern, on another kind of mobility, or we enlarge our domains, or on all the parameters that influence that rhetoric.

AM: We could colonize other planets.

WM: We are actually working on 'outer space' at the moment. With ASA and BIR we examine what more we can do with our satellites than just communicate. Can we produce energy up there and send it back to the Earth? Can there be agriculture? Is it a good place to influence the weather? At GEO, 38 000 km away from the Earth, fixed satellites composed out of giant fields of Teflon can create shadow over positions that create differences in temperature, pressure and, therefore, causes rain.

AM: Is your plan for building a second layer over or under the built environment of Rotterdam and Amsterdam also part of this second trajectory?

WM: You're describing the *3D City Project*, which was more or less the next step. The need for more space, caused by the growing population and its desires, can

Ethnicity and Race by Countries

Costa Rica	**white (including mestizo) 96%, black 2%, Indian 1%, Chinese 1%**
Côte d'Ivoire	**Baoule 23%, Bete 18%, Senoufou 15%, Malinke 11%, Agni, foreign Africans (mostly Burkinabe and Malians, about 3 million)**
Croatia	**Croat 78%, Serb 12%, Muslim 0.9%, Hungarian 0.5%, Slovenian 0.5%, others 8.1% (1991)**
Cuba	**mulatto 51%, white 37%, black 11%, Chinese 1%**
Cyprus	**total: Greek 78% (99.5% of the Greeks live in the Greek area, 0.5% live in the Turkish area), Turkish 18% (1.3% live in the Greek area, 98.7% live in the Turkish area), other 4%**
Czech Republic	**Czech 94.4%, Slovak 3%, Polish 0.6%, German 0.5%, Roma (Gypsy) 0.3%, Hungarian 0.2%, other 1%**
Denmark	**Scandinavian, Eskimo, Faeroese, German**
Djibouti	**Somali 60%, Afar 35%, French, Arab, Ethiopian, and Italian 5%**
Dominica	**black, Carib Indians**

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

be fulfilled in outer space, but as well with the realization of extra levels above and under our cities. This suggestion implied so many questions. Can it really be done? And, if so, how? Can it be phased? Can it become livable, not claustrophobic; interesting and socially acceptable? Current statistics, current data were used as a reference, in order to create a comparative judgement. Is such a city that expensive? Is it ecologically better? Is it really more compact? Does it create new syntheses? Can it create technical innovations?

The ultimate model for this exercise was shown as the environment for the Manyfacts ballet with Scapino in Rotterdam. Imagine a very compact city. See it as a cube, to make it easier. Say, it is an autonomous city; it has no neighbors, like *Metacity/Datatown*, but now we want to put all the different functions and programs into that one cube. How big would that cube be for one million inhabitants? Actually you can put it in a cube of 2 x 2 x 2 kms, but that's without air. How much air do we need for physical as well as psychological reasons? We pumped the cube up to 5 x 5 x 5 kms; still smaller than Mount Everest.

The inner composition of that city caused enormously different possibilities. For that we had to follow a series of hypotheses about the best place for everything. Take leisure: is or isn't the best place for leisure everywhere? Is the best place socio-democratically organized, or is it very hierarchical? It you take the hypothesis that the best places for leisure are not hierarchical, you already get a `mixmax' solution. Depending on different hypotheses, you get different cities. How to develop these differences? How to compare them? How to rank them? Don't we forget possibilities?

This line of thinking brings us into a new machine age, a next method of dealing with the translation from data into production. In order to understand and control the kind of choices I described, and the complexities that are the effect of these choices, we developed a series of software.

It started with the *Functionmixer*, which is a program that absorbs and compares different hypotheses for urban development. The *Functionmixer* simply optimizes – that's the keyword in this process – what under given and chosen

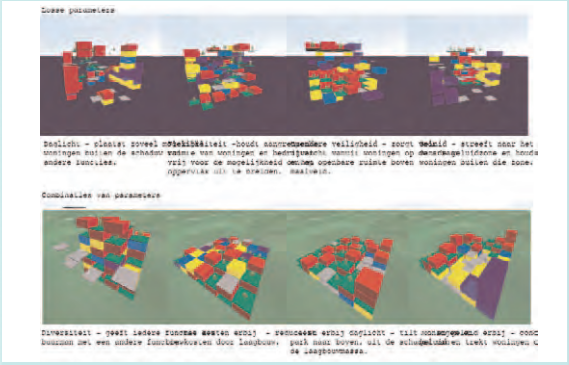
Ethnicity and Race by Countries

Dominican Republic	**white 16%, black 11%, mixed 73%**
East Timor	**Malay and Papuan descent**
Ecuador	**mestizo (mixed Indian and Spanish) 65%, Indian 25%, Spanish 7%, black 3%**
Egypt	**Eastern Hamitic stock (Egyptians, Bedouins, and Berbers) 99%, Greek, Nubian, Armenian, other European (primarily Italian and French) 1%**
El Salvador	**mestizo 94%, Indian 5%, white 1%**
Equatorial Guinea	**Bioko (primarily Bubi, some Fernandinos), Río Muni (primarily Fang), Europeans less than 1,000, mostly Spanish**
Eritrea	**ethnic Tigrinya 50%, Tigre and Kunama 40%, Afar 4%, Saho (Red Sea coast dwellers) 3%**
Estonia	**Estonian 61.5%, Russian 30.3%, Ukrainian 3.2%, Belorussian 1.8%, Finn 1.1%, other 2.1% (1989)**

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

parameters the direction of the urban development will be. Of course this works within a frame, in an archival setting, as you called it. You ask something, you search for information, you get knowledge back, that can be added to the software. New knowledge can be added as well, causing new optimizations. It can be seen as a tool that accompanies the process of innovation.

Functionmixer



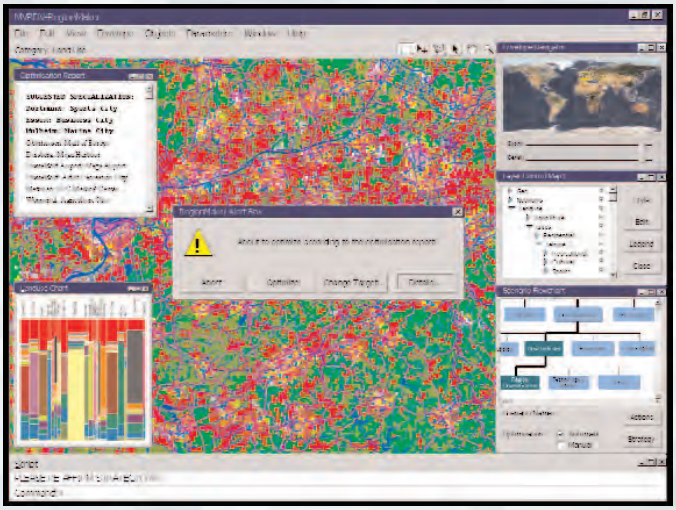
AM: Do you consider the outcomes of this sort of informational trajectory as possible buildings or as hypotheses or visualizations?

WM: Both. The machines that we are developing right now, like the *Functionmaker* and the *Regionmaker*, can act as planners and analyzers; archives and producers; simulators, vizualizers and speculators; extremizers and compromisers; and as proposers and creators. The *Functionmixer* can generate neighborhoods. Ultimately its formal suggestion can be connected with CAD equip-

Ethnicity and Race by Countries

Ethiopia	**Oromo 40%, Amhara and Tigrean 32%, Sidamo 9%, Shankella 6%, Somali 6%, Afar 4%, Gurage 2%, other 1%**
Fiji	**Fijian 49%, Indian 46%, European, other Pacific Islanders, overseas Chinese, and other 5%**
Finland	**Finn 93%, Swede 6%, Sami (Lapp) 0.11%, Romany (Gypsy) 0.12%, Tatar 0.02%**
France	**Celtic and Latin with Teutonic, Slavic, North African, Southeast Asian, and Basque minorities**
Gabon	**(1993) Bantu tribes, including six major tribal groupings: Fang 25%, Punu 23%, Nzeiby 13%, Mbede (Obamba/Bateke) 9%, Kota 7%, and Myene 5%; Pygmies 0.7%, naturalized population 0.3%, foreigners 15%**
Gambia, The	**African 99% (Mandinka 42%, Fula 18%, Wolof 16%, Jola 10%, Serahuli 9%, other 4%), non-Gambian 1%**
Georgia	**Georgian 70.1%, Armenian 8.1%, Russian 6.3%, Azeri 5.7%, Ossetian 3%,**

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html



Regionmaker

ment, and turn the outcome into buildable architecture, without the interference of architects. The *Regionmaker* can calculate new infrastructures that, in the same way, can be detailed. These software packages are highly individualized in their use: every action group, architect, citizen or politician can use them, because they are based on existing systems of knowledge, like the Internet. That makes them public tools. 'Publicness' has been always seen as one the main considerations of architecture and urbanism.

Another quality of these machines is that they are able to unravel complexity. As I already mentioned, urbanism and architecture are becoming too complex. There's been a lot of thinking about complexity in the last 20 years, but it was all on a philosophical level, which is not that interesting to be honest. There are also computer systems that work with complexity on a practical level, which is more valid. But these systems were not yet used for the planning aspect of urbanism and architecture. There has been some blob architecture, but complexity-producing computer systems have not yet been applied on straight build-

Ethnicity and Race by Countries

	Abkhaz 1.8%, other 5%
Germany	German 91.5%, Turkish 2.4%, Italians 0.7%, Greeks 0.4%, Poles 0.4%, other 4.6%
Ghana	black African 99.8% (major tribes: Akan 44%, Moshi-Dagomba 16%, Ewe 13%, Ga 8%), European and other 0.2%
Greece	Greek 98%, other 2%; note: the Greek government states there are no ethnic divisions in Greece
Grenada	black African descent 85%, mixed 11%, white, other 0.3%
Guatemala	Mestizo—mixed Amerindian-Spanish ancestry (in local Spanish called Ladino) 56%, Amerindian or predominantly Amerindian 44%
Guinea	Peuhl 40%, Malinke 30%, Susu 20%, smaller tribes 10%
Guinea-Bissau	African 99% (Balanta 30%, Fula 20%, Manjaca 14%, Mandinga 13%, Papel 7%), European and mulatto less than 1%
Guyana	East Indian 51%, black and mixed 43%, Amerindian 4%, European and

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

ings or banal production or the positioning of buildings. That was another objective of the *Functionmixer* and the *Regionmaker*.

AM: Projects like *Mixmax*, *Functionmixer* and *Regionmaker* aim at the development of different scenarios that one could follow or maybe just discuss. In your book *The Regionmaker*, for example, you show four scenarios for the development of the RheinRuhrCity: a park scenario, a campus scenario, an archipelago scenario and a network scenario. And then you show a time sequence of how to get to either one of these goals, starting from the current Rhein Ruhr region, which is basically a dead industrial zone in the northwest of Germany trying to reclaim life. The *Regionmaker* is partly a dream and partly a project. In the book you dream of 'a global planning device, which can select, sort and combine data and illustrate processes. It could compare and evaluate data, even simulate and generate proposals. It may even speculate, or at least form a tool for our own speculations, or even warn and alarm us'. In your approach, either on a regional or a global scale, there are either people or institutions around the world that collect information, and you put all those dataflows into your scenario-producing machines.

WM: Yes. This already happens, but you can speed it up, connect worldwide sources with different 'connectors', mini machines that can compare the data, activate scenarios, develop solutions and generate visualizations. Global issues can be combined with local ones.

AM: So you focus all the existing dataflows on one region, say the Rhein Ruhr region, and then you look at what happens there. You can direct this influence a bit, like when you say that you prefer a campus scenario for development, which is a sort of filter for the dataflows. But as with the hypothetical cubes, the original region itself is an inert mass, into which you can download one of your scenarios. You don't allow the inert mass to influence your dataflows. I

Ethnicity and Race by Countries

	Chinese 2%
Haiti	black 95%, mulatto and European 5%
Honduras	mestizo (mixed Indian and European) 90%, Indian 7%, black 2%, white 1%
Hungary	Hungarian 89.9%, Gypsy 4%, German 2.6%, Serb 2%, Slovak 0.8%, Romanian 0.7%
Iceland	homogeneous mixture of descendants of Norwegians and Celts
India	Indo-Aryan 72%, Dravidian 25%, Mongoloid and other 3%
Indonesia	Javanese 45%, Sundanese 14%, Madurese 7.5%, coastal Malays 7.5%, other 26%
Iran	Persian 51%, Azerbaijani 24%, Gilaki and Mazandarani 8%, Kurd 7%, Arab 3%, Lur 2%, Baloch 2%, Turkmen 2%, other 1%
Iraq	Arab 75%–80%, Kurdish 15%–20%, Turkoman, Assyrian, or other 5%
Ireland	Celtic, English
Israel	Jewish 82% (Israel-born 50%, Europe/Americas/Oceania-born 20%,

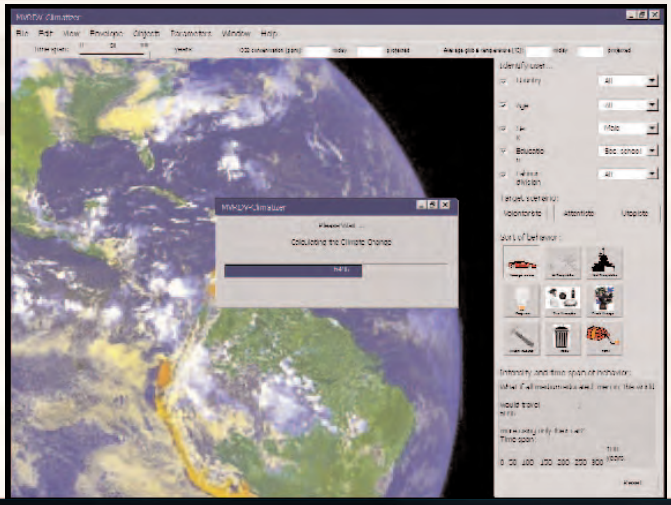
Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

mean, your machines are not so much 'planning prostheses' as you call them in the *Regionmaker* book, but political tools, aimed at creating awareness – environmental, economical, political ... Somehow it seems more a tool for discussion to me than for actual planning.

WM: It is definitely still a dream and it is still more a visualizer than a prosthesis. Inertia is definitely an important topic. These days it's almost impossible to make a region. It takes a lot of time, a lot of communal effort, a lot of communal sources and a lot of luck. The Rhein Ruhr area, for instance, is insanely situated in the empty middle of the European metropolises. It came into being because of data from the 1930s, and maybe now, because of a geriatric demography, it's better for the region to simply pack up and go away.

In order to move the inert aspects of regional planning, more components have to be added. Firstly, a 'socializer' should be added, that compromises the quests and possibilities and is able to communicate directly, that is connect-

Climatizer



Ethnicity and Race by Countries

	Africa-born 7%, Asia-born 5%), non-Jewish 18% (mostly Arab) (1993 est.)
Italy	Italian (includes small clusters of German-, French-, and Slovene-Italians in the north and Albanian-Italians and Greek-Italians in the south), Sicilians, Sardinians
Jamaica	African 76.3%, Afro-European 15.1%, East Indian and Afro-East Indian 3%, white 3.2%, Chinese and Afro-Chinese 1.2%, other 1.2%
Japan	Japanese 99.4%, other 0.6% (mostly Korean)
Jordan	Arab 98%, Circassian 1%, Armenian 1%
Kazakhstan	Kazak (Qazaq) 46%, Russian 34.7%, Ukrainian 4.9%, German 3.1%, Uzbek 2.3%, Tatar 1.9%, other 7.1% (1996)
Kenya	Kikuyu 22%, Luhya 14%, Luo 13%, Kalenjin 12%, Kamba 11%, Kisii 6%, Meru 6%, Asian, European, and Arab 1%, other 15%
Kiribati	Micronesian

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

ed to everyone's PC, that visualizes the effects online. Secondly, a 'timer' has to be added that can predict expected changes and therefore show possible changes in time. Thirdly, large-scale changes have to be monitored and positioned that will suggest dramatically the expected tendencies and changes. One could call this an 'apocalyptizer'. But it should suggest alternatives on the spot and elsewhere. It can behave as a 'positioner'. This scale is about demography, economy, trade, climate and migration. One of my students developed a free migration city, that, for instance, would drastically change Europe.

In the *Climatizer* project for the Cité de Sciences in Paris the influence of the expected or created changing climates is combined with the changes of regions and cities. It can develop improved positions for programs. It can suggest the required accommodations for existing programs. It can show its Kyoto Treaty performance. This is almost impossible in the current models of regional planning, because regions only talk about themselves. Everyone wants to have the headquarters of BMW, and that's it. But with this type of technology, one is able to show and calculate the best position, to negotiate its relation with other regions, trade off alternative programs elsewhere, develop nuanced tax and investment systems, and balance between specialization and concurrence.

These kinds of development models partly exist in the planning world, but the integration and the visualizing part of it makes them communicable for politicians, regional economists and regional planners, who are at the moment at such a great distance from each other. I am sure that in the near future we will see complete regions being build in Europe. Spain, for example, has a lot of potential, because of the climate. It can become the California of Europe; Switzerland can be the outdoor leisure center. In the near future there will a complete reorganization of agricultural regions, and that will lead to the development of new regions. There will be no agriculture in the Netherlands, because all of it will be in Poland. Regions will be appearing and disappearing.

AM: So what your machines show is: forget about the old politics that works

Ethnicity and Race by Countries

Korea, North	racially homogeneous
Korea, South	homogeneous (except for about 20,000 Chinese)
Kuwait	Kuwaiti 45%, other Arab 35%, South Asian 9%, Iranian 4%, other 7%
Kyrgyzstan	Kyrgyz 52.4%, Russian 18%, Uzbek 12.9%, Ukrainian 2.5%, German 2.4%, other 11.8%
Laos	Lao Loum (lowland) 68%, Lao Theung (upland) 22%, Lao Soung (highland) including the Hmong ("Meo") and the Yao (Mien) 9%, ethnic Vietnamese/Chinese 1%
Latvia	Latvian 51.8%, Russian 33.8%, Belorussian 4.5%, Ukrainian 3.4%, Polish 2.3%, other 4.2%
Lebanon	Arab 95%, Armenian 4%, other 1%
Lesotho	Sotho 99.7%, Europeans 1,600, Asians 800
Liberia	indigenous African tribes 95% (including Kpelle, Bassa, Gio, Kru, Grebo, Mano, Krahn, Gola, Gbandi, Loma, Kissi, Vai, and Bella),

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

with a roots idea for cities and regions, and move into an extreme rationalization of the planning of regions on a global scale?

WM: You can put your ideals in them too, because ideals can be clearly parameterized.

AM: The question that keeps troubling me is how you get structure out of data plus an inert mass.

WM: In this case, it's a matter of hierarchy and targeting and optimization. That creates structures. And you can discuss what would be the best structure: is it a grown one, or a partly designed one or a fully designed one?

AM: The question I'm trying to ask is: if you work with such dynamic data flows, and you want to actually build and not just remain virtual, how do you keep the thing dynamic?

WM: Through the software by direct updating of information, by continuous improvements of the technology and by enlarging the possibilities of a public influencing. Also in the realized urbanism and architecture by generating flexibility through the application of a lighter form of urbanism and through the realizations of more neutral buildings structures. And by seeing realized architecture and urbanism as test zones. Every realization is a test that anchors a transition, that anchors flows. The highway solution in Eindhoven that I discussed can be seen as a test zone for other highways we're asked to work on and which we hope to turn into a similar urbanistic enterprise. We are aiming to build in Almere (the Netherlands) a housing mix area that was designed with the *Functionmixer*, and we only added a CAD program. We didn't add architecture to it. This will produce a test zone, which we can reorganize in another project or change if necessary or adapt to new views and observations.

Ethnicity and Race by Countries

	Americo-Liberians 5% (descendants of former slaves)
Libya	Berber and Arab 97%, Greeks, Maltese, Italians, Egyptians, Pakistanis, Turks, Indians, Tunisians
Liechtenstein	Alemannic 87.5%; Italian, Turkish, and other 12.5%
Lithuania	Lithuanian 80.1%, Russian 8.6%, Polish 7.7%, Belorussian 1.5%, other 2.1%
Luxembourg	Celtic base (with French and German blend), Portuguese, Italian, and European (guest and worker residents)
Macedonia	Macedonian 65%, Albanian 22%, Turkish 4%, Serb 2%, Rom (Gypsy) 3%, other 4%
Madagascar	Malayo-Indonesian (Merina and related Betsileo), Cotiers (mixed African, Malayo-Indonesian, and Arab ancestry—Betsimisaraka, Tsimihety, Antaisaka, Sakalava), French, Indian, Creole, Comoran
Malawi	Chewa, Nyanja, Tumbuko, Yao, Lomwe, Sena, Tonga, Ngoni, Ngonde, Asian,

Source: http://kids.infoplease.lycos.com/ipka/A0855617.html

AM: You're not building fixed buildings any more?

WM: We accept change; our architectural production is about that. You can build in such a way that it allows for change afterwards to accommodate a building to new wishes and new perspectives. This will happen more and more in the future, especially in dense environments, where an office building can be changed into houses, or vice versa. That leads to more columns instead of structural walls, higher ceilings, deeper buildings etc. In sub-urbanism we develop an urbanism without heavy infrastructure and with short-term real estate (surreal estate) that can create cities that can be changes in shorter time. A lighter urbanism.

AM: Is there still a place for classical architectural parameters as gravity?

WM: The actual construction is just one of the factors in the machines. The same applies to satellites: when you're building in a G1 or 0 or 2 space the end results are totally different in appearance and therefore in architecture. I would love to make a G0 disco by the way and test its potentials.

AM: And you would also like to approach regions as test zones?

WM: I'd love to. Certain regions already have been test zones, in China, Russia, and in the Netherlands as well. Like some of the Polders, maybe we can add some tests. Can we test the Veluwe on its natural and forestalled potentials? Shouldn't we test our riverbeds and river cities on their waterstorage necessities? Can we test light urbanism in some of our new suburbs? It can replace, nuance and enrich the current realizations in suburban Holland. The failure is that all the 40 Vinex locations are doing the same test, where one could have tested 40 different urbanistic approaches. We would have learned and gained more.

Ethnicity and Race by Countries

	European
Malaysia	Malay and other indigenous 59%, Chinese 32%, Indian 9%
Maldives	Sinhalese, Dravidian, Arab, African
Mali	Mande 50% (Bambara, Malinke, Sarakole), Peul 17%, Voltaic 12%, Songhai 6%, Tuareg and Moor 10%, other 5%
Malta	Maltese (descendants of ancient Carthaginians and Phoenicians, with strong elements of Italian and other Mediterranean stock), Spanish, English, Arab
Marshall Islands	Micronesian
Mauritania	mixed Maur/black 40%, Maur 30%, black 30%
Mauritius	Indo-Mauritian 68%, Creole 27%, Sino-Mauritian 3%, Franco-Mauritian 2%
Mexico	mestizo (Indian-Spanish) 60%, Amerindian or predominantly Amerindian 30%, Caucasian or predominantly Caucasian 9%, other 1%

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