

Working Papers on The Nature of Evidence:
How Well Do 'Facts' Travel?
No. 23/08

**Escaping the Laboratory:
The Rodent Experiments
of John B. Calhoun
& Their Cultural Influence**

Edmund Ramsden & Jon Adams

© Edmund Ramsden & Jon Adams
Department of Economic History
London School of Economics

January 2008



“The Nature of Evidence: How Well Do ‘Facts’ Travel?” is funded by The Leverhulme Trust and the ESRC at the Department of Economic History, London School of Economics.

For further details about this project and additional copies of this, and other papers in the series, go to:

<http://www.lse.ac.uk/collection/economichistory/>

Series Editor:

Dr. Jon Adams
Department of Economic History
London School of Economics
Houghton Street
London, WC2A 2AE

Tel: +44 (0) 20 7955 6727
Fax: +44 (0) 20 7955 7730

Escaping the Laboratory: The Rodent Experiments of John B. Calhoun & Their Cultural Influence

Edmund Ramsden & Jon Adams

Abstract

In John B. Calhoun's early crowding experiments, rats were supplied with everything they needed – except space. The result was a population boom, followed by such severe psychological disruption that the animals died off to extinction. The take-home message was that crowding resulted in pathological behaviour – in rats and by extension in humans. For those pessimistic about Earth's "carrying capacity," the macabre spectacle of this "behavioural sink" was a compelling symbol of the problems awaiting overpopulation. Calhoun's work enjoyed considerable popular success. But cultural influence can run both ways. In this paper, we look at how the cultural impact of Calhoun's experiments resulted in a simplified, popular version of his work coming to overshadow the more nuanced and positive message he wanted to spread, and how his professional reputation was affected by this popular "success."

Introduction

In 1947, John B. Calhoun's neighbour agreed to let him build a rat enclosure on disused woodland behind his house in Towson, Maryland. Calhoun would later reflect that his neighbour probably expected a few hutches, perhaps a small run. What Calhoun built was quarter acre pen, what he called a "rat city," and which he seeded with five pregnant females. Calhoun calculated that the habitat was sufficient to accommodate as many as 5000 rats. Instead, the population levelled off at 150, and throughout the two years Calhoun kept watch, never exceeded 200. That the predicated maximum was never reached ought to come as no surprise: 5000 rats would be tight indeed. A quarter acre is little over 1000 square meters, meaning each rat would have to itself an area of only about 2000 square centimetres, roughly the size of an

individual laboratory cage. Be that as it may, a population of only 150 seemed surprisingly low. What had happened?

Employed in the Laboratory of Psychology of the National Institute of Mental Health from 1954, Calhoun repeated the experiment in specially constructed “rodent universes” – room-sized pens which could be viewed from the attic above via windows cut through the ceiling. Using a variety of strains of rats and mice, he once more provided his populations with food, bedding, and shelter. With no predators and with exposure to disease kept at a minimum, Calhoun described his experimental universes as “rat utopia,” “mouse paradise.” With all their visible needs met, the animals bred rapidly. The only restriction Calhoun imposed on his population was of space – and as the population grew, this became increasingly problematic. As the pens heaved with animals, one of his assistants described rodent “utopia” as having become “hell” (Marsden 1972).

Dominant males became aggressive, some moving in groups, attacking females and the young. Mating behaviors were disrupted. Some became exclusively homosexual. Others became pansexual and hypersexual, attempting to mount any rat they encountered. Mothers neglected their infants, first failing to construct proper nests, and then carelessly abandoning and even attacking their pups. In certain sections of the pens, infant mortality rose as high as 96%, the dead cannibalized by adults. Subordinate animals withdrew psychologically, surviving in a physical sense but at an immense psychological cost. They were the majority in the late phases of growth, existing as a vacant, huddled mass in the centre of the pens. Unable to breed, the population plummeted and did not recover. The crowded rodents had lost the ability to co-exist harmoniously, even after the population numbers once again fell to low levels. At a certain density, they had ceased to act like rats and mice, and the change was permanent.

Calhoun published the results of his early experiments with the rats at NIMH in a 1962 edition of *Scientific American*. That paper, “Population Density and Social Pathology,” went on to be cited upwards of 150 times a year.¹ It has since been included as one of “Forty Studies that Changed Psychology,” joining papers by such figures as Freud, Pavlov, Milgram, Rorschach, Skinner, and Watson (Hock 2004). Like Pavlov’s dogs or Skinner’s pigeons, Calhoun’s rats came to assume a near-iconic status as emblematic animals, exemplary of the ways in which behavioral experimentation at once marks and violates the human-animal distinction. The macabre spectacle of crowded psychopathological rats and the available comparisons with *human* life in the densely-packed inner cities ensured the experiments were quickly adopted as “scientific evidence” of social decay. Referenced far outside of the fields of ecology and mental health, Calhoun’s rats have – or certainly had – come to seem part of the common cultural stock, shorthand for the problems of urban crowding just as Pavlov’s dogs were for respondent conditioning. Along with their public popularity, the experiments played a critical role in the development of disciplines and research fields, so much so that sociologist and human ecologist Amos Hawley (1972) would remark that the extent of their influence was itself a “curious phenomenon.”

¹ Calhoun reflects on this in: Calhoun, J. B. C. 1979. “Employee’s contribution to the Performance Assessment of his Scientific Service. [Draft.]” 4 December. John B. Calhoun Papers, National Library of Medicine (NLM), Bethesda, MD. n.p.

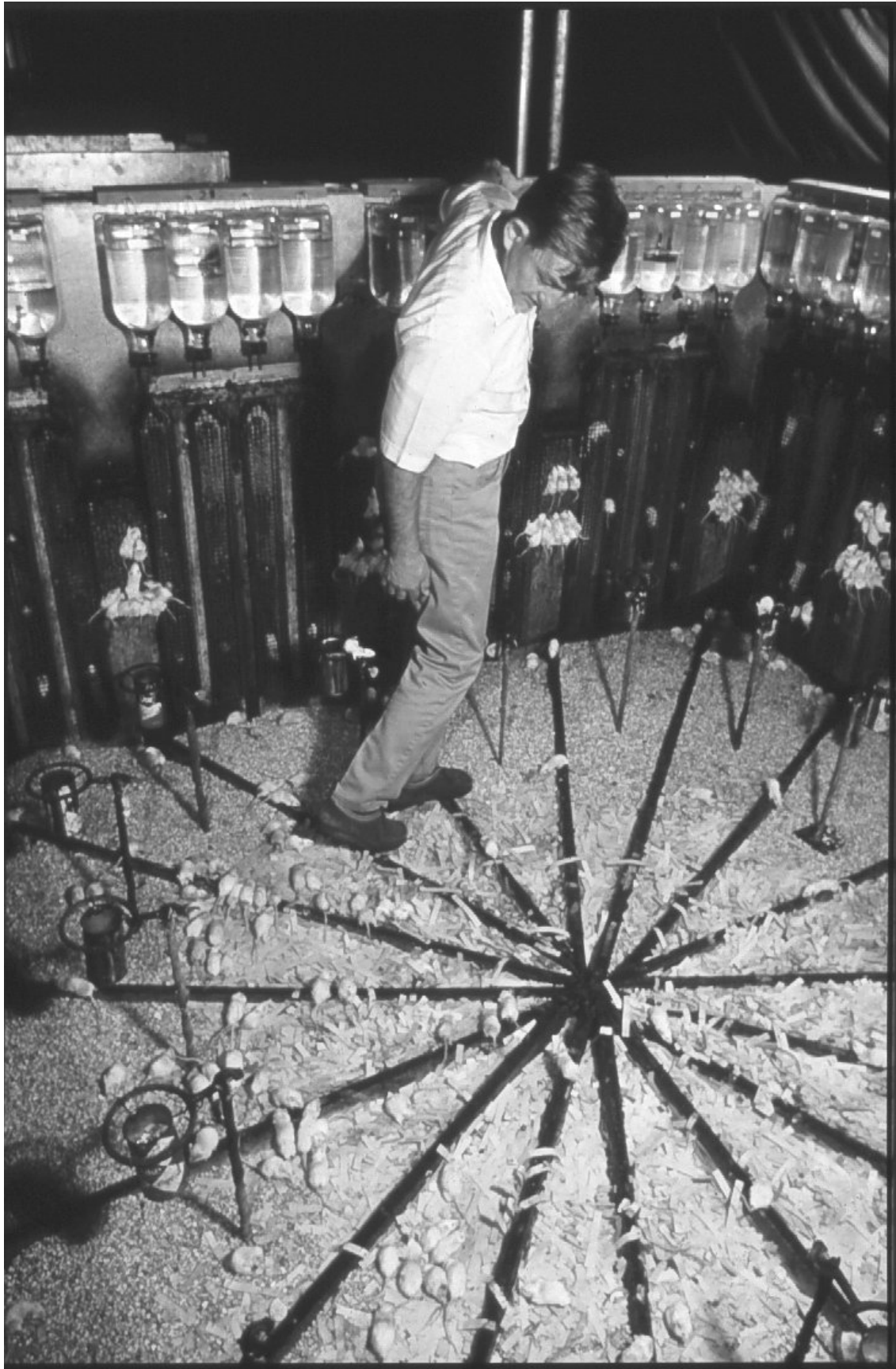


Fig 1. *John B. Calhoun in rodent Universe 133*

Calhoun began his career as an animal ecologist. Born in Elkton, Tennessee on 11 May 1917, he recalled a childhood spent immersed in nature.² Already a keen amateur naturalist, it was as a collector for the labs at the University of Virginia, Charlottesville, that he became known to the biology department, from which he graduated in 1939. Later that year Calhoun began postgraduate studies in zoology at Northwestern. A number of temporary appointments in biology faculties followed, and then, in 1946, Calhoun moved to the Johns Hopkins School of Hygiene and Public Health. Here, his formative training in the practical skills of trapping and collecting were put to use on the North American Census of Small Mammals (a vast and ambitious project to record numbers and species which Calhoun was to coordinate until 1956). Now married, Calhoun would settle here in Maryland, and it was here that the first rat experiments took place.

As part of a project looking at ways to control Baltimore's rodent population, two communities of Norway rats were studied: one in a row of backyards in Baltimore, and the other set out in Chesapeake Bay on Parson's Island. The contrast between "natural" and man-made settings would prove portentous; templates for the Towson enclosure built the following year and for much of his later work (Calhoun 1949, 1950, 1963a). Calhoun's interest in the relation between space and numbers was shared by the US Army, and in 1951 Calhoun continued his population studies at the Walter Reed Military Academy in Bethesda, MD. Calhoun's work at Walter Reed had been supported by a grant from the National Institute of Mental Health, and commencing 1954, he would move across the road to begin a full-time appointment with the Section on Perception at the Laboratory of Psychology, NIMH. Moving out into the fields above Bethesda, Calhoun first leased a barn from a

² The "Education" section of his CV for this period does not list grades and subjects studied. Instead, Calhoun charts his growth as a naturalist: "1931 ... elementary school, hunting and collecting turtles and bird eggs," "1935 ... covered the state collecting birds, bird eggs, insects." "Curriculum Vitae," Calhoun Papers, NLM. Box 18

farmer where he built the first of his rodent universes. Eventually, he is settled in building 112 in an annexe to the NIMH. Initially allowed considerable latitude, he would remain here for most of his career, constructing ever more elaborate universes, ever more ambitious research cycles. Meanwhile, as word of the experiments spread, his work became increasingly popular.

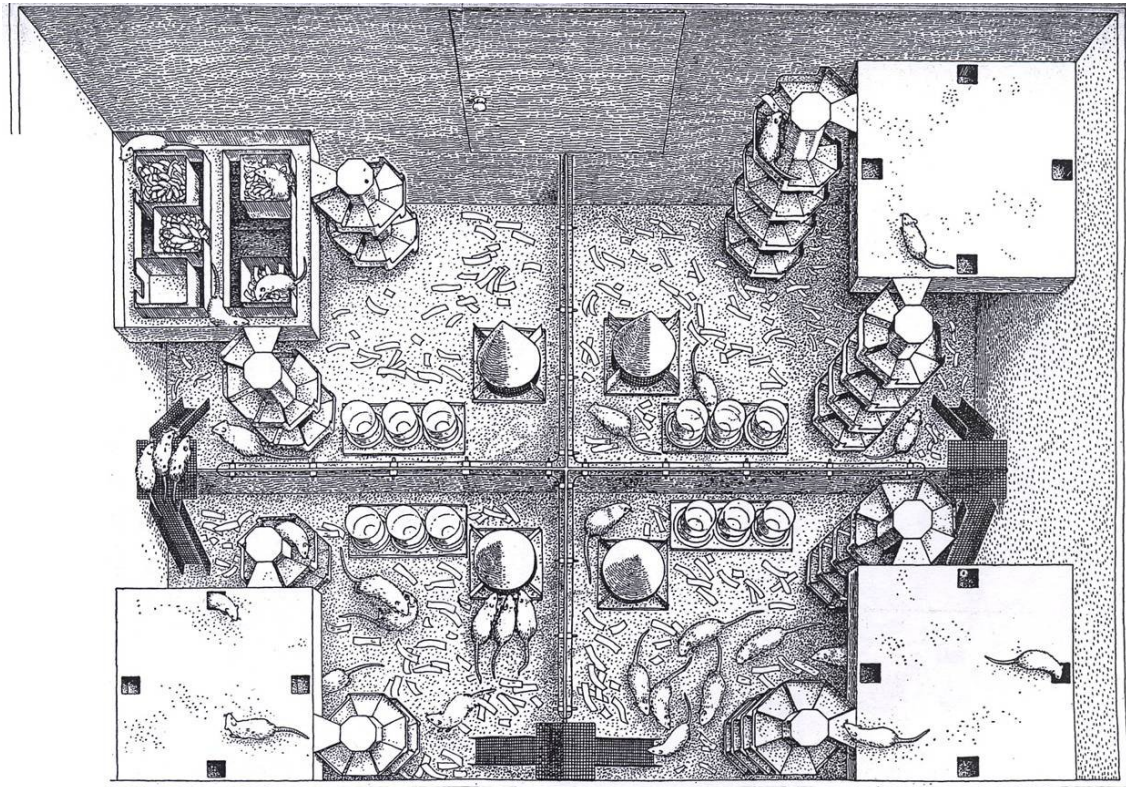


Fig 2. *Aerial view of early rat enclosure*

Although Calhoun would work at NIMH for over three decades, it was during this first period – 1954 to 1962 – that much of what he would later be remembered for would happen. This early research received a huge amount of attention – both publicly and professionally. We pursue these issues in the first part of this essay, examining how Calhoun's approach – notably his blurring of the human-animal boundary – impacted upon the concerns of a generation, encouraging numerous behavioral scientists to enter into the study of crowding among human beings. What made the NIMH experiments uniquely influential,

however, was not only Calhoun's decision to focus on behavioral rather than physical pathology (*vice* as opposed to *misery* – the more common of Malthusian concerns), but also his careful use of language. The transition from lab notes to *Scientific American* to the pages of newspapers and novels required relatively little translation. Constructing a typology of pathological crowding behaviors, he gives the groups names immediately resonant with human types. Most successful of all, the tendency to congregate in dense huddled knots of squalor and violence he called "the behavioral sink." The mobility of Calhoun's findings was also aided by his preferred experimental organism: the rat, a creature synonymous with urban and indeed moral degeneration.

This paper will explain is how the popularity of his experiments came to impact upon his later research and reputation as a scientist. The *public* image of what Calhoun had achieved was largely negative: concerned with the macabre spectacle of the behavioural sink, with the horror story of the crowd, and disseminated through popularisations, journalism, science fiction, and even comic books. We shall see that this success in translating his work to broader audiences had serious repercussions for its interpretation among behavioural scientists concerned with the modern human condition: for as Calhoun's rodents moved beyond the boundaries of NIMH and behavioral ecology more generally, escaping into the broader social world and into the popular imagination, they also escaped from his control. While, *professionally*, his work became a (seemingly obligatory) touchstone reference for a wide number of fields ranging from architecture to zoology, the numerous simplistic and sensational popular accounts of Calhoun's work resulted in his association with an unduly pessimistic and cataclysmic vision of man's future in a crowded world, a vision that

many chose to counter.³ To his growing frustration and dismay, few drew upon his later research, dedicated to ameliorating the ill-effects of crowding. Through the effective design of space, he attempted to develop more collaborative and intelligent rodent communities, capable of withstanding greater degrees of density. For Calhoun, contrary to many interpretations, population growth was not inherently bad and humanity was not destined to destroy itself.

Finally, the paper will explore how, as he struggled to have his message understood and acted upon, the scientific, artistic and popular imaginations began to fuse. Having long been happy to draw inspiration from writers such as H. G. Wells and George Orwell, he increasingly saw his rodent laboratories as providing evidence for the alternative futures these authors imagined. Humanity must undergo a conceptual and “compassionate” revolution, or else (like his rodents) descend to stagnation and death. He mapped the development of his rodent populations, of human cultural evolution, and his own career on to one another.⁴ Just as subordinate rats and mice struggled to find more creative solutions to the problems of increased density, as opposed to their aggressive and conservative superiors, he, like other creative thinkers, had also struggled professionally. Existing on the boundary between the social and the biological sciences meant that all too often, he existed on the periphery of both. His use of cultural referents to promote a more *positive* vision of humanity’s future in a crowded world, met with much less success. With his failure to secure the necessary institutional support to complete his project in the 1980’s, Calhoun

³ See Burnham (1987) for an account of the deleterious effects of sensationalism in popular presentations of scientific material.

⁴ The history, philosophy and sociology of science is only just beginning to explore the ways in which scientists become attached to their work and experimental organisms to the degree that it influences individual subjectivity. See for example Hayward (2001) and Leonelli (2007). Hayward extends Callon and Latour’s analysis of networking in science, arguing that the process also has an important impact on “domestic life, human desire, and personal identity” (Hayward 2001: 615).

feared that the pessimistic Orwellian future with which he had been all too readily aligned would become a reality.

Scientific and professional influences

Crowding was the problem to which Calhoun dedicated his entire professional life as a scientist, and in ways that traversed the borders between scientific cultures and social worlds. He was first encouraged to begin his studies of growth in confined populations by two leading figures of population biology, W. C. Allee and Raymond Pearl (Calhoun 1977). When doing so as part of the rodent ecology project at Johns Hopkins six years later, he and his colleagues contributed to a central debate in ecology (Keiner 2005). Allee, Pearl, and Charles Elton in Britain, all focused their attention on the rise and fall of population numbers over time (Kingsland 1985, 2005; Mitman 1992); investigating whether these shifts and fluctuations were caused by climate, food supply, predation, or if instead there was some internal regulatory mechanism triggered by increased numbers. While Elton focused on external forces, even seeking explanations in cosmic events (Elton 1924; Erickson and Mitman 2007), Allee and Pearl believed that some intrinsic factors would have evolved to ensure that a species did not outstrip its means of subsistence (Allee 1931; Pearl 1925). Pearl experimented with fruit flies in a bottle, Thomas Park (1932, 1933) with flour beetles and F. A. E. Crew with mice (Crew and Mirskaia 1931). In these cases, the population levelled-off at a certain point of density, a process aided by certain extreme behaviors such as cannibalism and reproductive dysfunction (cf. McAtee 1936).

A particularly fruitful line of inquiry was developed by ecologist John J. Christian, Calhoun's colleague at Johns Hopkins. Christian turned to Hans Selye's conception of stress: adrenalin for fight-or-flight

responses was maladaptive under situations of extreme or prolonged stress, leading to a breakdown in bodily systems (Christian 1950, 1961). This was expressed in a triad of physical changes: adrenal hypertrophy, atrophy of lymphatic structures, and ulceration of the stomach and duodenum (Viner 1999). Seeking to identify and replicate the social, physiological, and evolutionary effects of crowding stress in laboratory and field, researchers turned their attention to a host of species such as voles, lemmings, snowshoe hares, sika deer, monkeys, cats, and (of course) rats and mice (Chitty 1967, 1996; Christian and Davis 1964; Leyhausen 1965; Snyder 1968; Southwick 1971; Wynne-Edwards 1965).

Calhoun, therefore, was not the only researcher interested in the study of density, nor was he solely responsible for the growing interest in its behavioral effects. The crowd had long been associated with pathology: with mass panic, with the spread of disease, with political radicalism, aggression, and unruly social behavior. Many of these issues had been brought to the fore by contemporary events: rioting in American cities from 1965 to 1968, campus demonstrations, the rise of drug-culture, the apathetic non-response of many witnesses to the brutal rape and murder of Kitty Genovese in Queens in 1964 – all were considered problems of “the crowd.”⁵

Meanwhile, the crowd itself was directly associated with the problems of population growth, another subject of concern. America in the decades following the Second World War experienced rapid change and growth as technological progress, catalyzed by the war effort and

⁵ W. Horsley Gantt, psychiatrist at Johns Hopkins University, contributed the failure of the numerous witnesses to help Kitty Genovese, or even phone the police, to the stress of overcrowding in the city (*The Cedar Rapids Gazette*, 27 January 1965). The social demographer David Heer also suspected that the murder “may illustrate,” in part, “the type of social pathology occasioned by high population density” (1975: 41). For links made between crowding and urban violence there is a useful review paper by Adams (1972); while Carstairs (1969a) made direct links between the pathological effects of overcrowding in animals and urban riots in his report for the National Commission on the Causes and Prevention of Violence.

sustained by a buoyant economy, supplied the citizenry with a surfeit of luxuries. Yet with an improved economy came an accelerated birth-rate, coinciding with an increased shift from rural to urban living. The problem of space seemed urgent, the expansion unsustainable. Housing projects sought to ease the pressure by packing residents into vast concrete hives. Among the most vilified was the Pruitt-Igoe development in St Louis. Erected in 1951 and eventually demolished in 1972, it was a project which rapidly came to symbolize how failures in planning could catalyze social degeneration (Gillis 1983: 3-4).

It is into this milieu that Calhoun's work emerges, fusing the idea of the crowd as a pathological process, concern about the modern urban individual being overloaded by stimuli, and the belief that all social animals share certain biological needs and societal structures. Indeed, from their inception, Calhoun's experimental designs reflected his concern with human populations: his rodent homes resembling high-rise tower-blocks complete with narrow stairwells and congested entrances. These miniature cities seemed to model the world without, and the physical similarities offered a seductive behavioral analogy – here in the rodent universe, many of man's social ills were seemingly explained by the relation between space and numbers.

Central to Calhoun's experimental design was his contention that there exists an upper limit to the number of meaningful social interactions that an individual could cope with before stress became a factor (Calhoun 1971a). This innate limit determined a maximum group size – a figure Calhoun set at twelve in both rats and man (Calhoun 1963b, 1966). As population density increased it became evermore difficult for an individual to control the frequency of social contact. The result was unwanted interaction, leading to adverse reactions such as hostility and withdrawal, and ultimately, to the type of social and psychological breakdown seen during the latter stages in his crowded

pens. In this, Calhoun's work intersected neatly with the growing interest of anthropologists, sociologists, and social psychologists in the processes of social interaction (Garfinkel 1964; Goffman 1963, 1971; Hall 1966; Milgram 1970); with the influence of cybernetics, systems theory and holistic thinking in the bio-medical sciences (Dubos 1965; Hoagland 1963); and with the attention urban planners, architects and designers began to pay to ecology, ethology, and the behavioral sciences as a means of ensuring that we no longer built *against* but *with* the laws of the natural world (Alexander 1964; Greenbie 1976; McHarg 1964, 1969).

Yet Calhoun's work is unique not only in the degree to which it connected with existing social and scientific trends, but in the degree to which it inspired new approaches. Drawing upon Calhoun's work, researchers in human ecology, social psychiatry, social epidemiology, and the new environmental psychology – such as George Carstairs (1969b), Aristide Esser (1973), William Michelson (1970), Harold Proshansky (et al 1970), Robert Sommer (1969), and D. H. Stott (1962) – identified the problem of density in the city, home, and institution as impinging directly on health and development.⁶ The interest was reciprocated by biologists such as Paul R. Ehrlich, who believed that the problems of crowding would help bring population issues to the urban masses. Ecology was not simply concerned with the preservation of the wilderness for the elite, but with eradicating rat-infested slums – the poverty of which correlated with the wealth of numbers (Ehrlich 1969; Ehrlich and Holdren 1971).

Stimulated by Calhoun's research, it was Ehrlich who encouraged a recent PhD in psychology, Jonathan Freedman, to begin the first

⁶ The combination of environmental psychology, urban sociology and environmental design is described as the "new environmentalism" (Bradbury 1976). Its emergence in the late 1960s is reflected in the founding of the journal *Environment & Behavior* and the *Environment Design Research Association* in 1968, followed by the journals *Man-Environment Systems* and *Design and Environment* in 1970.

laboratory studies of crowding among human beings at Stanford University in the late 1960s (Freedman 1975). These were joined by surveys which sought to correlate density with a variety of pathologies deemed analogous to those found in Calhoun's laboratory (Galle, Gove, and McPherson 1972; Gillis 1974; Winsborough 1965). Social scientists also sought to identify social pathologies in institutions where individuals were collected together for considerable periods of time, such as the prison, the hospital, the college dormitory, and the school (Baum and Valins 1977; Hutt and Vaizey 1966; Paulus et al 1975).

These were for the main part young researchers disaffected with the previous generation's failure to deal adequately with the problems of space and numbers, problems with which they were greatly concerned (Altman 1978: 7-8). Seeking to justify this shift in focus, they turned to Calhoun. It seems to have become almost obligatory to begin any study, analysis, or reflection on crowding with a description (or at least a reference) to Calhoun's now "classic" experiment. While most addressing density issues among animals believed that the work had relevance to the human condition (particularly in relating stress to physical pathology), it was Calhoun who made the study of animal crowding behavior his own, and further, made his interest in human behavior explicit.

One of Calhoun's first roles at NIMH was to help the psychiatrist, Leonard Duhl, to organize a regular series of seminars which brought together a diverse group of experts. Nicknamed the "Space Cadets", they were united by a concern with the influence of the physical environment on health, behavior and wellbeing.⁷ Indeed, Calhoun's

⁷ The full title of this informal group was the Committee on Physical Environmental Variables as Determinants of Mental Health. Its members met twice a year for three days from 1954 through to 1966, and included among its long-term members, the psychiatrist Erich Lindemann, the urban economist Harvey Perloff, the sociologist Herbert Gans, the philosopher, Scott Buchanan, the biomathematician Nicolas Rashevsky, the ecologist Edward Deevey, the physicist John Q. Stewart, and the chemist and planner Richard Myer (cf Duhl 1963).

work was spread over so many bases that the old disciplinary categories seemed oddly inappropriate. Asked to state his disciplinary affiliation in a 1969 NBC television interview, Calhoun flounders momentarily. When the presenter suggests psychologist, Calhoun agrees he could be a psychologist, or an ecologist, or a human ecologist.⁸ What the interviewer is really interested in is whether Calhoun sees his work as relevant to humans or animals, a distinction to which Calhoun displayed a genial indifference. When it came to zoomorphism – reading animal behavior into the behavior of men – Calhoun made it clear that the burden of proof lay with those who made pre-Darwinian claims for human uniqueness (Calhoun 1973c: 94). Any resistance to zoomorphism was just another anthropocentrism.

Others agreed, and went further. At the end of the 1960s, popular books by Robert Ardrey and Desmond Morris urged that we view our own behavior in exactly the same way as we view the behavior of animals. They combined Calhoun's work with the growing ethological interest in aggression and territorial behavior (Lorenz 1963). Re-describing humans as "naked apes," Morris insisted our inherited habits could not be "civilized-out," and urged we organize society accordingly (Morris 1967: 39). Much like rats, our "rules" for social interaction "were designed for use in a small, closely knit tribal unit, not in a vast metropolis. In the big city we are constantly intermixing with hundreds of [...] strangers. This is something new, and it has to be dealt with" (Morris 1967: 84-85). Like Morris, Ardrey (playwright turned pop-anthropologist) shuttles between animal studies and human social ills, deploying the former to understand the latter. Also like Morris, he singles out the city for special attention: "We face in the urban concentration something new under the sun, something unanticipated.

⁸ Calhoun, "Space Bubble" interview (along with Edward Hall and Aristide H. Esser) NBC, May 5, 1969. John B. Calhoun Papers, National Library of Medicine (NLM), Bethesda, MD. Box 20, Cassette V2.

[...] we may live in our cities like ants in an ant-hill, as vertebrates we are genetically unprepared for such contingency” (Ardrey 1970: 219).⁹

Exposed to Calhoun’s experiments, it was surely difficult to resist making connections between the rodent colonies and the problems of increasingly crowded cities. When Senator Robert Packwood called on the government to consider the problem of population growth in 1971, it was to Calhoun that he turned.¹⁰ Lewis Mumford draws upon Calhoun in a way that was increasingly common in the 1960s and 70s:

No small part of this ugly barbarization has been due to sheer physical congestion: a diagnosis now partly confirmed with scientific experiments with rats – for when they are placed in equally congested quarters, they exhibit the same symptoms of stress, alienation, hostility, sexual perversion, parental incompetence, and rabid violence that we now find in the Megalopolis. (1968)

The particulars in the above quotation reflect two further aspects of Calhoun’s research that made it so attractive. The first was the sheer range of behavioral pathologies identified; the second was his association of these “unnatural” and immoral behaviors with such an unpopular, tainted animal as the rat. Like man, the rat could be said to exist on the boundary between the natural and the unnatural. In the folk-taxonomy that sorts species by relation to humankind,¹¹ the rat is neither domesticated nor entirely wild; rather it is an unwelcome but perennial cohabitant of the built environment. The rat seemed

⁹ Ardrey provides a good account of the rodent experiments and the history of overcrowding research. Ardrey’s account apparently forms the basis for a subsequent popularization of Calhoun’s research – A. H. Drummond’s *The Population Puzzle* – a work aimed at schoolchildren.

¹⁰ Senator Bob Packwood, 92nd Congress, 1st sess. *Congressional Record* (April 1, 1971)

¹¹ By “folk taxonomy” we mean the unofficial but ubiquitous system of classification which categorizes animals as variously “edible,” “suitable pet,” “beast of burden” etc. All of which, as George Lakoff has noted, sounds very much like the anthropocentric categories Borges lists in “The Celestial Emporium of Benevolent Recognition”: “those that belong to the Emperor,” “those that are trained,” and so on. (Lakoff 1987: 92; Borges 1966: 108).

indigenous to the city, and what made the species so repellent was precisely what made it so successful: thriving where squalor is most pronounced, often to epidemic, plague-like proportions. It is thus unsurprising that when seeking illustrations of the adverse affects of crowding on behavior, it was the *rat*, rather than the vole, deer, or snowshoe hare, which was more commonly chosen by writers. The ready-made cultural taint and untouchable status of rats seemed to amplify the impact of Calhoun's work. And although Calhoun increasingly used mice in his more ambitious later experiments, it is nearly always with reference to rats that the work is written about, especially in the more populist formats. Given the cultural climate into which they emerged, it comes as no surprise to find that Calhoun's work is quickly picked up on by the more alert social commentators, journalists, and writers of the day.¹²

Popular impact in the behavioral sink

Calhoun's experiments appeared in *Scientific American* at a propitious time: interest in crowding was piqued. A receptive audience was assured, and Calhoun's rats swarmed into the public sphere. Calhoun's interest in vice, crowding, isolation, disruptive behavior, and social collapse align his research with some of the dominant themes of post-war literature. The period following his publication in *Scientific American* sees a rush of popular books and films which rehearsed an apocalyptic view of a future crippled by over-population – books like *Terracide*

¹² Newspaper and magazine articles are too numerous to exhaustively list. Ever since a 1948 *Time* magazine article ("Displaced Rats," 14 June), Calhoun's work has sporadically appeared in the mass-circulation press, where it illustrates a variety of themes: in series of articles on modern pollution, Bethami Probst uses Calhoun's research to discuss stress in the city (widely syndicated, e.g., "It's Enough To Make You Sick, Part IV: Driven to Distraction!" *The Capital Times* (Madison, WI) 24 April 1970, 20); science writer Frank Carey picks up on Calhoun's work for a widely syndicated 1973 article (e.g., "Population spoils paradise for mice" *Oshkosh Daily Northwestern*, 14 March 1973 13); and in a 2002 book review (King, John. "City Dumps" rev. of *The City in Mind: Notes on the Urban Condition*, by James Howard Kunstler, *San Francisco Chronicle*, 3 February 2002).

(1970) by Ron M. Linton; *My Petition for More Space* (1974) by John Hersey; *Make Room! Make Room!* by Harry Harrison, published in 1966 and later filmed as *Soylent Green* (1973, dir. Richard Fliescher); the film *Z.P.G.* (1972, dir. Michael Campus); the novels *Logan's Run* (1967), by William Nolan and George Johnson; *334* (1974) by Thomas Disch; and *Stand on Zanzibar* (1968) by John Brunner. In Anthony Burgess's *The Wanting Seed* (1962), massive overpopulation result in ultra-violence, compulsory homosexuality, hermetic isolation. In Robert Silverberg's *The World Inside* (1970), billions of human beings are contained in vertical cities and the pathology of overcrowding is countered by an oppressive communal ideology that stifles individuality. Nor was this type of referencing entirely benign: fictional "cases" were also being used to promote policy. *Voyages: Scenarios for a Ship Called Earth* (ed. Sauer), an anthology of short stories and extracts focusing on the dangers of population growth, resource depletion, and crowding, was published by the Zero Population Growth Movement in 1971. Sandwiching the fiction between polemical essays on overpopulation, the ZPG apparently aims to use the imaginative productions of writers including Doris Lessing and J. G. Ballard as *evidence* for the looming threat. (Whilst *Voyages* itself does not make direct reference to Calhoun, it does establish that fiction was explicitly perceived as capable of playing a persuasive role in shaping public opinion.)

On the other side of the Atlantic, British comic book *2000AD*, launched in 1977, bears the imprint of that era's interest in dense, violent conurbations. Judge Dredd, the comic's flagship character, brutally polices massively overcrowded "MegaCities" – urban environments which had exceeded what Calhoun called the "megacrisis," the point at which the problems of overcrowding became irresolvable. The populations of the megacities live in "[v]ast towerblocks, each housing 60,000-plus people" – a way of living that "isolated citizens," as it "bound [...] them together." The lifestyle causes

“distortions in the hypothalmus [sic]” – just like the stressed-out rats in Calhoun’s pens. They become “surly, illogical, violent,” their “pack instinct is stimulated.” Anarchy and war result. If those terms seem resonant with Calhoun’s work, it is no coincidence. *Judge Dredd*’s co-creators, Alan Grant and John Wagner, both recall being alert to Calhoun’s work.¹³ Grant, especially, cites Calhoun’s experiments as a direct influence, and would later return to the theme – making explicit references to the crowded rats of Calhoun’s experimental universes. In a *Batman* comic written by Grant in 1995,¹⁴ a character called “The Ratcatcher” plans to usurp humans and repopulate the world with a breed of self-conscious rats called “*Rattus sapiens*.” At one point, Ratcatcher lectures an audience of rats on an example of man’s brutal treatment of their species: Calhoun’s rodent experiments (note that “universe 133” was actually a mouse experiment, but it is as ever with reference to *rats* that the work is recalled):

¹³ John Wagner, letter to authors, 20 February 2007; Alan Grant, email to authors, 22 June 2007.

¹⁴ Grant/Balent/Smith. “Batman: The Secret of the Universe, Part 2” *Catwoman*. Baldwin, NY: DC Comics. 26 November 1995, 6-7.



Fig. 3. Panels from the "Ratcatcher" comicbook

The altogether seedier “underground” comic book scene apparently found Calhoun’s work especially appealing. In 1970, a Californian horror comic called *Insect Fear* makes a short run. It’s a garish, Robert Crumb-meets-William Burroughs¹⁵ affair, suggested “For Adult Intellectuals Only.” The content graphically documents excesses of lust, aggression, and self-abandon in an urban setting. The subtitle is: “*Tales from the Behavioral Sink*.”

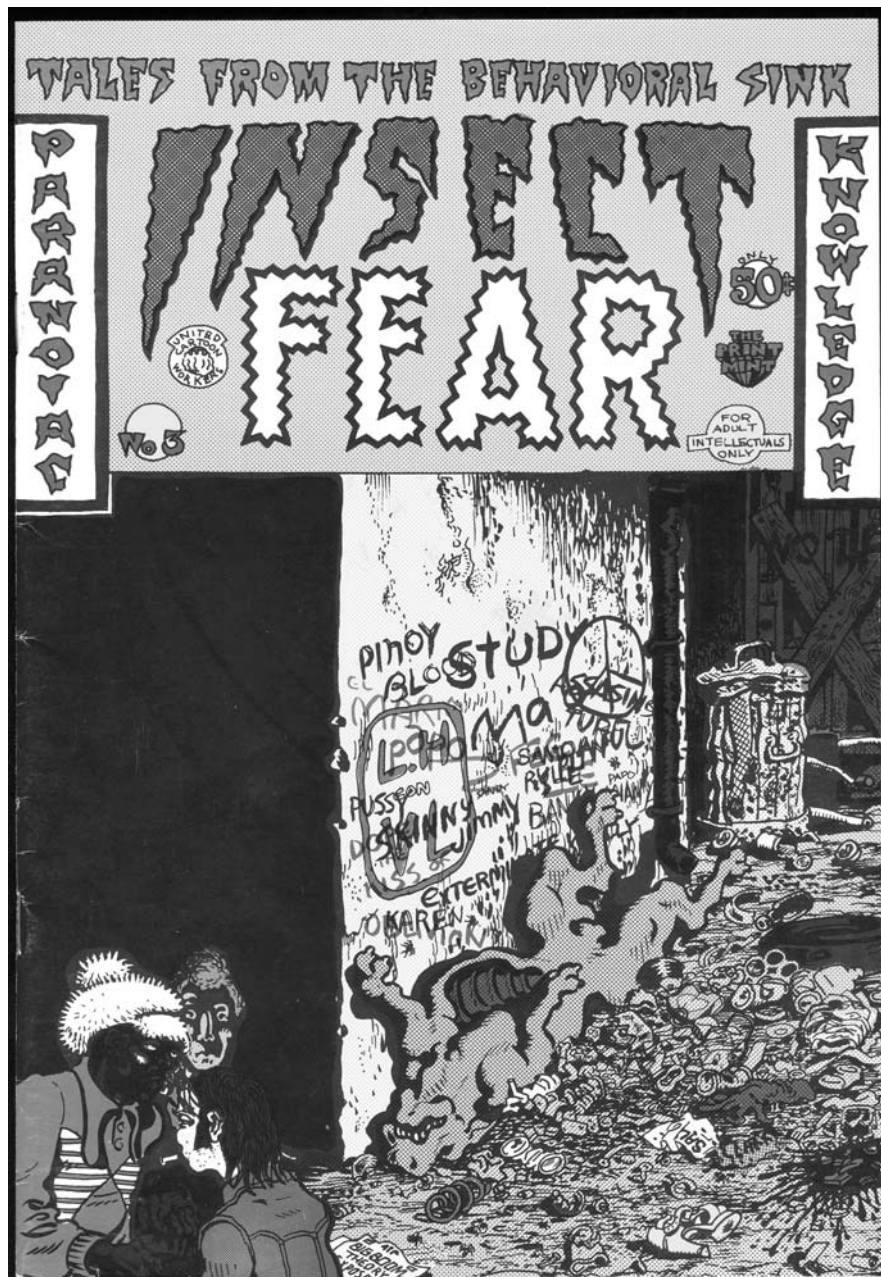


Fig 4. Cover art for “*Tales from the Behavioral Sink*”

¹⁵ Crumb had even contributed a story to issue #1 of *Insect Fear*.

Calhoun does much to facilitate such crossovers. The stacked nesting pens he creates not only look like tower-blocks, they are described as such. The names he gives their behaviors come to sound increasingly resonant with human culture and inner city vice. He uses terms such as the “pied pipers” to describe a group of females that follow objects obsessively; obsessive groomers are “beautiful ones;” there are “social dropouts,” “somnambulists” and “autistics” for withdrawn individuals; “probers” or “juvenile delinquents” for the hypersexual and excessively violent; while aggressive females are “Amazons” (Calhoun 1962a, 1973b).¹⁶ When Calhoun calls the congregation of rats around the same water bottle “bar-flies” or “social drinkers,” the analogy with a crowded bar is almost impossible to push out. It sounds like a Hubert Selby, Jr. novel. Indeed, the hopeless cities of Selby’s imagination and the available connections have not gone unnoticed – literary critic Tony Tanner makes the link between Selby’s vision of urban chaos and Calhoun’s rodent universes: “A good way to describe what Selby is doing is to say that he is trying to depict a human version of what the ecologist John Calhoun called a ‘behavioral sink.’” (Tanner 1971: 345). The point here is not that Selby has read Calhoun or was consciously trying to write about a human behavioral sink.¹⁷ The point is rather that Tanner as an exegete finds that Calhoun’s work sheds light on Selby’s writings in ways which he expects readers of Selby will find useful. Understanding Calhoun, Tanner feels, helps us to understand Selby.

Of all the ways that Calhoun’s work travels outside his experimental setting, it would be this phrase – “the behavioral sink” –

¹⁶ See also “Looking Forward: feedforward from the Beautiful Ones: a developing book” 18 September 1990. Calhoun Papers, NLM. Box 105. Esp. pages 14-17.

¹⁷ When an interviewer later asks Selby if Tanner’s reading is “an accurate assessment,” Selby would deny that Calhoun had been an intermediary influence, claiming that he was simply trying to “create real people” – and adding that “if in doing that, it ends up these people fall into what this guy categorizes as a ‘behavioral sink,’ then it may be true, but it was never my intent” (Vorda 1992: 290).

that would become the most resonant. Because the term originates with Calhoun, it becomes a marker by which his cultural influence might be charted. And because he chose the phrase quite carefully, we can also see how Calhoun's descriptions of his experiments fed into and encouraged a variety of concerns with the state of the human condition in modern society.

The behavioral sink is not a pathological behavior *per se*, but a sort of para-pathology, which seemingly appears from, and supervenes upon, the behavior of individual animals within the crowded group (Calhoun 1962a, 1962b). The way Calhoun describes it, behavior becomes more and more erratic until, eventually, the behavioral sink emerges like a vortex. Thereafter it acts as an accelerant, exacerbating the effects of the other pathological behaviors: "The unhealthy connotations of the term are not accidental: a behavioral sink does act to aggravate all forms of pathology that can be found within a group" (Calhoun 1962a: 144). It is important to note that the behavioral sink was not inevitable, but emerged as a consequence of individual rats becoming so used to contact when eating that they begin to associate the process with the presence of others. By altering the feeding arrangements to reduce social contact, Calhoun found he was able to prevent its development. Without the sink, crowding was less lethal, but remained grotesque: infant mortality in severely overcrowded enclosures levels out at about 80%. With a behavioral sink, that figure skips to 96% (Calhoun 1962a: 148). Crowding pathology, therefore, was not dependent upon the behavioral sink, but it seemed to mark a point at which the rats are overwhelmed by the crowding, leading to a societal state-change.

Insect Fear's use of the term probably came via Tom Wolfe, who would write an article called "Oh Rotten Gotham! Sliding Down into the Behavioral Sink" for the Sunday supplement of the New York *World*

Journal Tribune, later collected as the last chapter to 1968's *The Pump House Gang*. Wolfe's usage would find its way to fellow radical journalist Hunter S. Thomson, who was so enamoured of the phrase that he wrote a letter to Wolfe congratulating him on the collocation and calling it "a word jewel," "a flat-out winner, no question about it."¹⁸ Wolfe apparently comes to the behavioral sink through an interview with Edward Hall, and how he then reports it is typical of the manner in which Calhoun's research lends itself to wider arguments against the imminent collapse of American culture, with Wolfe easily describing downtown New York in the same language that Calhoun had used to describe described swarming rats, and identifying many of the same pathologies:

Overcrowding gets the adrenalin going, and the adrenalin gets them hyped up. And here they are, hyped up, turning bilious, nephritic, queer, autistic, sadistic, barren, batty, sloppy, hot-in-the-pants, chancered-on-the-flankers, leering, puling, numb...

It got to be easy to look at New Yorkers as animals... running around, dodging, blinking their eyes, making a sound like a pen full of starlings or rats or something (1968: 233)

If Wolfe's usage of Calhoun seems to carry the rodent findings over to humanity a little too fluidly, Calhoun himself certainly doesn't seem to disapprove. He would later write of Wolfe's piece:

Ned [Edward Hall] and I share the view that social ideas become effective only after gaining coinage in common parlance. Ned once took a walk through New York City with Thomas Wolfe, a result of which was Wolfe's devoting much of the last chapter of *The Pump House Gang* to my concept of the "behavioral sink". Although Wolfe used a considerable

¹⁸ Thompson calls it "the second best in the language" after "atavistic endeavor" – apparently a coinage of his own. Thomson mistakenly believes "behavioral sink" to be Wolfe's own; so even calibrated against Wolfe's writing, this one is good.

literary twist, many readers must have gotten the notion of traps we unknowingly can get into. Certainly many of these readers would hardly have encountered the idea in a scientific journal (Calhoun 1977: 47).

Although Calhoun is credited with the specific collocation, “sink” had long been used to denote a concentration of moral (rather than just physical) squalor. Along with being a “pool or pit ... for the receipt of waste ... a receptacle for filth or ordure,”¹⁹ the OED lists a second sense of “sink” as: “A receptacle or gathering-place *of* vice, corruption, etc.”²⁰ – and includes references dating back to the early 16th century. Here then is another sense of *sink* – or a likely site where it might have slipped from naming a topographical low-point to naming an ethical one.²¹ “Sink” seems to have transferred quickly from referring to the lowest place to the lowest people – “the rascall and vile sort of men: y^e sinke of the citie” (1573)²² – and as this quotation suggests, the connection with specifically *urban* corruptions seems to have been present from the start. So the problem was not simply one of numbers, but of organization. In failing to provide adequate spaces for privacy and communality, the *city itself* was complicit, it is the city that crowds the man. Analyzing “Urban Geography and the Human Condition,” Jean Gottman views this as a shift from perceiving the urban dweller as greedy, sinful, and corrupt, to seeing the city itself as the source of that corruption. The inhabitant was a victim of his habitat: “The density, the mass, the congestion, the pollution, the noise, and the turmoil are among the characteristics deplored in the modern city” (Gottman 1966:

¹⁹ See: sink, n¹ l. 1a. OED, 2nd ed. (1989)

²⁰ See: sink, n¹ l. 2a OED, 2nd ed. (1989)

²¹ It seems to have been this sense that attracted Calhoun’s attention: he claims to be making an analogy between “social stagnation and behavioral pathology” present in the behavioral sink and the “geomorphic sink with its decaying vegetation and stagnant waters” (1973b: 16).

²² See: sink, n¹ l. 2d. OED, 2nd ed. (1989); and see entry for “Rascals,” in Baret, J. (1573, 1580) *An alvearie or triple (quadruple) dictionarie in Englishe, Latin, and French*. (London: Henry Denham)

6). Calhoun's description of the behavioral sink not only captured the sense of a city as a destructive force, but further, seemed to explain why it was that such a horrific environment seemingly acted almost as an attractor, drawing and holding such large numbers of people. The process was one of "pathological togetherness," individuals conditioned to seek out the presence of others, even to the detriment of the self and society.

A complementary sense is presently active in the use of the phrases "sink estate" and "sink schools." These are derogatory terms used by British journalists to describe the very poorest areas, and act as shorthand for the moral decay and hopelessness that accompanies such poverty. "Sink estate" seems to have surfaced in the 1970s. The earliest reference the OED can find is from the *Daily Mail* (4 October 1972, 25), although it seems that the direct referent isn't Calhoun (or, indeed, Wolfe, whose new collection of essays had recently been published and would likely be familiar to journalists).²³ Anticipating talk of "sink estates" and "sink schools," anthropological literature from the first decades of the twentieth century sees the term briefly appear in a parallel sense. In 1924, one J. R Swanton proposes "cultural sinks" to name areas where cultural development is stunted; that is, areas of "low" rather than "high" culture. In 1953, Andrée F. Sjoberg refers to the same as an "ethnographic sink." Neither term seems to have caught on, and in 1956, William W. Newcomb, Jr. writes an apparently decisive rejection of "sinks," finding the term both unhelpfully vague and unpleasantly evaluative:

It is difficult to know what Swanton meant by cultural "sink,"
although he said he was borrowing "a geological term." The

²³ Instead, the journalist here (education correspondent Michael Ryder) seems to assume the term comes from "kitchen sink" – aligning with a theatrical tradition of realist plays set in low-income households. Given the etymology sketched out above, that seems unlikely. Kitchen sink drama is drab and often melancholy, but it isn't violent or morally corrupt. The "sink estate," on the other hand, is supposed to point to something altogether more pernicious.

connotation this phrase has for me is that of a depressed area into which flows by some mysterious means the dregs and the cultural offal of neighboring areas (Newcomb 1956: 145).²⁴

Newcomb's impression of what a "cultural sink" might mean explains at once what makes the term repellent to post-Boasian anthropologists and yet attractive to the cultural pessimists of the 1970s. Calhoun, of course, hadn't used "sink" to talk about human culture, but of rats – hence Calhoun's "sink" escapes the sort of censure that Swanton's use is exposed to. By mooring the "unhealthy connotations" of the sink in rodent studies, Calhoun provides an opportunity to employ this sort of language in a permissible setting – that is, *merely* analogically. Unlike Swanton, who is judging and ranking *human* cultures, Calhoun is simply describing animals.

Thus Calhoun's choice of the phrase is canny for a number of reasons. He has tapped into an extensive etymological precedent linking sinks with both cities and entropy. At the same time he has made available a term which, though evocative, was previously anathema when used anthropologically on account of the chauvinistic overtones of "low" and "high" culture. There is no similar taboo on talking of a sink of rats. Added to this, of course, the term appears in an intellectual climate sympathetic both to Calhoun's manner of zoomorphism, and pessimistic about the problems of overpopulation and urban decay. The term's success might then be understood as a "perfect storm" confluence of these factors. And the result, in Thompson's phrase, is "a word jewel."

²⁴ "[The sink tribes] seem to share no traits that would set them aside from other cultures. Cannibalism hardly suffices to distinguish them..." (Newcomb 1956: 147) – embedding here a teasing connection with Calhoun's later use.

Backlash

Yet even as he was being favourably cited in the national press and in syndicated newspaper stories, specialist voices within the academy began to signal a swell of dissent. While it may or may not be the case that this growing backlash was motivated by the popularity of Calhoun's rodents, it is certainly the case that the complaints were based not upon a careful reading of the technical papers, but upon the *popular* image of Calhoun's work. The runaway success of the initial rat experiments came to overshadow much of the work he had done since. By the 1970s, some twenty years after the very first crowding experiments, and a decade after the *Scientific American* article, Calhoun had increasingly focused his attention on improving the psychological well-being of the crowded population. But still the popularisations (both the expositions and the entertainments) invariably focused on the negative aspects: the macabre appeal of the behavioural sink being such that it dominated his representation and his reputation.

We have seen how Calhoun's research and language captured the imagination of both scientists and the public. However, as many flocked to the laboratory, field and census, seeking to identify and replicate crowding pathologies among human populations, others vehemently resisted this trend. They were aided by inconsistencies in the results. While some researchers did establish positive correlations and associations between density and pathology in human beings, others did not, and some even identified an inverse relationship (Booth 1976; Cassel 1972; Factor and Waldron 1973; Freedman 1971, 1975; Mitchell 1971, 1974; Schmitt 1966). These inconsistencies were seized upon by many who, like Hawley, felt uneasy at Calhoun's growing influence (Altman 1975; Baldassare 1979; Choldin 1978; Lawrence 1974).

Urban sociologists Claude Fischer, Mark Baldassare and Richard Ofshe, argued that inconsistent results were to be expected, the inevitable result of “Calhoun’s rats... pulling a fast-moving bandwagon” (Fischer et al 1975: 415). The “cities-are-teeming-behavioral-sinks” debate had encouraged researchers to approach society armed with a simplistic “pathology check-list” (Baldassare and Fischer 1977: 274). However, if they expected to uncover evidence of humans going “berserk”, they were sorely mistaken: Calhoun was guilty of anthropomorphism, and his case for uncovering a law of numbers common to both human and non-human animals built upon loose analogy. Calhoun had long encountered such responses. Following his presentation to the Royal Society of Medicine in 1971, he was admonished by his chair, J. Z. Young, for carelessly extrapolating from mice to men (Calhoun 1972a, 1973a). From the late 1970s, however, such criticisms intensified. While rodents may have struggled in the utopias that Calhoun had constructed, human capacities for culture, social organization and technological innovation, ensured they were capable of coping with crowding (Lazarus and Cohen 1977; Smith 1980; Stokols 1972). Calhoun was still being referenced, but increasingly for illustrative purposes, a means of capturing the reader’s attention when addressing the problems of space and numbers. Relevance to man was less frequently admitted.

Popularisations of Calhoun began to work against him. In Freedman’s influential book, *Crowding and Behavior* (1975), criticism of Calhoun was fused with an assault on the “pop-ethology” of Morris and Ardrey. This was no doubt spurred by the tendency of such populist accounts to omit any reservations about the transferability of Calhoun’s animal studies – Morris here is exemplary: “if our populations go on increasing at their present terrifying rate, uncontrollable aggressiveness will become dramatically increased. *This has been proved conclusively with laboratory experiments*” (1967: 177 – *emphasis added*). Fischer

and Baldassare (1975: 531) associated Calhoun's work with "best-selling books and popular novels" whose "torrent of dramatic prose has portrayed men and 'killer apes,' trapped in the 'human zoo' that we once called the city." Zlutnick and Altman (1972) surveyed the numerous newspaper and magazine articles on crowding, through which, they suggested, Calhoun's speculative hypotheses had been alchemized into scientific *fact*. As Calhoun's work became increasingly simplified and caricatured, reduced to the simple causal claim – density equals pathology – it began to assume the role of an "modern folk-myth," more useful as a gauge of society's fears than as a source of information for planning purposes (Porteus 1977: 176). As such, Calhoun was also seen to hold a dark and pessimistic vision of humanity's future in a crowded world. His work was not only flawed, it was dangerous. In the words of Fischer and Baldassare (1977: 531): "A red-eyed, sharp-fanged obsession about urban life stalks contemporary thought." Calhoun's work had precipitated an unwelcome assault on urban living, an assault that needed to be repelled. To this end, Freedman concluded *Crowding and Behavior* with a chapter entitled "In Praise of Cities" where he extolled the benefits of high density living. Fischer (1975), meanwhile, was a leading exponent of a revised "subcultural theory," which proposed that areas of high density allowed for the development of deviant subcultures which, while often exhibiting pathological behavior, simultaneously fostered community, innovation and creativity. Further, in focusing upon density as the central problem, other causes of urban pathology, such as poverty and inequality, were being ignored. Jettisoning Calhoun had advantages, as Freedman argued: "If the world cannot conveniently blame its problems on overcrowding, it will be forced to look elsewhere for the causes" (1975: 1).

Much of this criticism was understandable. In a critical review, Gunter Gad commended animal researchers for their care in *not* extrapolating their findings to human beings. Calhoun, in contrast, was

censured for failing “to resist the temptation” (1973: 375).²⁵ As we have seen by the language that Calhoun used, where other researchers might be careful to minimise the possibility of anthropomorphism, he seemed at times to positively encourage it. He often made direct comparisons between his animal pathologies and those present among human beings: “probers” were like “juvenile delinquents,” the aggression of mothers towards pups was comparable to the “battered child” syndrome, and withdrawal to “autism” (e.g., Calhoun 1973c). When responding to J. Z. Young’s criticism in later work, he did not seek qualification or caveat, but made another inferential leap, comparing his pathological rodents to the Ik of Uganda. As documented by Colin Turnbull (1972), Ik society was characterized by immense cruelty, even towards children. This was the effect, Calhoun argued, of being moved off their land and out of small hunter-gatherer bands into larger, permanent villages. Their culture and social organization could not stand the strain of increased density: “The Ik failed to remain human. I have put mice to the same test and they failed to remain mice” (Calhoun 1972a).²⁶

Between optimism and pessimism

So associating Calhoun with extreme pessimism was entirely comprehensible. He had, after all, described his rodent universe as “Utopian”: “a 16-unit high rise apartment, an always replete cafeteria... no epidemic disease, no famine” (Calhoun 1973b: 22). With its subsequent descent into “hell,” he seemed to be questioning the

²⁵ Gad’s apprehension was shared by some ecologists, Dennis Chitty (1971), Don Hayne (1965) and Bruce Welch (1964), all commenting on the controversial and speculative nature of Calhoun’s approach, particularly his “free and frequent transferal of conclusions to the human counterpart” (Hayne 1965: 388).

²⁶ This, however, did not dissuade critics. It gave them further ammunition, one reviewer writing: “The Ik are hardly crowded on their mountain. What appears obvious is that they lost there culture and sense of worthiness, becoming literally demoralized in the process” (Kleinman 1980: 249).

viability of the welfare democracy – the more resources we supplied to the population, the more profound our problems became. Any attempt to realize social equality seemed doomed from the start. Even though Calhoun's use of inbred strains ensured that his rats and mice were genetically alike, not only was social hierarchy inevitable, but it became increasingly destructive with increased density: those at the top of the social hierarchy resorting to violence, those at the bottom, to withdrawal.²⁷ In explaining this, he was drawn to the language of Orwell: "ALL ANIMALS ARE EQUAL – BUT SOME ANIMALS ARE MORE EQUAL THAN OTHERS" (Calhoun 1977: 30). (It was a connection he would return to with increasing frequency.) In other ecological studies, social hierarchy helped maintain population stability, the weaker animals were pushed to the edge of an ecological range, restricted in access to mates and suffering greater degrees of morbidity and mortality (Wynne-Edwards 1965). For Calhoun, however, such ecological ideals as "carrying capacity" or "balance of nature" no longer applied to the human species, just as they no longer applied to his rats and mice. When growth passed a certain threshold, a population supplied with adequate resources did not decline to a point of lower density; it became extinct. Behavioral norms and social roles that once held a society together now undermined it: violence became more acute, withdrawal more severe. In other words, we'd go mad long before we'd starve; we'd kill one another long before hunger killed us. Malthus seemed moot.

Calhoun adopted Heinz von Foerster's "doomsday" predictions (1971a: 370). Based upon an extrapolation of mankind's ever-increasing rates of reproduction, von Foerster, one of the founders of cybernetics, had "calculated" that population growth would become

²⁷ Calhoun did use wild Norway rats in his early experiments, taken from Parsons Island in Chesapeake Bay. As they were isolated on the island, he believed to be genetically similar though generations of inbreeding. In later studies he turned to the Osborne-Mendel strain of rat and the BALB/c mouse.

infinite on Friday 13 October 2026. To avoid this eventuality we could, following the advice of the Zero Population Growth movement and von Foerster himself, introduce legislation to restrict fertility to replacement level, two children per couple. For many, this was the logical conclusion to be taken from Calhoun's research: as population density would inevitably result in social breakdown, the solution was to "uncrowd" (a process involving an equally chilling range of oppressive policies) (Worchel 1978: 217).

But Calhoun thought this sort of restriction undesirable and unnecessary. He challenged directly the "dismal theorem" of Paul R. Ehrlich in which each additional human was perceived as having a negative impact on the environment (Calhoun 1971b). Man was a "positive animal," for whom the pressures of density had driven innovation and social complexity, leading to a division of labour and new social roles. Thus, as *physical* space declined, man was forced to extend his "*conceptual* space" –the network of ideas, technologies – enabling more efficient use of resources while ensuring that each individual maintained a limited number of meaningful social interactions consistent with their biological makeup (Calhoun 1969). This allowed for increased population growth; the process governed by a series of positive feedback mechanisms. There was of course a limit to both numerical and conceptual growth, beyond which our social and physical infrastructure would be overrun, but if the population were to be stabilized at the present density, human potentiality would stagnate: "every role vacated will be filled precisely by a similar one. Such stability and predictability have rarely been the way of evolution over any protracted period of time. Stable products rarely last" (Calhoun 1971b: 4). The message from the rodent universes was that some degree of hierarchical inequality was required. Our conception of "utopia" as an environment in which the basic requirements of the population were met and social hierarchy obsolete, failed to account for social, biological,

and psychological needs: the border between utopia and dystopia was not merely fine and easily crossed, it was fictitious. As he stated in an interview: "Human beings thus face a predicament: If we try to make everyone totally happy, we'll destroy mankind" (Pines 1971: 163).

Calhoun again found Orwell a useful point of reference. The innovations, technological and cultural, stimulated by population growth would allow for a further "communication-electronic revolution." Calhoun initially predicted this revolution to take place in 1988, the point where existing communication networks would prove ineffective in the face of increasing physical and conceptual density. He then altered this date to 1984 in "deference" to Orwell's premonition of the dangers inherent in these new powers of control (Calhoun 1971a: 373). Like Orwell, however, Calhoun was not suggesting that the alternative futures of stagnation or extinction were inevitable. *1984* was a warning of a possible future, but there was an alternative, one that harnessed the positive potential of population growth while ensuring future survival. In seeking such a solution, Calhoun returned to his rats and mice.

In his early experiments in the outdoor pens, Calhoun had witnessed a creative act by his rats that he likened to the discovery of the wheel by man: when building a new burrow they did not simply dig out the dirt as they went, as any normal rat would do, instead they packed it into a large ball which they then rolled out (Calhoun 1973b). This innovation had not come from the socially dominant animals but from a highly disorganized and predominantly homosexual group of subordinates, partially withdrawn from the larger social organization. As Calhoun saw it, the repression they had suffered at the hands of their superiors had resulted in deviant, *creative*, and thus *adaptive* behaviour (Calhoun 1977: 30). Inspired by this example, in his laboratory at NIMH, Calhoun attempted to design rodent universes that would both *stimulate*, resulting in "creative deviants," and *ameliorate*: removing the

worst excesses of crowding pathology. Through a variety of methods, such as operant conditioning and determining which of the mice and rats could eat, sleep, live, with whom, he sought to design ever more intelligent and collaborative rodent communities, capable of withstanding ever greater degrees of density. Here, then, was the hopeful agenda: if the wrong environment would drive us to destruction, perhaps the correct environment would be our remedy.

Just as the pathologies his rats had so reliably exhibited could be mitigated by improvements in the built environment, so too with man. Calhoun urged that “no single area of intellectual effort can exert a greater influence on human welfare than that contributing to better design of the built environment.”²⁸ While the specific design of cities, buildings and institutions he left to architects and planners, he would ensure that the “psycho-ecological” perspective was basic to this process. So even as his work was being critiqued within the behavioural sciences, it was being enthusiastically taken up by many architects and designers, notably Ian McHarg and Barrie Greenbie, who saw in Calhoun’s rat cities a stark warning of the dangers of designing against nature, and in his ameliorative experiments an opportunity to rectify present failures in urban planning. Andrew Euston, a director in the Department of Housing and Urban Design, described Calhoun as the “guru of the young environmental designers” (Wigotsky 1970).²⁹ Meanwhile, Calhoun dedicated himself to a different kind of design: the design of social, intellectual, and information networks. He was convinced that the problem of adapting to the new pressures imposed by an increasingly urbanized built environment could be solved only if

²⁸ Calhoun, J. B. C. “Annual Report Summary 1979: Unit for Research on Behavioral Systems.” Calhoun Papers, NLM. URBS Doc. No. 270, 5 July 1979: 2.

²⁹ Calhoun’s impact upon architects and urban planner is an issue that we will be exploring in closer detail in future work. However, it’s worth noting that even this influence seems to have failed to stand the test of time. In a recent collection of McHarg’s lectures, an obvious reference to Calhoun’s work is now misattributed to Hans Selye, as if to erase any trace of Calhoun’s influence (note 4, in McHarg 2007: 75).

channels of communication were arranged in such a way that access to the relevant information was not inhibited by disciplinary and institutional structures. But in seeking to explain his optimistic vision, Calhoun – having been long referenced by fiction writers – now increasingly came to explain his own ideas with reference to fiction. To many observers, it must have looked as if the tide of influence had begun to flow the other way.

It had been 1968, Calhoun recalled, when he first realized that the “portent of change” he saw “could not be clarified without building an incipient ‘World Brain.’”³⁰ The direct referent here is H. G. Wells’ visionary story which imagines all human knowledge made accessible through aggregation in a pre-digital “supercomputer.” Calhoun, too, spoke of “externalizing” the mind. The human brain has, he writes in 1991, “become inadequate to deal with the complexity and diversity of life.”³¹ The information glut meant it was increasingly likely that useful facts and insights would be lost among the noise, never reaching the communities who might use them.³² Calhoun suggested organizing scientists into a global, intercommunicating network composed of independent but interconnected groups and sub-groups. Only then could the necessary conceptual growth to avoid a catastrophic sink be achieved. He claimed it was “toward a concern with science as a world

³⁰ Calhoun, “A ‘Gedanken Experiment’ / A Statement of Intent” unpublished notes, dated 30 September, 1991. Calhoun Papers, NLM, Box 11, 1.

³¹ Calhoun, J. B. Abstract for symposium “Towards a Science of Human Behavior”, Washington DC, 26 September, 1991. Calhoun Papers, Box 11, NLM.

³² This was a situation which Erwin Chargaff called “the tower of babble,” where individual scientists would increasingly find they were unable to “know more than an ever smaller portion of what they must know in order to function properly” (1974: 777). Calhoun’s solution was to prepare a “reader” of sorts: “it should be possible to reassemble highly selected thought behaviors from many authors to form insight provoking manuscripts” (Abstract for symposium “Towards a Science of Human Behavior”, Calhoun Papers, Box 11, NLM). Focusing on mental health, population, and the environmental and behavioral sciences, Calhoun led by example: he clipped and assembled a vast array of extracts from a total of 162 authors. These he entered into a computer database, numbering them by page and paragraph, isolating keywords, ordering the broad field he had spent his life working within. The finished work would be an anthology called *Environment and Population*. The achievement was not simply the content, but the indexical system itself.

system which must be understood if the human race is to survive.”³³ He saw these attempts to defer social pathology as the centerpiece and real import of his work. Here was the profit, the positive signal from the noise of the behavioral sink.

It was in through this growth in conceptual space – enabled by the design of new buildings, new technologies, new social and intellectual networks – that humanity was presented with a more desirable future: what Calhoun called “Dawnsday” in opposition to von Foerster’s “Doomsday.” All of mankind might become part of a single “world brain,” consisting of numerous and diverse subsystems, each interlinked to, aware of, and dependent upon, the other. Although Calhoun’s intent was ameliorative, by employing the same apocalyptic rhetoric as the doomsayers such as Ehrlich and the ZPG movement, Calhoun’s already speculative predictions came to seem merely fantastical. It surely didn’t help that he explained his ideas by analogy with science fiction. Calhoun referred his readers to physicist-turned-author Leo Szilard’s “Calling All Stars,” where the distant planet *Cybernetica* is populated by 100 interlinked computer “minds” whose connectedness results in rapid cognitive progress. In Szilard’s story, the limits of physical space had been surmounted by conceptual expansion (Calhoun 1972b). Calhoun uses it almost as proof of possibility.

If employing fiction in this way was unlikely to impress the scientific community, Calhoun only compounded the breach by increasingly writing in an autobiographical mode. As he charted his alternative and optimistic future for humanity, the parallel between his own life and those of his “creative deviants” seems to have become more and more compelling. He often described his struggle to find a permanent position in science as having given him the advantage of the outsider and the generalist. Just as with his creative deviant rats, “[o]ut

³³ Calhoun, J. B., Memorandum, 5 May, 1965. Calhoun Papers, Box 118, NLM, 22.

of pathology came progress, new freedoms of action. ... Losing one's job, having it come to an end, is a kind of failure. My job at John Hopkins [came] to an end... that placed my thinking and behavior in some turmoil" (Calhoun 1973b: 8). Yet the "exhaustion, isolation, and despair all contributed to the churning of rational ideas and perhaps irrational hallucinations."³⁴

He went further. Just as his withdrawn and deviant rats were comparable to the creative scientist's tendencies towards "uncertainty, spontaneity, waste, tolerance, and variability," the behavior of dominant animals could be compared to "normal" and "conservative" science which celebrated "efficiency, order, yield, power, and conformity."³⁵ Drawing from Kuhn's model of scientific revolutions, Calhoun self-consciously presented his work as "meta" as opposed to "normal science" (1971a: 331). It was crucial that the insights of those (such as himself) existing on "a frontier of science, a zone of tension and change between traditional systems of thought," be subsumed within the broader whole. The creative solutions that emerged among those on the periphery needed to travel across hierarchies, disciplines, and, in this case, species. While the limited social structures and biological templates of the rat or mouse restricted this transfer, not so with man. Therefore, Calhoun's rat and mouse universes not only provided a vision of the future destruction of humanity, but pointed to the potential for further evolution.³⁶

³⁴ Calhoun, J. B., Memorandum, 5 May, 1965. Calhoun Papers, Box 118, NLM, 37.

³⁵ Calhoun, J. B., Memorandum, 5 May, 1965. Calhoun Papers, Box 118, NLM, 37

³⁶ A further example of Calhoun's tendency to blend the personal, scientific and fictional can be found in the projects that he was working on at the end of his life. He had been writing a science fiction novel as a means of developing and broadcasting his scientific ideas. At the same time, he was also writing an autobiography and a comprehensive book of his scientific research, both of which occupied the same manuscript for Johns Hopkins University Press. A letter from an editor at the Press gently suggests these sections be trimmed: "even at this early stage, we have some thoughts of our own to suggest for your consideration. One is that you not seek to include a personal history of your entire career of research in the substantive chapters" (Anders Richter [of JHU Press], letter to Calhoun, 24 April, 1984, Calhoun Papers, NLM, Box 18, 2). But of course, for Calhoun, the autobiographical sections are substantive: he has begun to identify with his rats.

But institutional support for these research programmes was not forthcoming. Profitable grants for the development of “mood drugs” meant the type of behavioural cures Calhoun proposed had gradually fallen out of favour. By 1981, William Mayer, of the Alcohol, Drug Abuse, and Mental Health Administration, was able to declare that “N.I.M.H. is drugs, period.”³⁷ Behavioural studies could highlight the problems, but their solutions would only be found in neuropharmacology – in Ritalin, in Prozac. In 1983, the decision was taken to terminate Calhoun’s contract – one year before the completion of his research cycle, and teasingly close to 1984. Casting himself as Winston Smith, Calhoun begins to find echoes of 1984’s oppressive bureaucracy in the nested structure of the American health system. In August of 1986, on the cusp of his forced retirement, he composes a piece called “A ‘Hitchhiker’s Guide’ to Three Worlds: Fused in 1986 (?)” Abandoned at manuscript stage, it includes a braided chronology, “Sign Posts Through 40 Years.”³⁸ This features three timelines, labeled “Orwell”, “NIMH,” and “Calhoun,” each calibrated against the other for a series of “significant” dates. There is bitterness here with his perceived mistreatment at the hands of an organization that no longer cares for behavioral science and has (he believes) shifted away from trying to help and liberate people and towards trying to suppress and control them: “No longer is there any reason why we should try to understand how our relations with out fellows derail our ability to make choices, to seek fulfilment; ‘neuroscience [...]’ alone knows what people should be, [and] can see [to it] that they so become.”³⁹ Calhoun submitted a letter of resignation on 30 July 1986. On hearing no reply from the authorities, he writes: “Why should ‘The Leader,’ the most powerful Director IRP, NIMH (did I

³⁷ Calhoun, J. B. (1986b) “A ‘Hitchhiker’s Guide’ to Three Worlds: Fused in 1986 (?)” 13 August. Calhoun Papers, Box 18, NLM, 3. Calhoun reports that the remark was made at an awards ceremony on 31 July 1981.

³⁸ Calhoun, J. B. (1986b) “A ‘Hitchhiker’s Guide’ to Three Worlds: Fused in 1986 (?)” 13 August. Calhoun Papers, Box 18, NLM, 1.

³⁹ *Ibid.*, p. 11.

hear the name O'Brien?) pass his decisions up (or was it down?) the bureaucratic ladder. / 1986 is '1984.' C'est finis."⁴⁰

Discussion: Managing the reputation

Popular presentations have little room for nuance, and the “sound-bite” version of Calhoun’s work was that crowding caused madness, period. We’ve seen that Calhoun felt his work not only identified the symptoms and diagnosed the disease of modern society, but that it also pointed the way towards a cure. Yet his later experiments, concerned with trying to improve the lot of the crowded, receive far less attention – both from the popularisers, and (with the notable exception of the architects) from the professional and specialist communities on which he had initially made such an impact. It is a simplified version that aides Calhoun’s original success, but the tax on this is that it is only the simplified version that people are willing to acknowledge.

There are suggestive parallels here with Jane Gregory’s (2003) work on astronomer Fred Hoyle, and these are worth exploring for the similarities – the ways in which Gregory’s work can inform our understanding of what happened to Calhoun’s reputation – and for the ways in which our story about Calhoun differs. In Gregory’s account of Hoyle’s gradual marginalization and exclusion, an eminent but increasingly radical scientist finds he isn’t being taken seriously by fellow scientists, so (as the field moves on) he is forced to seek other means to promote his work. He chooses to do so through ever-more populist formats: from general interest science magazines through to science fiction novels. Hoyle is entirely serious about the content, and seeks in this way to employ the fiction as a means of promoting his work, and to control (and *retain* control) over his popular image. As Gregory has it, “while Hoyle might... have seen a distinction between

⁴⁰ Ibid, p. 13.

his science and his fiction, he also... made explicit links between the two, ... to capitalize on the authority of the one and the scope of the other" (Gregory 2003: 39). Hoyle is at the forefront of the popular work – actively employing the mass media and fiction in an attempt to manipulate opinion and have his ideas presented to as broad an audience as possible.

Calhoun is in this respect a very different case. Here is someone whose work becomes extraordinarily appealing to a popular audience. His early experiments capture the public imagination, and (at least initially) he is complicit in that – seeking to promote his work in popular media, and phrasing his findings in (anthropic) terms immediately transferable and strikingly resonant with the popular concerns of the day. However, the pessimistic conclusion that is disseminated and promoted as a result of this process is only half the story that he wants to spread. Calhoun agrees that crowding causes horrific consequences, and he agrees that overpopulation is likely, but he does not agree that humanity is doomed. On the contrary, he has an ameliorative intent: he thinks his experiments underline the need for a revolution in the way we organise our societies and our cities – and he thinks that his experiments embed the solution for that revolution. However, in the cacophonous furore surrounding the grim spectacle of the "behavioural sink," Calhoun finds that his ameliorative message is drowned out – everyone wants to hear the diagnosis, no one wants to hear the cure. Popular culture picks up Calhoun's message, but it only selectively. When comic books, novels and films allude to Calhoun's work, they do so almost exclusively with regard to the negative message. The sensationalist reporting he receives (in which, as mentioned, he was at least partially complicit) comes to define his public image and in turn the image that fellow scientists have of him. He is tainted, stigmatised almost, by the behavioural sink. It is a reputation he struggles to slough off.

So unlike Hoyle, who acted as steward to his public representation, Calhoun finds that the popular material has slipped out of his control. Meanwhile, the association in the minds of fellow scientists of Calhoun with popularisations and science fiction is only further cemented as Calhoun himself increasingly comes to use fictional references to explain his increasingly ambitious and increasingly radical research cycles.

Coda

There is one place where the positive message of Calhoun's work does reach a popular audience. In 1971, Robert Conly (under the pseudonym O'Brien) had published a children's novel, *Mrs Frisby and the Rats of NIMH*. The book tells how a group of hyper-intelligent rats cooperate to help save the home of a family of mice. The rats were escapees from the laboratories at the National Institute of Mental Health. Ten years later, the story (now re-titled *The Secret of NIMH* and appended with supernatural elements absent from the original novel) was made into a successful animated film by Don Bluth. This revived interest in Calhoun's work, with newspaper articles and magazine features using the film as a peg for stories about Calhoun's attempts to create more intelligent and adaptable rodent communities at NIMH. In 1982, *Science News* wrote an article called "The (Real) Secret of NIMH," which began – in typical fashion – "Pure fantasy, the stuff of summer movies. → Or is it?" (Herbert 1982: 92). Although the article was based around a brief interview with Calhoun, its author, Wray Herbert, remained reasonably cautious about Calhoun's influence on the movie: "the origins of the original story have been obscured in time," he wrote, but conceded that "several clues indicate that it was based closely on the work of NIMH psychologist John B. Calhoun" (Herbert 1982: 92). At about the same time, a *Washington Post* article on the creation of highly intelligent rats

– again called “Rats! The Real Secret Of NIMH” – concedes that “the book ... did have some of its roots in genuine rat research at NIMH” but is sceptical about the potential of Calhoun’s work to have created rats as smart as those in the film: “NIMH was another instance in which science fiction, even in a child’s story [sic.], anticipated science fact.” Surely most galling for Calhoun is how dismissive the article is about the limited efficacy of behavioural studies – for, after all, the reporter says: “Calhoun’s rats weren’t injected with anything. They were just crowded.” The *Washington Post* article reports that Calhoun remembers Conly visiting the lab in the late 1960s, and even suggests that Mrs Frisby’s name is taken from the blue Frisbee hung behind the lab door.⁴¹ Calhoun clipped and annotated the Post article. In the margins, he has written that his own copy of *Mrs Frisby and the Rats of NIMH* “includes many notes of so many parallels” that Conly “must have visited his research lab – bldg. 112 NIHAC.” He seems to have collected these notes together for the journalist from *Science News*, who includes such unlikely details as the use of identical carrying cages and the fact that the dominant rat in Calhoun’s early studies and Nicodemus, the leader of the Rats of NIMH, were both blind in one eye.

⁴¹ Rovner, S. 1982. “Rats! The Real Secret of NIMH.” *Washington Post* 21 July. B4: 1+4.

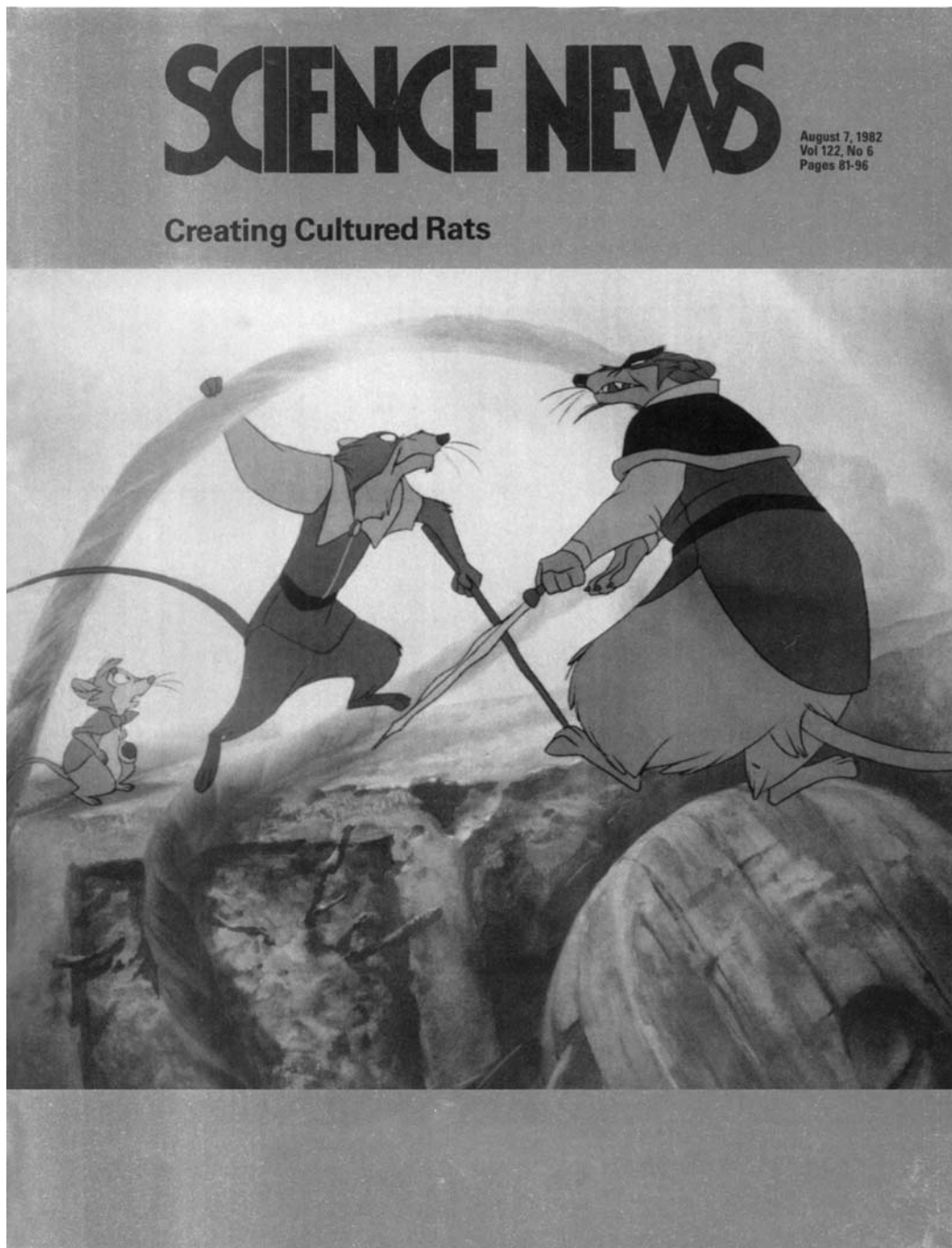


Fig 4. Cover of *Science News* from August 1982

Was Calhoun a direct influence on Conly's book? It's difficult to tell. Calhoun clearly thinks so, though Conly himself, apparently, remained silent on the topic. He had been a journalist at *National Geographic* during the nineteen sixties, and it is likely he would have been exposed to Calhoun's work at some point. Calhoun had headed-up the laboratory at NIMH during the same period. And Calhoun *had*

tried to create “super-rats,” of a sort: one of the ameliorative aims of his research was to condition rodents to tolerate the crowded environment, facilitating dramatic conceptual growth. He writes: “I propose to make the rats in my contrived environment comparable after five years to apes in their natural environment.” “In essence, I propose to make an ape out of a rat.” These, then, are the rats of NIMH. These are the rats who will show us how to adapt to the crowded modern cities, and how to avoid the dystopian future of the population boom.

Keen as Calhoun was to point to this as a way in which his positive message might be spread, *The Rats of NIMH* was only a children’s book and animated movie. As such, this meant that the message was not taken seriously. It was “the stuff of summer movies” – popcorn nonsense, a distraction. By comparison, material for an adult market – the novels, the books, the more respected journalists and cultural commentators such as Wolfe and Thompson and Ardrey and Morris – was taken more seriously (and as the ZPG’s *Voyages* compilation shows, could be used as persuasive), but embodied only the negative, destructive message of the behavioural sink. The negative message was a real and dire future; the ameliorative message was a fantasy. There’s an asymmetry here, too: beside the spectacle of the behavioral sink, any cognitive advances achieved by the crowded rats seemed insignificant. With the notable exception of Conly’s *Rats of NIMH*, the positive gains were largely ignored, and the status of the rat was certainly never elevated by these similarities. Rather than make the rats seem more like humans, Calhoun’s experiments simply had the effect of making humans look more animal, more debased, more corrupt.

Calhoun had carefully packaged his work to maximize its appeal, but the runaway popularity that followed meant that his reputation was created for him. Despite his insistence that his work ultimately

embedded a positive message, he instead came to be associated with the pessimism he was cited as corroborating. Meanwhile, that he was prominently employed by figures such as Ardrey and Morris and Wolfe had the unfortunate effect of making his work seem of a part with theirs: which is to say, of merely popular interest, lacking scholarly rigor. For Calhoun's willingness to cross species borders was matched by a similar disregard for disciplinary borders. Describing him as "a maverick's maverick in the field of psychology," Ardrey praises him for just this willingness to take ideas outside their specialism: "Calhoun is blessed with the capacity of slipping through the formidable fences of American psychology" (Ardrey 1970: 184). Consequently, Calhoun's "maverick" promethean willingness to share specialist knowledge with those outside the "fences" seems illicit, not so much sharing as smuggling.⁴² Although he saw himself as existing at the nexus of many fields of inquiry, ultimately, he comes to seem only on the periphery of each. Despite Ardrey's characterization of Calhoun as an intellectual escapologist, given how little control Calhoun ultimately has over his reputation, it seems more accurate to say that it was only his *rats* which slipped through the fences. Calhoun, then, suffered from his early success. He had ridden a "fast-moving bandwagon" but one which he was not steering. As the rats escaped from his lab, they escaped from his control, and left exposed to the crude exigencies of popular taste, only the most corrupt of his progeny thrived.

⁴² In light of subsequent scholarship on boundaries, it's interesting that Ardrey apparently conceives of disciplinary territory as a fenced border – a secure barrier which prevents escape. Framing the issue in these terms also goes some ways to explaining why people *outside* the "fences" might be happier with Calhoun's disciplinary transgressions than those within.

References

- Adams, J. S. 1972. "The geography of riots and civil disorders in the 1960s," *Economic Geography* 48: 24-42.
- Alexander, C. 1964. *Notes on the Synthesis of Form*. Cambridge MA: Harvard University Press.
- Allee, W. C. 1931. *Animal Aggregations: A Study in General Sociology*. Chicago: University of Chicago Press.
- Altman, I. 1975. *The Environment and Social Behavior*. Monterey: Brooks/Cole.
- Altman, I. 1978. Crowding: Historical and contemporary trends in crowding research. In: A. Baum and Y.M. Epstein, (eds.) *Human response to Crowding*. Hillsdale NJ: Lawrence Erlbaum Assoc.
- Ardrey, R. 1970. *The Social Contract: A Personal Inquiry into the Evolutionary Sources of Order and Disorder*. London: Collins.
- Baldassare, M. 1979. *Residential Crowding in Urban America*. Berkeley: University of California Press.
- Baldassare, M. and Fischer C. S. 1977. "The Relevance of Crowding Experiments to Urban Studies," in D. Stokols (ed.) *Psychological Perspectives on Environment and Behavior*. New York: Plenum Press.
- Baum, A. and Valins, S. 1977. *Architecture and Social Behavior: Psychological Studies of Social Density*. Hillsdale NJ: Lawrence Erlbaum.
- Booth, A. 1976. *Urban Crowding and its Consequences*. New York: Praeger.
- Borges, J. L. 1966. *Other Inquisitions*. New York: Washington Square Press.
- Bradbury, J. H. 1976. "Walden Three: New Environmentalism, Urban design and Planning in the Nineteen Sixties," *Antipode*, 8: 17-28.
- Burnham, J. 1987. *How Superstition Won and Science Lost: Popularizing Science and Health in the U.S.* New Brunswick, NJ: Rutgers University Press.

- Calhoun, J. B. 1949. "A method of self-control of population growth among mammals living in the wild," *Science* 109: 333-5.
- Calhoun, J. B. 1950. "The study of wild animals under controlled conditions," *Annals of the New York Academy of Science* 51: 113-22.
- Calhoun, J. B. 1962a. "Population Density and Social Pathology," *Scientific American* 306: 139-148.
- Calhoun, J. B. 1962b. "A Behavioral Sink" in E.L. Bliss (ed.), *Roots of Behavior*. New York: Harper.
- Calhoun, J. B. 1963a. *The Ecology and Sociology of the Norway Rat*. Bethesda, MD: U.S. Department of Health, Education and Welfare.
- Calhoun, J. B. 1963b. The Social Use of Space, In W. Mayer, R. van Gelder (eds.) *Physiological Mammalogy*. New York: Academic Press.
- Calhoun, J. B. 1966. "The Role of Space in Animal Sociology," *Journal of Social Issues* 22: 46-59.
- Calhoun, J. B. 1969. "Meta-Environmentalism," *Man-Environment Systems*, July.
- Calhoun, J. B. 1971a. "Space and Strategy of Life," in A. H. Esser (ed.), *Behavior and Environment: The Use of Space by Animals and Man*. Plenum: New York.
- Calhoun, J. B. 1971b. "The Positive Animal: Increased Human Potentiality enhances Stability of the Total Ecosystem and Preserves Evolution," *Man-Environment Systems*, September.
- Calhoun, J. B. 1972a. "Plight of the IK and Kaiadilt is seen as a Chilling Possible End for Man," *Smithsonian Magazine*, November: 27-32.
- Calhoun, J. B. 1972b. "The Population Crisis Leading to the Compassionate Revolution and Environmental Design," *World Journal of Psychosynthesis* 4:6
- Calhoun, J. B. 1973a. "Death Squared: the Explosive Growth and Demise of a Mouse. Population," *Proceedings of the Royal Society of Medicine* 66: 80-89.
- Calhoun, J. B. 1973b. "What sort of box?" *Man-Environment Systems* 3: 3-30.

- Calhoun, J. B. 1973c. "From Mice to Men," *Transaction and Studies of the College of Physicians of Philadelphia* 41: 92-118.
- Calhoun, J. B. 1977. "Looking Backward from 'The Beautiful Ones,'" in W. R. Klemm (ed.), *Discovery Processes in Modern Biology*. Melbourne, FL: Krieger.
- Calhoun, J. B. (ed.) 1983. *Environment and Population: Problems of Adaptation*. New York: Praeger.
- Carstairs, G. M. 1969a. "Overcrowding and Human Aggression," in H. D. Graham and T. R. Gurr (eds.), *Violence in America: Historical and Comparative Perspectives*. New York: Bantam.
- Carstairs, G. M. 1969b. "Overpopulation and Mental Health," in H. Reiger and J. B. Falls (eds.), *Exploding Humanity: The Crisis of Numbers*. Toronto: House of Anasi Press.
- Cassel, J. 1972. "Health Consequences of Population Density Crowding," in R. Gutman (ed.), *People and Buildings*. New York: Basic Books.
- Chargaff, E. 1974. "Building the Tower of Babble," *Nature*, 248: 776-79.
- Choldin, H. M. 1978. "Urban Density and Social Pathology," *Annual Review of Sociology* 4: 91-113.
- Chitty, D. 1967. "The Natural Selection of Self-Regulatory Behavior in Animal Populations," *Proceedings of the Ecological Society of Australia* 2: 51-78.
- Chitty, D. 1971. "Crowding Together," review of *Behavior and Environment*, by Aristide Esser. *Science* 173: 42-43.
- Chitty, D. 1996. *Do Lemmings Commit Suicide? Beautiful Hypotheses and Ugly Facts*. New York and Oxford: Oxford University Press.
- Christian, J. J. 1950. "The Adreno-Pituitary System and Population Cycles in Mammals," *Journal of Mammology* 31: 247-59.
- Christian, J. J. 1961. "Phenomena associated with population density," *Proceedings of the National Academy of Sciences of the United States of American* 47.4: 428-449.
- Christian, J. J., and D. E. Davis. 1964. "Endocrines, Behavior and Population." *Science* 146: 1550-60.

- Crew, F. A. E. and L. Mirskaia. 1931. "The Effects of Density on an Adult Mouse Population." *Biologia Generalis*, 7, 239-250.
- Drummond, A. H. 1973. *The Population Puzzle*. Reading MA: Addison-Wesley.
- Dubos, R., 1965. *Man Adapting*. New Haven: Yale University Press.
- Duhl, L. (ed.) 1963. *The Urban Condition: People and Policy in the Metropolis*. New York: Basic Books.
- Ehrlich, P. R. 1969. "Overcrowding and Us," *National Parks Magazine* 166: 10-12.
- Ehrlich, P. R. and Holdren, J. P. 1971. "Impact of Population Growth," *Science* 171: 1212-1217.
- Elton, C. S. 1924. "Periodic fluctuations in numbers of animals; their causes and effects," *British Journal of Experimental Biology* 2: 119-163.
- Erickson, P. and Mitman, G. 2007. "When Rabbits Became Human (and Humans, Rabbits): Stability, Order, and History in the Study of Populations." *Working Papers on The Nature of Evidence: How Well Do 'Facts' Travel?* 19/07. Department of Economic History, LSE.
- Esser, A. H. 1973. "Experiences of crowding: Illustration of a paradigm for man-environment relations," *Representative Research in Social Psychology*, 4.1: 207-218.
- Factor, R. and Waldron, I. 1973. "Contemporary population densities and human health," *Nature* 243: 381-4.
- Fischer, C. S. 1975. "Toward a Subcultural Theory of Urbanism," *The American Journal of Sociology* 80: 1319-1341.
- Fischer, C. S. and Baldassare, M. 1975. "How far from the maddening crowd?" *New Society* 32: 531-533.
- Fischer, C. S., Baldassare, M., and Ofshe, R. J. 1975. "Crowding Studies and Urban Life: A Critical Review," *Journal of the American Institute of Planners* 41: 406-18.
- Freedman, J. 1971. "The Crowd: Maybe Not so Maddening After All," *Psychology Today* 5: 58-61.
- Freedman, J. L. 1975. *Crowding and behavior*. San Francisco: W. H.

Freeman.

- Gad, G. 1973. "'Crowding' and 'Pathologies': Some Critical Remarks," *Canadian Geographer* 17: 373-390.
- Galle, O. R. Gove, W. R. and McPherson, J. M. 1972. "Population Density and Pathology: What are the Relations for Man?" *Science* 176: 23-60.
- Garfinkel, M. 1964. "Studies in the Routine Grounds of Everyday Activities," *Social Problems*, 11: 225-50
- Gillis, A. R. 1974. "Population Density and Social Pathology: The Case of Building Type, Social Allowance and Juvenile Delinquency," *Social Forces* 53: 306-14.
- Gillis, A. R. 1983. "Strangers Next Door: An Analysis of Density, Diversity, and Scale in Public Housing Projects." *Canadian Journal of Sociology*, 8, 1-20.
- Goffman, E. 1963. *Behavior in Public Places*. New York: Free Press.
- Goffman, E. 1971. *Relations in Public*. New York: Harper.
- Greenbie, B. B. 1976. *Design for Diversity: Planning for Natural Man in the Neo-Technic Environment: An Ethological Approach*. Amsterdam: Elsevier.
- Gregory, J. 2003. "The Popularization and Excommunication of Fred Hoyle's 'Life From Space' Theory," *Public Understanding of Science* 12: 25-46
- Hall, E. T. 1966. *The Hidden Dimension*. Garden City, NY: Doubleday.
- Hawley, A. H. 1972. "Population Density and the City," *Demography*, 9.4: 521-29.
- Hayne, D. W. 1965. "Mechanisms of Population Control," *Ecology* 46: 388-389.
- Hayward, R. 2001. "The Tortoise and the Love-Machine: Grey Walter and the Politics of Electroencephalography," *Science in Context* 14: 615-641.
- Heer, D. M. 1975. *Society and Population*, Second Edition. Englewood Cliffs N.J. : Prentice-Hall.

- Herbert, Wray. 1982. "The (Real) Secret of NIMH," *Science News* 122: 92-93
- Hoagland, H. 1963. "Cybernetics of Population Control," in R. O. Greep (ed.), *Human Fertility and Population Problems*. Cambridge MA: Schenkman.
- Hock, Roger R. 2004. *Forty Studies That Changed Psychology: Explorations in the History of Psychological Thought*. 5th Ed. New York: Prentice Hall.
- Hutt, C. and Vaizey, M. J. 1966. "Differential Effects of Group Density on Social Behavior," *Nature* 209: 1371-72.
- Keiner, C. 2005. "Wartime rat control, rodent ecology, and the rise and fall of chemical rodenticides," *Endeavour* 29: 119-125.
- Kingsland, S. E. 1985. *Modeling nature: episodes in the history of population ecology*. Chicago: University of Chicago Press.
- Kingsland, S. E. 2005. *The Evolution of American Ecology, 1890-2000*. Baltimore: Johns Hopkins University Press.
- Kleinman, D. S. 1980. "Human Adaptation and Population Growth: A Non-Malthusian Perspective." Montclair: Allanfield, Osmun & Co., and New York: Universe Books.
- Lakoff, G. 1987. *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*. Chicago, IL : University of Chicago Press.
- Lawrence, J. E. 1974. "Science and sentiment: Overview of research on crowding and human behavior," *Psychological Bulletin*, 81: 712-720.
- Lazarus, R. S. and Cohen, J. B. 1977. "Environmental Stress", in I. Altman and J. F. Wohlwill (eds.) *Human Behavior and Environment: Advances in Theory and Research, Volume 2*. New York and London: Plenum Press.
- Leonelli, S. 2007. *Weed for Thought: Using Arabidopsis thaliana to Understand Plant Biology*. PhD Thesis, Vrije Univeriteit Amsterdam.
- Leyhausen, P. 1965. "The Sane Community – A Density Problem?" *Discovery* 26: 27-33.
- Lorenz, K. 1963. *On Aggression*. San Diego: Harcourt Brace.
- Marsden, H. M. 1972. "Crowding and Animal Behavior," in J. F. Wohlwill

and D. Carson (eds.) *Environment and the Social Sciences: Perspectives and Applications*. Washington: American Psychological Association.

McAtee, W. L. 1936. "The Malthusian Principle in Nature," *The Scientific Monthly* 42: 444-456.

McHarg, I. L. 1964. "The place of nature in the city of man," *Annals of the American Academy of Political and Social Science* 352: 1-12.

McHarg, I. L. 1969. *Design with Nature*. New York: Natural History Press.

Michelson, W. 1970. *Man and His Urban Environment*. Reading MA: Addison-Wesley.

Milgram, S. 1970. "The Experience of Living in Cities," *Science*, 167, 1461-1468.

Mitchell, R. E. 1971. "Some Social Implications of High Density Housing," *American Sociological Review* 36, 18-29.

Mitchell, R. E. 1974. "Misconceptions about Man-Made Space: In Partial Defense of High Density Housing," *The Family Coordinator* 23: 51-56.

Mitman, G. 1992. *The State of Nature: Ecology, Community, and American Social thought, 1900-1950* Chicago: University of Chicago Press.

Morris, D. 1967. *The Naked Ape*. London: Jonathan Cape.

Mumford, L. 1968. *The Urban Prospect*. New York: Harcourt, Brace and World.

Newcomb, William W. 1956. "A Reappraisal of the 'Cultural Sink' of Texas," *Southwestern Journal of Anthropology* 12: 145-153.

O'Brien, R. C. [Robert Conly] 1971. *Mrs Frisby and the Rats of NIMH*. New York: Atheneum.

Park, T. 1932. "Studies in Population Physiology: The Relation of Numbers to Initial Population Growth in the Flour Beetle *Tribolium Confusum* Duval," *Ecology* 13: 172-181.

Park, T. 1933. "Studies in Population Physiology, II: Factors Regulating Initial Growth of Growth of *Tribolium Confusum* Populations," *Journal*

of *Experimental Zoology* 65: 17-42.

Paulus, P. Cox, V., McCain G., and Chandler, J. 1975. "Some Effects of Crowding in a Prison Environment," *Journal of Applied Social Psychology* 5: 86-91.

Pearl, R. 1925. *The Biology of Population Growth*. Baltimore: The Williams and Wilkins Company

Pines, M. 1971. "How the social organization of animal communities can lead to a population crisis which destroys them," in Julius Segal (ed.) National Institute of Mental Health; Mental Health Reports – 5; DHEW.

Porteus, J. D. 1977. *Environment & Behavior: Planning and Everyday Urban Life*. Addison-Wesley: Reading MA.

Proshansky, H. M., Ittelson, W. M. and Rivlin, L. G. (eds.) 1970. *Environmental Psychology: Man and His Physical Setting*. Holt, Rinehart and Winston.

Sauer, R. (1971) *Voyages: Scenarios for a Ship Called Earth*. New York: Zero Population Growth/Ballantine.

Schmitt, R. C. 1966. 'Density, Health, and Social Disorganization', *Journal of American Institute of Planners* 32, 38-40.

Sjoberg, A. F. 1953. "The Culture of the Tonkawa, a Texas Indian Tribe," *Texas Journal of Science* 5.3: 280-304.

Smith, Michael P. (1980). *The City and Social Theory*. Oxford: Basil Blackwell.

Snyder, R. L. 1968. "Reproduction and population pressures," in E. Stellar and J. M. Sprague (eds.) *Progress in Physiological Psychology*. New York: Academic Press.

Sommer, R. 1969. *Personal Space: The Behavioral Basis of Design*. Englewood Cliffs: Prentice-Hall.

Southwick, C. H. 1971. "The Biology and Psychology of Crowding in Man and Animals," *The Ohio Journal of Science* 71: 65-72.

Stokols, D. 1972. "On the Distinction between Density and Crowding: Some Implications for Future Research," *Psychological Review* 79: 275-77.

- Stott, D. H. 1962. "Cultural and natural checks on population growth," in M. F. Ashley Montagu (ed.) *Culture and the Evolution of Man*. New York: Oxford University Press.
- Swanton, J. R. 1924. *Southern Contacts of the Indians North of the Gulf of Mexico* Annaes, XX Congreso Internacional de Americanistas. Rio de Janiero: Imprensa Nacional.
- Tanner, T. 1971 *City of Words: American Fiction 1950-1970*. New York: Harper and Row.
- Turnbull, C. M. 1972. *The Mountain People*. New York: Simon & Schuster.
- Viner, R. 1999. "Putting Stress in Life: Hans Selye and the Making of Stress Theory," *Social Studies of Science* 29: 391-410.
- Vorda, A. 1992. "Examining the Disease: An interview with Hubert Selby Jr.," *Literary Review*, 35: 288-302.
- Welch, B. L. 1964. "Experimental Population Ecology," *Science* 146: 49
- Wigotsky, V. W. 1970. "Engineering and the Urban Crisis: Part 3: Urban Congestion," *Design News* September 15: 48-60.
- Winsborough, H. H. 1965. "The social consequences of high population density," *Law and Contemporary Problems*, 10: 120-126.
- Wolfe, T. 1968. *The Pumphouse Gang*. New York: Farrar, Straus & Giroux
- Worchel, S. 1978. "Reducing crowding without increasing space: Some applications of an attributional theory of crowding," *Journal of Population* 1: 216-230.
- Wynne-Edwards, V. C. 1965. "Self-Regulating Systems in Populations of Animals," *Science* 147: 1543-48.
- Zlutnick, S. and Altman, I. 1972. "Crowding and Human Behavior," in J. F. Wohlwill and D. Carson (eds.) *Environment and the Social Sciences: Perspectives and Applications*. Washington: American Psychological Association.

**LONDON SCHOOL OF ECONOMICS
DEPARTMENT OF ECONOMIC HISTORY**

**WORKING PAPERS IN: THE NATURE OF EVIDENCE: HOW WELL
DO “FACTS” TRAVEL?**

For further copies of this, and to see other titles in the department's
group of working paper series, visit our website at:
<http://www.lse.ac.uk/collections/economichistory/>

2005

- 01/05: Transferring Technical Knowledge and innovating in
Europe, c.1200-c.1800
Stephan R. Epstein
- 02/05: A Dreadful Heritage: Interpreting Epidemic Disease at
Eyam, 1666-2000
Patrick Wallis
- 03/05: Experimental Farming and Ricardo's Political Arithmetic of
Distribution
Mary S. Morgan
- 04/05: Moral Facts and Scientific Fiction: 19th Century Theological
Reactions to Darwinism in Germany
Bernhard Kleeberg
- 05/05: Interdisciplinarity “In the Making”: Modelling Infectious
Diseases
Erika Mattila
- 06/05: Market Disciplines in Victorian Britain
Paul Johnson

2006

- 07/06: Wormy Logic: Model Organisms as Case-based Reasoning
Rachel A. Ankeny

- 08/06: How The Mind Worked: Some Obstacles And
Developments In The Popularisation of Psychology
Jon Adams
- 09/06: Mapping Poverty in Agar Town: Economic Conditions Prior
to the Development of St. Pancras Station in 1866
Steven P. Swenson
- 10/06: "A Thing Ridiculous"? Chemical Medicines and the
Prolongation of Human Life in Seventeenth-Century
England
David Boyd Haycock
- 11/06: Institutional Facts and Standardisation: The Case of
Measurements in the London Coal Trade.
Aashish Velkar
- 12/06: Confronting the Stigma of Perfection: Genetic Demography,
Diversity and the Quest for a Democratic Eugenics in the
Post-war United States
Edmund Ramsden
- 13/06: Measuring Instruments in Economics and the Velocity of
Money
Mary S. Morgan
- 14/06: The Roofs of Wren and Jones: A Seventeenth-Century
Migration of Technical Knowledge from Italy to England
Simona Valeriani
- 15/06: Rodney Hilton, Marxism, and the Transition from Feudalism
to Capitalism
Stephan R. Epstein

2007

- 16/07: Battle in the Planning Office: Biased Experts versus
Normative Statisticians
Marcel Boumans
- 17/07: Trading Facts: Arrow's Fundamental Paradix and the
Emergence of Global News Networks, 1750-1900
Gerben Bakker

- 18/07: Accurate Measurements and Design Standards:
Consistency of Design and the Travel of 'Facts' Between
Heterogenous Groups
Aashish Velkar
- 19/07: When Rabbits became Human (and Humans, Rabbits):
Stability, Order, and History in the Study of Populations
Paul Erickson and Gregg Mitman
- 20/07: Contesting Democracy: Science Popularisation and Public
Choice
Jon Adams
- 21/07: Carlyle and the French Enlightenment: Transitional
Readings of Voltaire and Diderot
T. J. Hochstrasser
- 22/07: Apprenticeship and Training in Premodern England
Patrick Wallis

2008

- 23/08: Escaping the Laboratory: The Rodent Experiments of
John B. Calhoun & Their Cultural Influence
Edmund Ramsden & Jon Adams