GlobalResearch
Center for Research on Globalization

Circumventing Invasive Internet Surveillance with "Carrier Pigeons"

Rewilding the endangered world wide web of avian migration pathways

By Anthony Judge
Global Research, July 01, 2013
laetusinpraesens.org
Theme: Police State & Civil Rights

Introduction

Recent disclosures have revealed the extreme level of surveillance of telephone and internet communications, as discussed separately with respect to the US National Security Agency, the UK GCHQ, and other members of the Five Eyes Anglosphere agreement (*Vigorous Application of Derivative Thinking to Derivative Problems*, 2013). There is therefore a case for exploring how such surveillance can be avoided, if that is considered desirable. The situation can be compared to that in any wilderness where predators deliberately create zones of fear through the manner of their engagement with potential prey — prior to any attack, as recently noted (*Scared to death: how predators really kill*, *New Scientist*, 5 June 2013, pp. 36-39).

Extensive use has been made in the past of carrier pigeons for secure communications, notably in arenas of threat, and most notably in World War I, continuing into World War II, but to a lesser degree. The founder of the news agency Reuters made use of carrier pigeons for the delivery of vital financial data in parallel with introduction of the telegraph. Other little-known examples are cited in what follows.

With the current development in the insecurity of computer and internet technology, there is a case for exploring alternative possibilities in the light of the threat of internet surveillance and the need for secure communications. Security agencies are effectively framing the "war on terrorism" as a global war in which independent governments and institutions are a source of potential security threat — as well as the world population at large.

It is to be expected that active consideration will be given to possibilities of secure communications by diplomatic services following the Wikileaks disclosures (*Alleged Breach of UN Treaty Obligations by US*, 2010). It is also to be expected that governments with any interest in preserving the confidentiality of their own communications, including developing countries and delegations to international conferences, will want to consider their need for such facilities — especially in the light of the recent disclosures regarding communications in such contexts (Ewen MacAskill, et al., *GCHQ intercepted foreign politicians' communications at G20 summits*, *The Guardian*, 17 June 2013; *GCHQ taps fibre-optic cables for secret access to world's communications*, *The Guardian*, 21 June 2013). Clearly use of internet facilities has become increasingly untrustworthy.

At the time of writing, new disclosures allege that EU facilities and communications in a

number of locations, including the United Nations, have been a specific "target" of NSA surveillance (*Attacks from America: NSA Spied on European Union Offices*, *Spiegel Online International*, 29 June 2013; *EU concern over Der Spiegel claim of US spying*, *BBC News*, 30 June 2013; *EU demands clarification over US spying claims*, *The Guardian*, 30 June 2013; *Key US-EU trade pact under threat after more NSA spying allegations*, *The Guardian*, 30 June 2013; *Washington Post releases four new slides from NSA's Prism presentation*, *The Guardian*, 30 June 2013; *New NSA leaks show how US is bugging its European allies*, *The Guardian*, 30 June 2013). There is now recognition of the manner in which major US internet companies used "locked mailboxes" through which to make available information to the NSA, despite earlier denials regarding such complicity (*Tech Companies Concede to Surveillance Program*, *The New York Times*, 7 June 2013). The companies allegedly included Google [YouTube, Gmail], Microsoft [Hotmail and Skype], Yahoo, Facebook, AOL, Apple, and Paltalk.

Reports in *The Guardian* noted that:

> The documents, seen by the Observer, show that — in addition to the UK — Denmark, the Netherlands, France, Germany, Spain, and Italy have all had formal agreements to provide communications data to the US. They state that the EU countries have had "second and third party status" under decades-old signal intelligence (Sigint) agreements that compel them to hand over data which, in later years, experts believe, has come to include mobile phone and internet data.
>
> Under the international intelligence agreements, nations are categorised by the US according to their trust level. The US is defined as 'first party' while the UK, Canada, Australia and New Zealand enjoy 'second party' trusted relationships. Countries such as Germany and France have 'third party', or less trusted, relationships.... On an average day, the NSA monitored about 20m German phone connections and 10m internet datasets, rising to 60m phone connections on busy days, the report said.

This exploration follows from recognition of transfer of information from one computer to another without use of a network linking them. Such transfer of electronic information, especially computer files, by physically moving removable media such as magnetic tape, floppy disks, compact discs, USB memory sticks, or external hard drives has been informally described as Sneakernet — a humorous contrast to transfer via *Ethernet*.

As discussed, it is clear that protective measures against invasive surveillance will need to take a different form and scale if they are to be viable. On the other hand the reassurance by the UK Foreign Secretary William Hague that *If you have nothing to hide, you've nothing to fear...* (9 June 2013) could now be offered to European institutions currently preoccupied by the matter.

Recognized competence of carrier pigeons

This argument is based on the innate homing capacity of so-called homing pigeons, selectively bred to find their way home over extremely long distances. The instinct derives from the capacity to return to one "mentally marked" point that they have identified as their home, as with returning to the nest to mate. As employed in competitive pigeon racing, flights as long as 1,800 km have been recorded by birds in competition at an average speed of 80 km/hour over moderate distances, such as 800 km, although higher speeds have been

recorded for shorter distances.

As used to carry messages, they have been called carrier pigeons, especially in any system of "pigeon mail" or so-called pigeon post — with the sender holding the receiver's pigeons prior to release. Messages have typically been written on thin paper rolled into a small tube attached to the bird's leg. White homing pigeons are used in release dove ceremonies at weddings, funerals, and some sporting events. Homing pigeons, as extensively used in wartime, have been termed war pigeons.

A range of innovations and adaptations were developed and tested by Julius Neubronner, including aerial photography with the aid pigeons — extensively used in World War I. These included invention of the mobile dovecote and training of unruly pigeons to get used to it. The problem of making carrier pigeons accept a displaced dovecote with only a minimum of retraining had however been tackled with some success by the Italian army around 1880. The French artillery captain Reynaud solved it by raising the pigeons in an itinerant dovecote. This circumvented the obvious problem of restriction to "one way" use of carrier pigeons.

Demonstrated non-military messaging capacity of carrier pigeons

In the 6th century BC, Cyrus, king of Persia, used carrier pigeons to communicate with various parts of his empire — which would necessarily include military preoccupations (as discussed below). Carrier pigeons are reported to have been used to communicate the names of victors of the Olympic games from 700 BC to 300 AD.

Indians, notably during the Mughal Empire, also used pigeons extensively, but mostly for exchanging messages among lovers (princes and princesses), especially when the women were denied the contact with their lovers due to varied reasons — caste differences, rich vs poor lovers, and the like.

There is a long history of use of a so-called pigeon post. *Wikipedia* offers accounts of use of the Pigeon Post of Paris (1870-1871), the Pigeon Post of Canada(1891-1895), the Pigeon Post of Catalina Island (1894-1898), and the Pigeon Post of Great Barrier Island (New Zealand) (1897-1908).

From 1847 through 1851, Paul Reuter, founder of the Reuters news agency, employed carrier pigeons between Brussels and Aachen to bridge a gap in telegraph stations on the route connecting Berlin to Paris, thereby providing a low-latency data feed for market-moving events.

In 1999, an 800-strong pigeon corps was still being used by a local police department in the Indian state of Orissa — as the only reliable link between the town and the district headquarters of Cuttack

Demonstrated non-messaging capacity of carrier pigeons

Aerial photography: Use of pigeons for aerial photography — so called pigeon photography — was developed by Julius Neubronner between 1907 and 1920, using miniature cameras designed to be attached to carrier pigeons via tiny leather harnesses. Although developed as a hobby, some of the inventions were patented and were recognized to have military uses (as noted below). In 2004, the BBC used miniature television cameras attached to falcons and goshawks to obtain live footage, and today some researchers, enthusiasts and

artists similarly deploy crittercams with various species of animals.

Lockheed experiment in the USA (1982): The Lockheed Missile and Space Company in California has used carrier pigeons as the most cost-effective means of transferring copies of graphic design projects to workers 30 miles away over twisting mountain roads. The company had acquired a computer-linked machine that would transmit the needed designs between the two installations, but it was only used as a backup for the pigeons because of the expense. Whereas it cost $10 a print to use the machine, the pigeons cost $1 — with the claim that: ”Pigeons just need a little love, care, feed and water, about $100 a year.” (*Carrier Pigeons Ferrying Lockheed Microfilm*, *The New York Times*, 19 August 1982; *Carrier Pigeons: newest “birds” for Lockheed*, *Lodi News-Sentinel*, 18 June 1982). During the 16 months of the project the pigeons transmitted several hundred rolls of film, and only two were lost due to hawks.

Carriage of vital samples: Various cases of use of blood and tissue samples have been noted. In Plymouth (England) birds were fitted with tiny leather harnesses that were designed to hold blood samples taken from the city’s hospitals until the 1980s. Pigeons are still used to carry blood samples from remote regions of Britain and France (Mary Blume, *The hallowed history of the carrier pigeon*, *The New York Times*, 30 January 2004).

Search and rescue: In 1987, pigeons were trained in a search-and-rescue operation in the USA called Project Sea Hunt. Due to the pigeons superior eyesight and concentration – compared to that of humans – they proved very effective as spotters. During the training process, three pigeons were placed in a dome underneath a helicopter, each facing in a different direction. Trained to distinguish the colours of life jackets and rescue craft, the pigeons pecked at an indicator when such coloured objects were spotted, and the indicator directed the pilot to fly in that direction.

Demonstrated military capacity of carrier pigeons

The Romans used pigeon messengers to aid their military over 2000 years ago. Frontinus said that Julius Caesar used pigeons as messengers in his conquest of Gaul.

Messaging and photography: During the 19th-century Franco-Prussian War, besieged Parisians used carrier pigeons to transmit messages outside the city; in response, the besieging German Army employed hawks to hunt the pigeons. Before the advent of radio, carrier pigeons were frequently used on the battlefield as a means for a mobile force to communicate with a stationary headquarters.

Carrier pigeons were used in World I and in World War II, to transport messages back to their home coop behind the lines — as well as their use for aerial reconnaissance. A range of pigeon-related innovations and adaptations, including photography, that had been developed and tested by Julius Neubronner (as noted above) were extensively used in World War I. To that end, the German army used mobile dovecotes in the Battle of Verdun, and similar facilities were used on a larger scale in the Battle of the Somme. It has been estimated that some 20,000 pigeons were lost during that particular war.

Although war pigeons and mobile dovecotes were used extensively during the Second World War, it is unclear to what extent, if any, they were employed for aerial photography in that period. The trainers of war pigeons for the U.S. Army Signal Corp have been celebrated in a movie (*The Pigeoneers*, 2012).

Subsequent to World War II, pigeon photography has been employed by the US Central Intelligence Agency which developed a (still classified) battery-powered pigeon camera. The U.S. military used pigeons until 1957, long enough for pigeon-based equipment to be given its own communications system designation, such as AN/CBQ-1 for the "Air-transportable Pigeon Loft and Message Center".

It was only in 1994 that the Swiss terminated their military use of pigeons after 77 years (Robert L. Kroon, *Swiss Budget Cutters Clip Army's Platoon of Carrier Pigeons*, *The New York Times*, 23 December 1994). According to that report, the 266 private pigeon-keepers train their 23,000 birds for an annual two-week military refresher course.

> That involves dispatching unaccompanied homing pigeons by train to some border destination, where the stationmaster releases the doves from their baskets. The birds then fly home at an altitude of 2,000 meters (6,500 feet), at speeds of about 75 kilometers an hour (47 miles per hour).

The Swiss army had however provisionally retained its own squadron of 7,000 "military liaison doves". Although homing carrier pigeons mingle with other birds, they are held to be invulnerable to enemy countermeasures. The decision to terminate such use was questioned by some Swiss military commanders since modern military communications can be intercepted by the enemy or jammed by electronic countermeasures. It was recognized that "one or preferably two homing pigeons could be highly useful."

As remarked by David Hambling (*Spy Pigeons Circle the World*, *Wired*, 25 October 2008), pigeons continue to be used for surveillance purposes. This was noted with respect to Iranian nuclear facilities (*Iran arrests pigeons 'spying' on nuclear site*, *The Telegraph*, 20 August 2008; *Iran Nails 'Spy Pigeons' Near Nuke Site*, *Wired*, 20 October 2008).

Consideration has been given in France to further use of pigeons as a low-tech response to certain challenges, as noted by Gabriele Parussini (*In France, a Mission to Return the Military's Carrier Pigeons to Active Duty*, *The Wall Street Journal*, 11 November 2012):

> And yet the French Defense Ministry still operates a military dovecote — Europe's last — with 150 birds drafted into the 8th regiment for communication and transmission. The birds reside at the Mont-Valérien fortress in Suresnes, to the west of Paris. While a corporal sees to their upkeep and training, they are not ranked as a strategic asset.

There is a concern at the degree of development of carrier-pigeon expertise in China, which is alleged to maintain a platoon of 50,000 birds with 1,100 trainers for communication in border and coastal areas, according to the Chinese Ministry of National Defense.

German "unmanned camera pigeon" in World War I
(Reproduced from *Wikipedia* entry on war pigeon

Assessment of viability of data transfer by carrier pigeons

In contrast to the historically demonstrated capacity of message transfer by carrier pigeons (noted above), members of the computer networking community have sought to articulate this possibility formally — as a widely publicized “in-group” joke.

Initially this took the form of a so-called *Standard for the transmission of IP datagrams on Avian Carriers* (RFC 1149). This was produced by David Waitzman (1 April 1990) as a standard submission to the *Wikipedia* *April Fools’ Day Request for Comments* (RFC). This has been framed otherwise as IP over Avian Carriers (IPoAC) — namely as a proposal to carry Internet Protocol (IP) internet traffic by birds such as homing pigeons.

> This memo describes an experimental method for the encapsulation of IP datagrams in avian carriers. This specification is primarily useful in Metropolitan Area Networks. This is an experimental, not recommended standard.... Avian carriers can provide high delay, low throughput, and low altitude service. The connection topology is limited to a single point-to-point path for each carrier, used with standard carriers, but many carriers can be used without significant interference with each other, outside of early spring. This is because of the 3D ether space available to the carriers, in contrast to the 1D ether used by IEEE802.3.
>
> The carriers have an intrinsic collision avoidance system, which increases availability. Unlike some network technologies, such as packet radio, communication is not limited to line-of-sight distance. Connection oriented service is available in some cities, usually based upon a central hub topology.
>
> The IP datagram is printed, on a small scroll of paper, in hexadecimal, with each octet separated by whitestuff and blackstuff. The scroll of paper is wrapped around one leg of the avian carrier. A band of duct tape is used to secure the datagram’s edges. The bandwidth is limited to the leg length. The MTU is variable, and paradoxically, generally increases with increased carrier age. A typical MTU is 256 milligrams. Some datagram padding may be needed. Upon receipt, the duct tape is removed and the paper copy of the datagram is optically scanned into a electronically transmittable form.

> Multiple types of service can be provided with a prioritized pecking order. An additional property is built-in worm detection and eradication. Because IP only guarantees best effort delivery, loss of a carrier can be tolerated. With time, the carriers are self-regenerating. While broadcasting is not specified, storms can cause data loss. There is persistent delivery retry, until the carrier drops. Audit trails are automatically generated, and can often be found on logs and cable trays.
>
> Security is not generally a problem in normal operation, but special measures must be taken (such as data encryption) when avian carriers are used in a tactical environment. (RFC 1149 – Standard for the transmission of IP datagrams on avia, FAQS.org, 1 April 1990)

Norwegian experiment (2001): In the spirit of the original proposal (RFC 1149), a "p-mail" experiment was successfully undertaken by members of the Bergen Linux User Group (*Putting the Pigeon in IP*. *Geek*, 11 May 2001).

> … the CPIP (Carrier Pigeon Internet Protocol) to ping a two-computer network placed a few kilometers apart at 0.15 bps on April 28th…. The birds, bearing data packets on small rolls of paper strapped to their legs, were released at 7.5 minute intervals. The first set of DataPigeons took a side trip to hang out with a local flock of their brethren, but then made it to the other computer after about an hour. BLUG members at the destination computer scanned the data packets in using OCR software, then sent return packets back to the starting point. The first test yielded a transfer rate of 0.08 bits per second (bps), but other tests almost doubled that speed to 0.15 bps. CPIP could thus get a simple e-mail or webpage transferred in a couple of hours or so.

Israeli experiment (2004): A related experiment was undertaken in the presence of several dozen "Internet geeks and experts" (*Pigeons' Bandwidth Advantage Quantified*, *Slashdot*, 31 March 2004):

> During the test, 3 homing pigeons carried 4 GB (gigabytes) for 100 km distance, achieving, what apparently looks as pigeons' world record in data transfer to a given distance. Bandwidth achieved by the pigeons was 2.27 Mbps…Transferring a similar volume of information through a common uplink of ADSL line would have taken no less than 96 hours..

South African experiment (2009): A widely noted experiment was undertaken in South Africa to highlight the inadequacies of internet rates in the Durban region (*SA pigeon 'faster than broadband'*, *BBC News*, 10 September 2009; *Pigeon transfers data faster than South Africa's Telkom*, *Reuters*, 9 September 2009; *A Race to Send Data: Pigeon vs Broadband*, *Foo Forum*, 10 September 2009).

> A Durban company (Unlimited IT) pitted a carrier pigeon (Winston) against the largest South African ISP (Telkom) to transfer 4 GB of data 60 miles (97 km) from Howick to Durban. The pigeon, carrying the data on a memory stick, arrived in one hour eight minutes, with the data taking another hour to transfer off of the memory stick. During the same two-hour period, only about 4.2% of the data had been transferred over the ADSL link. Telkom said it was not responsible for the firm's slow internet speeds.

United Kingdom experiment (2010): A similar experiment was conducted in England in September 2010; the "pigeonnet" also proved superior (*Pigeon flies past broadband in data speed race*, *BBC News Technology*, 16 September 2010; Jane Fae Ozimek, *BT feathers ruffled over pigeon-based file transfer caper*, *The Register*. 17 September 2010).

> Ten USB key-laden pigeons were released from a Yorkshire farm at the same time a five-minute video upload was begun. An hour and a quarter later, the pigeons had reached their destination in Skegness 120km away, while only 24% of a 300MB file had uploaded.

Social and personal implications of use of carrier pigeons

Security implications: The recent disclosures regarding invasive internet surveillance will necessarily engender protective responses. Given the obvious power of those variously delivering and controlling internet communication facilities, it is clear that protective measures will need to take a different form and scale if they are to be viable. High-tech solutions are clearly vulnerable to those with technical expertise and resources to penetrate protective electronic measures as currently envisaged — as is obvious from the incidence of malware, backdoors, and the like (cf. *NSA Built Back Door In All Microsoft Windows Software Since 1999*, *Washingtons Blog*, 10 June 2013).

In considering use of alternative messaging facilities, it is clear that (although humorous) the examples and experiments noted above would need to be adapted and informed by the newly apparent security dimension — as a vital parameter in the assessment of the viability of pigeons in comparison with the security risks of the internet. This was already evident to a fairly obvious degree with respect to their use in war time. Although humorous, the experiments noted above with respect to the relative speeds of data transfer by carrier pigeons (in comparison with internet facilities), merit extension with respect to a focus on the relative security of the two modes of data transfer.

Clearly there is a case for recognizing the value of carrier pigeons in the event of those (civil defence) emergencies exacerbated by power blackouts and other failures. Given some predictions of the increasing likelihood of both emergencies and power blackouts (and their communication implications), there is a case for recognizing the need for a longer-term backup for conventional communication facilities — perhaps for much longer time periods. Some military authorities clearly have a degree of awareness of this.

These possibilities are all the more credible to the extent that secret provisions have allegedly been made for cutting off access to the internet in some manner in time of conflict between nations and across continents — potentially under conditions of all-out cyberwarfare. The geographical dispersion of domain registrars and web hosting facilities (server farms, etc), especially when concentrated within one country (as with the USA), increases vulnerability to any such shut-down.

More pernicious is the possibility of selective blocking of internet addresses and communications by security agencies (or at their instigation under security provisions), whether from a particular computer or from a particular location. This would be an extension of facilities already used for spam filtering or to create filter bubbles for a given user (with the aid of cookies and otherwise).

Forms of communication for which invasive surveillance is considered to be irrelevant or

tolerable need necessarily to be carefully distinguished, namely communications where there is little concern at the possibility of problematic consequences of their being recorded and misused in some way. These facilities may however be placed at risk in the event of emergency. The concern here is with the particular attention required for more sensitive communications for which the internet is no longer viable in security terms.

Clearly any conventional data transfer is now usefully assumed to be insecure and untrustworthy, whereas that via avian carriers presents other security issues (to be assessed) — although for certain communications the risks involved may be preferable to those via the internet.

Use of carrier pigeons to ensure security of institutional systems: There is clearly an emergent concern for secure communications within any corporate system spread across space in a city or a region — especially to ensure the confidentiality of messages vital to ensuring competitive advantage. This may well be obvious in the case of the financial system. The same could be said for government agencies, as in a capital cities — or within cities favoured by a multiplicity of intergovernmental agencies (Geneva, Brussels, etc.). The issue may be significant for communications between embassies within such cities. The matter has become of great relevance to the European Union with the most recent disclosures (noted above).

Presumably the United Nations agencies have long been obliged to accept such surveillance.

The concern may similarly apply to some degree with respect to activist organizations articulating controversial views — or views which may be framed as "unacceptable" by government for whatever reason (*Major online websites in Singapore to protest against licensing requirement*, *The Online Citizen*, 30 May 2013; *Singapore Clamps Down on News Web Sites*, *The New York Times*, 9 June 2013; Spencer Ackerman and Dan Roberts, *US army blocks access to Guardian website to preserve 'network hygiene'*, *The Guardian*, 28 June 2013).

Ironically, given reported hacker penetration of military internet facilities (notably those of the Pentagon), the military may well have early recourse to the use of carrier pigeons.

Use of carrier pigeons for community, neighbourhood and home security: There is clearly a great deal of scope for extending the occasional pattern of isolated use of homing pigeons as a hobby to variants in which they may be used more extensively for communications jeopardised by invasive internet surveillance (possibly by criminal gangs) — or by unforeseen restriction of access to such facilities. The sense of "homeland security" may then acquire a new dimension more meaningful to those at the local level.

The question to be explored is how use of pigeons could compensate for endangered internet communication in communities, over what range, and how sustainably. The question will no doubt be a particular concern for homes and communities with a survivalist focus — actively anticipating wider societal unrest and collapse. This may now take the form of a "cyberattack" rather than a "nuclear attack".

Of particular interest is the development of civil defence provisions in countries with a long tradition of well-developed attention to such matters, as in the case of Switzerland or the Mormon communities of Utah.

Social networking facilitated by avian carriers: *Coo-ee* vs *Twitter*? Consideration could usefully be given to the possibility of adapting the facilities offered by "tweeting" (through Twitter) to an analogous mode based on avian carrier — perhaps to be framed as "cooing" (through "Coo-ee"?).

Imaginative innovation is clearly called for — as with the convocation of flash mobs, but especially in the case of demonstrations and protest movements currently relying on mobile phones. Such protests may now ironically be characterised by a remarkable number of message carrying pigeons.

Development, acquisition and private use of "drones": It is readily forgotten the extent to which "drones" constitute a development of model aircraft technology, notably as controlled by wireless. It is to be expected that "drone technology" will give rise to commercially available low-cost "drones" — effectively a more sophisticated form of model airplane. As with model planes, some may well be developed by hobbyists.

This could lead to widespread private ownership of "drones" of some form — curiously equivalent to the current enthusiasm of some hobbyists for homing pigeons and pigeon racing. It may well be the case that this development offers a private business opportunity — through adaptation of the hobby — to provide secure messaging services within a community. A parallel is to be seen in private electricity generation for a community when the public service is no longer operational.

There is the further possibility that conventional security firms may offer carrier pigeon facilities.

Implications of carrier pigeon use for intelligence agencies and security

Invasive surveillance, framed by security and intelligence objectives, has a long history — with its electronic enhancement being but a consequence of more recent technical developments. Ironically it could be said that the "cover" of the intelligence agencies has now been completely "blown". There is no activity involving computers or internet connectivity which can now be considered protected from such surveillance, whether passive or associated with data destruction possibilities. Declarations to the contrary are themselves now totally suspect and without the possibility of concrete proof as to their veracity.

Countermeasures: Intelligence agencies and security services are now faced with the need to develop countermeasures to alternative forms of data transfer and messaging. In the light of the proposal above, these clearly need to be framed as "avian countermeasures". Of particular relevance to their development is the possibility that those framed as "terrorists" may well develop skills in the use of carrier pigeons, given the tactical opportunity they represent. These might include:

- photographic surveillance and reconnaissance, as noted above in past wartime use — now extended to videocam possibilities
- messaging, again as noted in past wartime use — and as a substitute for vulnerable mobile phones
- dissemination of some form of small bombs, as noted with respect to past experimentation
- dissemination of biological agents — dispersion of genetically modified

organisms and bioweapons characteristic of bioterrorism

Learnings from aviation bird strike: Valuable insights into the nature of such countermeasures are offered by the extensive work on the problem of bird strike, most especially in the vicinity of airports. Experiments have been undertaken with high-tech forms of scarecrow, noise-making technology, use of predator birds (or their simulation), and lasers. In wartime other approaches have been considered including simply shooting down birds — a possibility which could now be automated, as with the use of lasers. Birds have however been noted for their adaptability and such control methods may not remain effective for long

One possibility for consideration is the use of AWAC-style facilities, perhaps with tethered balloons, to detect movement of pigeons in order to zap them with lasers from above.

Adaptation of falconry: An obvious possibility is breeding up the numbers of predators of carrier pigeons, notably hawks and falcons. There is some irony to the fact that a common descriptor of military aircraft favours their naming as “hawk” or “falcon”.

It is to be expected that those cultures with a tradition of falconry, notably a number of Islamic countries currently framed as havens of terrorists, could themselves develop their skills in order to use falcons to attack smaller drones designed to attack carrier pigeons.

“Turning” homing pigeons: Of particular interest in the case of enemy homing pigeons is the possibility of “turning them around” (or “diverting” them) in the light of more recent insights into the functioning of their navigation capacity — perhaps by engendering suitable magnetic fields. Use might be made of tethered balloons to hold the necessary equipment at an appropriate altitude — as with the use of such balloons during World War II (or even those of Google Project Loon)

Some of the experiments noted above recorded the extent to which the pigeons could be distracted enroute, if only temporarily, by the possibility of fraternising for mating purposes with others of their species. This suggests the development of attractors as decoys.

Use of drones: Recent technological developments suggest that the most obvious development, and probably the most economic, is the use of drones of smaller size adapted to attack pigeons — effectively substituting for the common predator of pigeons in nature. Presumably experiments to this end have already been envisaged in relation to the conventional aviation hazards of bird strike.

Legislation: An obvious countermeasure to be anticipated is the elaboration of a pattern of legislation regarding ownership and use of of carrier pigeons. This could be completely forbidden as a security risk, or as indicative of a potential threat to provisions for “homeland security” — perhaps citing “health hazards” as an excuse. As an example, Chicago has “pigeon law codes”. These cover banning, owning, and harboring pigeons, and managing or constructing any coop or cote for the sheltering of any live pigeon within any residential district — even the feeding of pigeons has been restricted. An interesting precedent is offered by controversial legislation in the USA governing the private growth of vegetables in a garden (*Prohibition of Vegetable Gardens*).

Irrespective of such legislation, clearly owners of carrier pigeons would merit registration on a (terrorist) “watch list”. With respect to security, ownership (or use) of pigeons could be

framed in a manner analogous to tax evasion. There is a curious parallel to those cultures which deprecate the drawing of curtains, preventing a view inside by passers by implying they have "something to hide" — in the recent framing, noted above, offered by UK Foreign Secretary William Hague. His argument raises valuable questions regarding the problematic nature of "official secrets".

A more radical innovation for consideration is to follow the precedent of the Catholic Church for an imprimatur — the requirement for an official declaration by a Church authority that a book or other printed work may be published. The possibility of a digital equivalent has been envisaged in an article by John Walker (*The Digital Imprimatur: how big brother and big media can put the Internet genie back in the bottle*, *Knowledge, Technology, and Policy*, 2003). This would be compatible with the formalization of internet censorship — potentially to be ensured under the authority of the NSA.

Another innovation to be anticipated could be the requirement that birds be individually identified — by tagging or implantation of electronic chips — to enable tracking of their movement by security agency surveillance. Precedents are evident in the tagging of pets, cattle and sheep.

A further possibility is that birds "acceptable" to the security community, or even serving its purposes, could be bred to have clearly identifiable coloration ("security pigeons") — in contrast to those which might have a camouflage coloration (for "under cover operations").

Engagement of "birds" in advanced communication technologies of the future

Photography: The adaptation of technology to avian capacities has been noted above with respect to the original emergence of technologies such as photography — perhaps now to be understood as a precursor of satellite photography and Google street mapping. These could be extended to use of videocam facilities — possibly even implanted as a glass eye (as anticipated in 007-style movies).

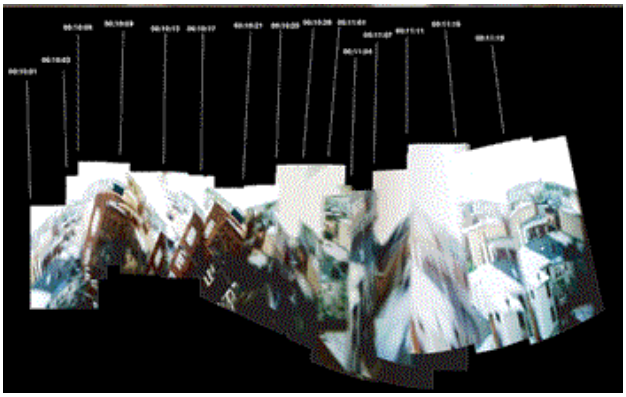
Following the initiative by Julius Neubronner (noted above), The Brooklyn Pigeon Project, initiated by architects Ben Aranda and Chris Lasch, is described as:

> An experiment in developing a satellite that records the city as seen by a flock of birds. Using trained pigeons and working with seasoned bird flyers, the project team equips pigeons that fly in regular spiral patterns over swatches of Brooklyn with wireless video cameras and microphones. Harnessed to these custom cameras and small battery packs, the birds become satellites carrying "earth-sensing" equipment that feeds images and sounds of the city back to a ground location. Their flight paths capture unconventional portraits both of the city below and of flock motions. This unique way to see Brooklyn contrasts directly with the way the city is increasingly recorded and represented today. The advent of geographic information technologies and the rise of network protocols have placed virtually all urban imaging and remote sensing systems "on the grid." Using a flock of birds as one component of an imaging apparatus, this project attempts to confront the limits of this grid by creating an equally rich disclosure of the city: seeing the city as a flock would. (Now Urbanism: Mapping The City, 13 December 2011)

Brooklyn Pigeon Project

Pigeons with cameras

Images from cameras



Project Orcon During World War II, Project Pigeon (later Project Orcon, for "organic control") was the effort by behaviorist B. F. Skinner to develop a pigeon-guided missile. The control system involved a lens at the front of the missile projecting an image of the target to a screen inside, while a pigeon trained (by operant conditioning) to recognize the target pecked at it. As long as the pecks remained in the center of the screen, the missile would fly straight, but pecks off-center would cause the screen to tilt, which would then, via a connection to the missile's flight controls, cause the missile to change course. Although skeptical of the idea, the US National Defense Research Committee nevertheless contributed $25,000 to the research. However, Skinner's plans to use pigeons in Pelican missiles was considered too eccentric and impractical; although he had some success with the training, he could not get his idea taken seriously.

The program was canceled in 1944, because the military believed that "further prosecution of this project would seriously delay others which in the minds of the Division have more immediate promise of combat application". Project Pigeon was revived by the Navy in 1948 as "Project Orcon" and canceled in 1953 when the reliability of electronic guidance systems was proven. (see also: C. V. Glines, *Top Secret WWII Bat and Bird Bomber Program*, *Aviation History*, May 2005; Jérôme Segal, *The Pigeon and the Predictor: miscarriage of a cyborg in spite of foundations supports*, In: G. Gemelli (Ed.), American Foundations and Large Scale Research: Construction and Transfer of Knowledge, Eds CLUEB, Bologna, 2001, pp. 131-157).

Cyborg development: Application of cybernetics to biology is the focus of biocybernetics and of the journal *Biological Cybernetics*. Recent developments of cybertechnology (most notably for humans) — involving artificial limbs and senses, as well as exoskeletons — suggest further possibilities with respect to avian carriers.

As reported by Jasper Humphreys of The Marjan Centre for the Study of Conflict and Conservation (*Military Cyborgs*, 31 May 2013), the first insect 'cyborgs', moths with integrated electronics in their thorax, have been demonstrated leading in the USA of the creation of the DARPA Hybrid-Insect-MEMS program (HI-MEMS). The goal, according to DARPA is to develop "tightly coupled machine-insect interfaces by placing micro-mechanical systems inside the insects during the early stages of metamorphosis". Military research is now focused on the utilisation of 'cyborg' animals for the purposes of gaining tactical advantage. The intention is eventually to develop HI-MEMS for dragonflies, bees, rats and pigeons.

It may well be the case that pigeon-drone adaptations will come to be understood as a spectrum of possibilities — ironically suggestive of the possibility that some drones may even be controlled by "bird brains", as suggested above by Project Orcon. *Wired* magazine has reported on developments by the Chinese (Noah Shachtman, *Cyborg Pigeons Revealed! Wired*, 27 February2007). Possibilities explored in the USA are noted by Jimmy Stamp (*The Robot Revolution Is for the Birds*, *Smithsonian.com*, 24 May 2013)

The possibility is also the theme of a song with lyrics starting as follows:

One Cybernetic Carrier Pigeon Said To Another... song by Allen Ramenberg
Don't let them go on About the way it used to be When your biology Would determine your destiny Your steel wings can take you Through the eye of any storm This surely is the best time For those like us, to be, born

Encoding and encryptions: Encryption for communication of messages in wartime has notably extended to the use of microdots — significant in reduction of the weight of any message on paper. More recent developments have envisaged or explored:

- steganography, namely embedding hidden messages in images
- microdot encoding, namely as used for vehicle identification in the event of theft
- holographic data storage in crystals
- *DNA data storage*, whereby 5.27 MB if data has been so stored (Monya Baker, *DNA data storage breaks records*, *Nature*, 16 August 2012), otherwise described as encoding 700 terabytes of data into a single gram (Sebastian Anthony, *Harvard cracks DNA storage*, *ExtremeTech*, 17 August 2012)
- *organic molecule storage*, suggesting the possibility of design and synthesis of new functional molecules (Guiyuan Jiang, et al., *Organic Functional Molecules towards Information Processing and High-Density Information Storage*, *Advanced Materials*, 20, 2008, 15, pp. 2888-2898)

In the use of carrier pigeons, these raise the further possibility of transmission of messages ingested as a constituent of the "chicken feed" by which pigeons are nourished. This suggests the exploration of replication of any message — then to be consumed by multiple birds — to insure against the possibility that one or more might be captured or destroyed in higher risk situations. This can be framed as a "shotgun" approach. Of course, for greater security, the same message could be split between several "seeds" to be carried by distinct birds — requiring that the recipient isolate and reintegrate those distinct parts.

Focusing on the "chicken feed" offers the option of enabling use of other bird species — possibly migrating over much longer distances — without the need to capture or house the birds, or to train them in any way.

All such options of course require that the bird shit be collected to isolate any message.

Clearly security services would need to set up facilities in anticipation of such possibilities. Indication that vital messages were being transmitted in this way at any time (especially by those suspect of aiding terrorism) would then clearly trigger a massive collection program by such services — with the output transmitted for scanning and "analysis" to specialists (perhaps to be appropriately known as "security anal-ysts").

Clearly there is the possibility that the process of dissemination via avian shit could be adapted for the aggressive dissemination of genetically modified organisms to destabilize ecosystems and spread disease — an extension of the process evident in the case of the avian flu virus.

Other possibilities are offered by use of memory chips implanted in the pigeons into which information could be "loaded" through an electrical connection or possibly by induction. The latter approach would open the way to rapid ("fly through") uploading and downloading of information and the use of pigeon relays for transfer over longer distances.

Selective breeding: As discussed further below, the dynamics of the relationship between pigeons and drones is susceptible to modification from the conventional pattern of prey and predator. Possibilities include:

- breeding of larger avian carriers constituting a greater challenge to smaller security drones
- increasing the aggressivity of avian carriers, such as pigeons, to enable them to challenge security drones more effectively — as with the alleged early development of "attack rabbits"

Revival of extinct species: Advances in genetic engineering have convinced some biologists that they will be able to re-create extinct species — using "de-extinction" or "resurrection" methodologies (*De-extinction critics at Scientific American have missed the point*, *The Guardian,* 7 June 2013). Genetic technology is moving so rapidly that amateurs may be able to revive extinct genelines within decades.

As reported by the Long Now Foundation, plans are underway in 2012 to revive the extinct passenger pigeon (*Ectopistes migratorius*). One flock in 1866 in southern Ontario was described as being 1.5 km wide and 500 km long, taking 14 hours to pass, and composed of in excess of 3.5 billion birds. Of the billions that once dominated the forests of eastern America, the last remaining passenger pigeon died a century ago.

The reconstitution will be accomplished from the museum-specimen DNA (*The Great Passenger Pigeon Comeback*, *Revive and Restore*; *Bringing Back the Passenger Pigeon*, *Revive and Restore;* Philip Bethge*, The Second Cooing: Raising Passenger Pigeons from the Dead, Spiegel Online International,* 12 April 2013; Antonio Regalado, *An Unlikely Plan to Revive the Passenger Pigeon*, *MIT Technology Review*, 19 March 2013; Greg Miller, *Say We Really Do Bring the Passenger Pigeon Back From Extinction — Then What? Wired*, 26 March 2013). Once the revival succeeds, the techniques will be applicable to hundreds of other extinct species. As noted by the Long Now Foundation:

> The passenger pigeon was selected for its iconic status and its relative practicality. Its DNA has already been sequenced. Some of its fans among scientists have the technical capability to begin the miracle of resurrection. The work will proceed by stages over the coming months, refining the

> sequencing of passenger pigeon DNA and compare it with the DNA of the extinct bird's closest living relative, the band-tailed pigeon.
>
> The genomes of the two birds will be compared in close detail, to determine which differences are most crucial. The viable band-tailed DNA will then be converted into viable passenger pigeon DNA. Later stages in the project, involving techniques being developed to generate live passenger pigeons from the DNA, and the birds will proceed to captive breeding and eventual return to the wild.

Stewart Brand has suggested that the first campaign to bring back an extinct species will effectively frame, for good or ill, all subsequent attempts. He has proposed that the ultimate goal be "deep ecological enrichment through extinct species revival."

Greening the world wide web using migratory birds

The previously unrecognized level of invasive surveillance of internet communications occurs in a period in which there is also concern at various measures variously described as designed to "stop the internet", "control the internet", and the like. (James Hurley, *Web Inventor Berners-Lee Warns Forces Are 'Trying To Take Control'*, *The Telegraph*, 23 June 2013; *Stop the Internet Blacklist Bills*, Electronic Frontier Foundation). Individual countries may have internal measures to that end.

Carbon footprint: Of interest in this respect, although still in the form of a "serious joke", is the proposal by a Canadian MP to "reduce the carbon footprint" (Olivia Chow *Going Green: Carrier Pigeons on the Hill Introduction of Avian Carriers*, 1 April 2012):

> In an effort to lower her office's carbon emissions, MP Olivia Chow is taking the initiative to reintroduce carrier pigeons to facilitate communication. Equipped with SD memory cards, the pigeons replace courier mail shipments to the Toronto constituency office. A single pigeon is usually equipped with a data capacity of 64 gigabyte, the Member of Parliament explains. On average, one of the Ontario-bred and trained pigeons takes seven hours for the Trip Ottawa-Toronto. This results in a transmission rate of 2,500 bit/second – far exceeding the constituency's office network connection to Parliament Hill. With the Toronto MP spearheading the initiative, the New Democrats are expecting more Parliamentarians to follow suit soon. The four homing pigeons are easy to maintain and a reliable in their courier services, the Official Opposition Transport Critic points out. Another advantage: being largely independent of the weather, the pigeons can be more reliable than road-bound transportation during inclement conditions, the Member for Trinity-Spadina concludes.

This example, despite its humorous context, points towards the possibility of "rewilding" endangered avian migration routes — with the reintroduction of species.

Also partially inspired by RFC 1149, Hiroki Kobayashi and Hiromi Kudo describe the theoretical underpinnings of the design of a Carrier Pigeon-like Sensing System (CPSS) for environmental care:

> … a future-present computing archetype that will enable the human race to observe inaccessible natural spaces, such as the contaminated forests around the Fukushima nuclear power plant. The system aims to elucidate the scientific knowledge underlying the self-repair mechanisms of contaminated natural

> areas and allows users to maintain a connection with forests in the absence of any human intervention for future societies . This novel sensing system can be used to create a sustainable balance between humans and animals to ensure that the self-repairing process of contaminated natural areas can be applied anywhere in the future. (Carrier Pigeon-like Sensing System: beyond Human-Red Forest Interactions).

Songlines of the biosphere? Given the role of avian migratory pathways around the world, an instructive comparison could possibly be made with the migratory passenger pigeon and the processes which led to its extinction one century ago. With the decline of songbirds, reactivation of avian migratory pathways could be described metaphorically as rewilding the "songlines of the biosphere". By comparison — for a knowledge-based civilization — any loss of internet pathways could be described metaphorically in relation to the noosphere (*From Information Highways to Songlines of the Noosphere*, 1996).

From a more general perspective, both could be understood as a source of human "nourishment" — potentially of a higher order. It might then be asked whether the evident human tendency effectively to destroy both reflects a tendency to civilizational self-harm. This is reminiscent of arguments raised by Jared Diamond (*Collapse: How Societies Choose to Fail or Succeed*., 2005) or with respect to civilizational energy systems by Thomas Homer-Dixon (*The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization*, 2006).

There is however very little sense of any correspondence between global information flow patterns and the patterns within the global environmental system, as discussed separately (*Psychology of Sustainability: embodying cyclic environmental processes*, 2002; *Existential Embodiment of Externalities: radical cognitive engagement with environmental categories and disciplines*, 2009). It might then be asked whether and how the former might possibly be "greened" by imaginative initiatives involving the latter, as discussed separately (*Embodying the world as a strategic opportunity*, 2013).

The arguments above for the transfer of "seeds of knowledge" by migratory birds recall the arguments for the creation of seedbanks protected against the possibility of environmental collapse with a view to subsequent "rewilding" of the natural environment. There is the ironic possibility that birds carrying such knowledge seeds, and "depositing" them at remote locations, might perfom an analogous role for civilizational knowledge. Wetlands as "internet server farms" of the future — conflating genetic and memetic functions? In the absence of other provisions for knowledge recovery from migratory bords, this could be seen as a conflation of the archaeological significance of middens and that of guano deposits — a strangely appropriate form of civilizational backup of cultural memory.

Engendering a pigeon-drone ecosystem: Curiously, but perhaps appropriately, development of drones (as "hawks") to attack pigeons effectively engenders a strange form of ecosystem — a predator-prey relationship in which the former are "artificial" and the latter "natural". Science fiction has speculated on such a pattern with the prey as humans.

The question of interest is then what thinking is required to gain insight into the potential functioning of such an ecosystem:

- modification of parameters in the predator-prey dynamics (as suggested above)
- development of modes of collaboration between drone predator and avian prey
- population dynamics with respect to a cybernetically enhanced drone-avian ecosystem

The following two configurations originate with the efforts of Edward Haskell, notably in the light of interaction between species in any ecosystem in a coaction cardioid (*Generalization of the structure of Mendeleev's periodic table*, 1972). The pattern has been further explored with respect to interactions in social systems by Timothy Wilken (*UnCommon Science*, 2001). Both have been used to explore sustainable relationships (*Cardioid Attractor Fundamental to Sustainability: 8 transactional games forming the heart of sustainable relationship*, 2005). These might be considered as indicative of a dynamic essential to health

Rewilding avian migratory pathways: Given the current interest in resurrecting the extinct passenger pigeon from genetic material (as noted above), of especial relevance to this argument is how the birds might then recover their requisite flying skills as these may be relevant to innate migratory instincts. The issue has been addressed with respect to endangered geese released from captivity into the wild with the aid of ultralight aircraft. (*Fly Away Home*, 1996; *Flight with Birds, "Father Goose"*, 2007; Bill Lishman, *Flight with Birds*). Current experiments are undertaken with the Whooping Crane.

There is a huge irony to the possibility that suitably adapted drones ("cyberpigeons") might be used as "role models" to escort young passenger pigeons to enable them to reactivate their instinctual relationship to their migratory pathways — rather than specially trained homing pigeons, as currently envisaged:

> But [Ben] Novak rejects the criticism. "Passenger pigeon parents were never incredibly involved in raising their young," he says. He also plans to teach the chicks the basics of passenger pigeon life by dyeing carrier pigeons and essentially using them as flight controllers for the returning species. "We'll ferry them with homing pigeons down to wintering grounds and back to the breeding area," he says. "After a few years, we have passenger pigeons that fly the same (routes) as their forefathers."
>
> As the captive flock continues to grow, Novak plans to train homing pigeons as guides to teach the passenger pigeons to migrate along the flyways of their extinct ancestors. The idea would be to dye the homing pigeons so they look like passenger pigeons, allow young passenger pigeons to imprint on them, and then release them all and hope that the passenger pigeons follow their homing-pigeon guides. "We'll get to see the passenger pigeon rediscover itself," Novak said in his talk in Washington.
>
> All this will take time. Novak estimates the first release is probably 20 or 30 years away, allowing 10 to 15 years to create the first pigeon, and a similar amount of time to grow the captive population. From that point, it could take another 50 to 75 years of captive breeding and successive releases to build up their numbers to the point at which giant flocks would once again darken North American skies.

There is considerable irony to the possibility that "passenger cyberpigeons" could be readily produced at this time — and even more ironic is the ease with which production of "billions" of drone emulations of passenger pigeons is now possible.

Thought might be usefully given to the role of any such variants in the transfer of plant seeds between distant locations, whether or not this is done for aggressive purposes, as noted above. Concerns will naturally be expressed regarding the accumulation of pigeon shit, already a source of complaint in some urban areas. Such complaints may extend to the

noise associated with pigeons. In the case of very large numbers — potentially of passenger pigeons — this may merit attention with respect to their weight when perched on telephone lines

Carrier pigeons for security and peace vs. Drones for insecurity and war?

The implications of such actions merit reflection in a period of ever increasing use of drones. In particular it is comprehensible that humans should invest such pigeons with courage, as is often done with domestic animals who have contributed to saving the lives of their owners. It is difficult to imagine how values of courage and heroism could be invested in the pilots of unmanned aerial vehicles ("drones") — perhaps more appropriately termed "unmanly aerial vehicles". Are these perhaps to be understood as an embodiment of cowardice in contrast with an embodiment of courage? For what might they be honoured? The dynamic might even be reframed as "heroic pigeons" vs "cowardly drones" — or "fearless pigeons" vs. "fearful drones". Are pigeons to be understood as offering a particular lesson in human values?

In a period of rapid extinction of species enabled by human activity, the rapid extinction a century ago of the passenger pigeon (which had numbered billions) also merits reflection in comparison with the extreme reduction in numbers of the bison in that period. The last passenger pigeon had been named Martha and died in 1914. Humans were almost exclusively accountable for the near-extinction of the American bison in the 1800s. At the beginning of the 19th century, tens of millions of bison roamed North America. Humans slaughtered an estimated 50 million bison, generally for their meat or pelts — reducing the population to hundreds. This pattern is curiously reminiscent of the extinction by genocide of the Aboriginal Tasmanians — of whom the last full-blooded, named Truganini, died in 1876.

Curiously the role of pigeons is much deprecated in modern urban environments. Ironically, however, they represent one of the few species which could be understood as sticking with humanity through all its disruptions to that environment — "companions on the evolutionary way" — as with dogs, cats, rats, cockroaches and fleas.

References

Andrew D. Blechman. Pigeons: The Fascinating Saga of the World's Most Revered and Reviled Bird. Grove Press, 2007

Jared Diamond. Collapse: How Societies Choose to Fail or Succeed. Penguin Books, 2005

Thomas Homer-Dixon (The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization. Knopf. 2006

Hiroki Kobayashi and Hiromi Kudo. Carrier Pigeon-like Sensing System: beyond Human-Red Forest Interactions [text]

Hiroki Kobayashi. Basic Research in Human – Computer – Biosphere Interaction. PhD Thesis, University of Tokyo, 2010.

P. Lee, D. Cheok, S. James, L. Debra, W. Jie, W. Chuang and F. Farbiz. A mobile pet wearable computer and mixed reality system for human – poultry interaction through th e internet. *Personal Ubiquitous Comput.* 10, 2006, pp. 301-317.

Judith Janda Presnall. Carrier Pigeons. KidHaben Press, 2004

D. Waitzman. A Standard for the Transmission of IP Datagrams on Avian Carriers. 1990 [text]

John Walker. The Digital Imprimatur: how big brother and big media can put the Internet genie back in the bottle. *Knowledge, Technology, and Policy*, 16, 2003, 3, pp. 24–77 [text]

Timothy Wilken. UnCommon Science. TrustMark, 2001 [text]
