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systems engineering.

n. de moncheaux

"System (n). The word itself is very general… [as for example] the "solar system" and the "nervous system…" [pertaining to] special arrangements of matter; there are also systems of philosophy, systems for winning with horses, and political systems; there are the isolated systems of thermodynamics, the New York Central System, and the various zoological systems…"

So explains a 1950 report to the US Air Force, on the urgent need to protect American territory against Soviet attack, not with a force (a unified, directional exercise of man and machinery characterising millennia of military efforts) but rather with a concept so uncommon at the time it needed careful definition: the system.

The resulting system was the Semi-Autonomous Ground Environment (SAGE), a network of interconnected installations protecting American airspace through the digital projection of spatial data.

AMERICAN DEFENCES COULD BE CONTROLLED IN REAL-TIME, AT COMPUTING CONSOLES SO SYMBIOTIC WITH THEIR OPERATORS THAT THEY CONTAINED, ALONG WITH A (REVOLUTIONARY) LIGHT-GUN AND CATHODE-RAY INTERFACE, A FOLD-OUT ASHTRAY AND 12-VOLT CIGARETTE LIGHTER.

SAGE was short-lived. The advent of ICBMs, arcing far above its surface-to-air defences, rendered the system obsolete by the late 50s. Yet, as would often become the case, one system supplanted another. America's subsequent missiles (Atlas, Titan, Minuteman) saw the system characterise not just the products of military-industrial enterprise, but also the now-continual process of their creation.

The commander of the ICBM-building enterprise, Air Force Lt. Colonel Bernard Schriever, had originally wanted to be an architect. However, the Great Depression had directed Schriever to the military.

But in the mid-1950s, he was the architect of a modernist revolution more profound than that of any aging émigré. Abandoning the traditional structure of military procurement, Schriever and his colleagues at the USAF's Western Development Division conceived a new framework, systems engineering, in which a network of suppliers, laboratories and military supervisors were interconnected by a complex web of standards and contracts whose structure recapitulated the boxes and wires of the ICBMs they produced.

Against a system of system-building systems, objects could not compete. The American architectural establishment eschewed the *artefacts* of the space-age and instead embraced the *system* itself.

And the establishment agreed: In 1965 US Vice President Humphrey said, "The techniques that will put a man on the moon are exactly those we will need to clean up our cities." Jay Forrester, who invented magnetic-core memory and led SAGE, was by 1969 writing extensively on "Urban Systems," as was the now retired Schriever. "I became convinced," Schriever reflected "that the solutions we devised in the Air Force to our technical and management problems were applicable to the problems of our cities."

But for all its sure-footedness in the vast enterprise of cold-war creation, the systems approach stumbled in the subtle landscape of the city.

Any attempt to reduce an urban artefact to a collection of variables, so Jane Jacobs argued in 1961, was doomed. Far from being unsystematic, urban situations were too much so, their variables "too numerous, too interconnected" for easy analysis. So as we try, as we must, to imagine systematic contributions to ever-more complex cities, we might remember Jacobs' assertion that, for all the resonance between system and city, the lines that knit them together are still, even as they approach our grasp, "as slippery as an eel."

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DALSTON, LONDON

twenty-one centigrade.

j.self

"This infinitely scrupulous concern with control is expressed in architecture by innumerable petty mechanisms. These mechanisms can only be seen as unimportant if one forgets the role of this instrumentation, minor but flawless, in the progressive objectification and the ever more subtle partitioning of individual behaviour."

MICHEL FOUCAULT

As an archetype, the airport occupies the pinnacle of occidental attempts at a self-disciplining population. No matter what the cultural background of the individual – whether from Belize or Belarus, Iceland or Indonesia – within minutes of entering the cool and polished atriums of any international terminal they are totally acclimatised and conditioned to the behavioural norms of the space. As if by osmosis the individual, who is quickly transforming into a passenger understands how they must act. But by what "innumerable petty mechanisms" is this achieved?

Perhaps the most important is the infrastructure surrounding the airport's air-conditioning. Intake vents, often more than a kilometre from the terminal, filter the air, extract dust and particulates, chemically scrub it to remove sulphates, nitrates and other exotic compounds, and finally deionise and dehumidify it. This pure, practically sterile air is then conditioned by a heat exchange and radiator. Altogether, this guarantees the stream of air exiting the system is never more than a half degree from 21c. A universal, homogenous atmosphere is thus created, from check-in to the most remote departure gate.

The selection of 21 degrees is far from arbitrary, and the seasoned traveller will note it rarely fluctuates from this figure by more than a degree or two.

The reason for this is simple: considering relative humidity and airflow, as well as average body fat, clothing and the median age of passengers, 21ºC is at the low end of the thermal comfort scale.

If it were to drop below 19 the passenger's metabolism would slow, and they would feel cold. A rise above 24 causes drowsiness. 21 maintains alertness, while reduced blood flow, heart rate and breathing induce calmness.

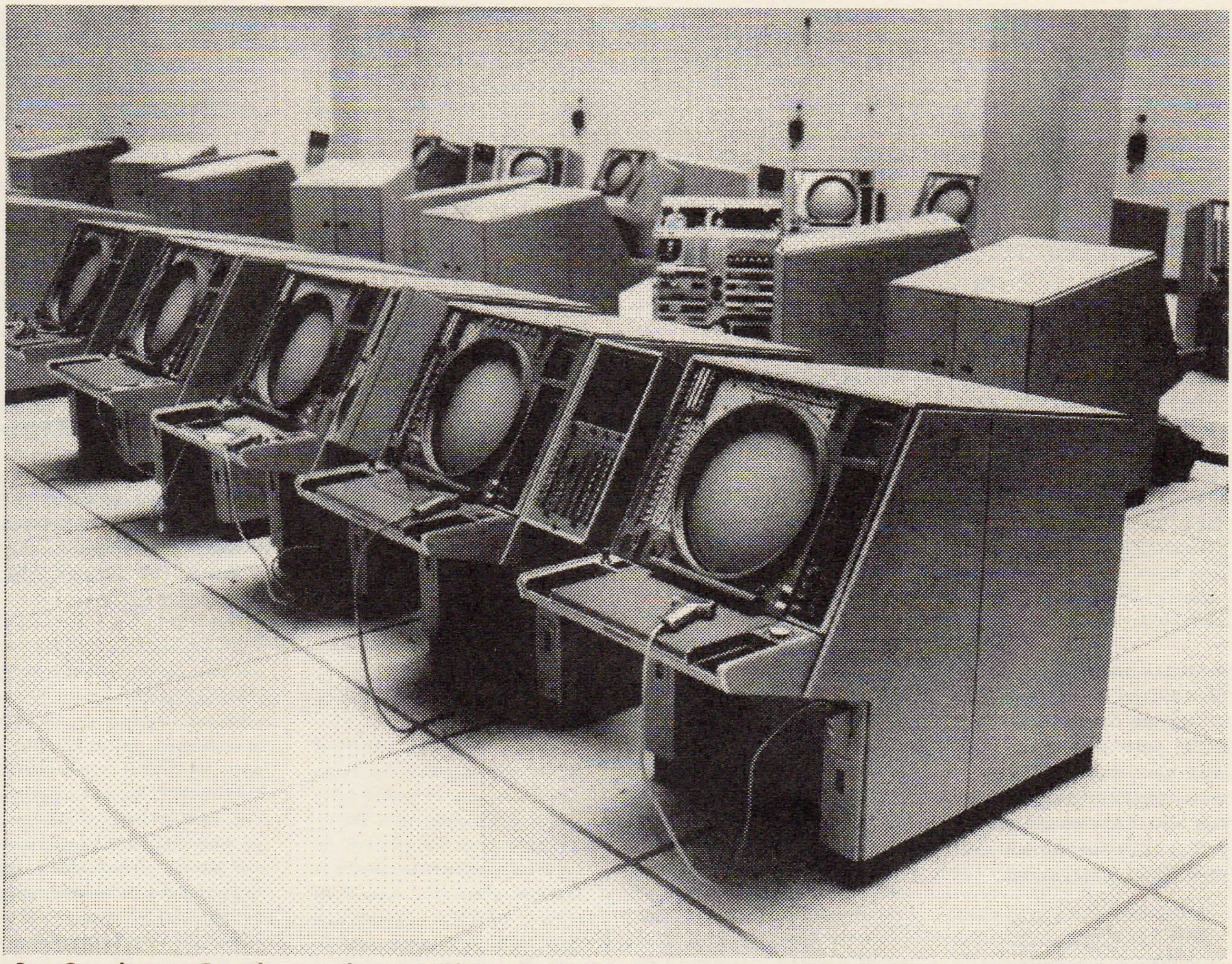
The culmination of this complex mechanical infrastructure is the terminal's computational nervous system: 1000s of sensors monitoring a range of atmospheric parameters. This information permits the building to use feedback loops to respond in real-time.

The speedy conditioning of the passenger occurs through the precision of this temperature, and the inescapability of the air-conditioning environment.

BY HARNESSING BIOMETRY TO DESIGN A SYSTEM-SPACE CAPABLE OF ONLY ONE PHYSIOLOGICAL REACTION, THE AIRPORT PROGRAMMES THE SUBJECT.

The motives behind this system are clear. As Baudrillard tells us, the unwillingness of certain classes to accept power can be seen as a response to the fact that a short causal chain can be pulled both ways. Oppressive power may exercise tight control over a population, but that transparency also leaves them vulnerable. The overall stability of the airport, and perhaps also the modern nation state, is therefore largely dependent on a class of workers unprepared to accept responsibility, or even to acknowledge they command power. This dissimulation is aided by the dispersion of authority through architecture-as-system, the "petty mechanisms" designed to conceal the fragility (and absurdity) of a computer as the ultimate source of control.

Jack Self edits Fulcrum. This article is indebted to the writing of Mark Cousins and Eleanor Dodman (see Fulcrum #4).



Sage Consoles, 1957. *From the original caption: "The heart of SAGE—electronic equipment coupled with man's ability to make decisions."* Credit : *Image 342-B-03-014-12-157241AC, courtesy National Archives at College Park, College Park, MD.*