

AccessionIndex: TCD-SCSS-X.20121208.003

Accession Date: 8-Dec-2012

Accession By: Prof.J.G.Byrne

Object name: Jonathan Swift's 'computer'

Vintage: c.1726

Synopsis: The earliest imagining of ensemble parallel computing.

Description:

Jonathan Swift (1667-1745) wrote in *Gulliver's Travels* [2] an episode imagining human ensemble parallel computing. Swift was a Dubliner, and a graduate of Trinity College Dublin, (B.A. 1686, Doctor of Divinity 1702), eventually in 1713 becoming Dean of St Patrick's Cathedral in Dublin. He published *Gulliver's Travels* in 1726.

In spirit his vision followed, amongst others, from Ramon Llull's (1232-1315) *Lullian Circles* 'combination machine', Athanasius Kircher's (1602-1680) new and universal version of the same, John Napier's (1550-1617) *Bones and Chessboard Calculator*, Wilhelm Schickard's (1592-1635) *Calculating Clock* add/subtract/multiply calculator, Pascal's (1623-1662) *Pascalene* adder/subtractor, Gottfried Leibniz's (1646-1716) *Stepped Reckoner* add/subtract/multiply calculator, etc. All of these were mechanical, but Swift both satirised, humanised and parallelised 'computation' with 40 human 'computers' that performed independent but essentially identical sub-tasks in parallel on mechanised subassemblies, the essence of ensemble computing.

According to Wikipedia [4] the earliest known written use of the term 'computer' for a person performing mathematical calculations occurred in 1613. A team of people would be used to divide-and-conquer a mathematical problem. In retrospect this has become known as 'human computing'.

Swift envisaged a wooden frame 20-ft square in a large room, around which stood 40 human computers. The frame consisted of many pieces of wood linked together by wire and connected to 40 handles; each piece was covered with paper on which were randomly written all the words of the language, see Fig.4. The rectangular frame with handles around sides might be said to be very faintly reminiscent, although on a larger scale, to those of prior machines (e.g. Schickard's, Fig.13), but those were for a single human computer, whereas Swift's frame was for 40 human computers acting in parallel. On command, each of Swift's 40 human computers would simultaneously rotate their handles, and then 36 of them would read out the newly displayed words, and if a few words made sense the other 4 computers would record them. This was repeated for about 6 hours per day. The relevant pages reproduced below are from Prof.J.G.Byrne's copy of *Dean Swift's Works* in this collection, see Figs.1-7.

Trivia: Weiss [6] pointed out Fig.4 shows only 31 handles, and row 5 has no handle ...

The origin of Swift's vision was explored in an interesting surviving 1986 letter from Prof.H.J.Real of Universität Münster to Prof.J.G.Byrne of Trinity College Dublin, see Figs.11-12. As indicated in this letter, Swift was open to a wide range of sources, lived beside Marsh's Library (Fig.10), and had an extensive personal library, as can be seen from its sale after he died in 1745; the auction catalogue lists 657 lots [4, 5].

The earliest realisation of his vision occurred 25 years later in 1750 when the 3-person French team of Alexis Claude Clairaut (1713–1765) [3] and his two colleagues, Joseph Lalande and Nicole-Reine Lepaute, successfully divided the computation to determine timing of the 1759 return of Halley's Comet. But the heyday of this human technique was in the 19th and early 20th century, particularly for navigational and astronomical calculations, especially for tables, but also for data reduction and prediction (for an especially good example see *Richardson's Fantastic Forecast Factory* elsewhere in the Hardware category of this catalog). After electronic computing began, its ensemble variations quite quickly followed (e.g. to implement Richardson's vision of weather forecasting).

250 years after publication Swift's *Gulliver's Travels* had a remarkable influence on terminology in computer architecture that permeates computing, in particular the instruction sets, addressable busses (e.g. address and data busses), networking (e.g. Ethernet), and documentation of computing standards. In 1980 Danny Cohen published a seminal article in the IEEE Computer: "*On Holy Wars and a Plea for Peace*" [7]. In this he applied the term *endian* to computing, a term borrowed from *Gulliver's Travels*, where by royal edict the King of Lilliput mandates cracking open boiled eggs at the little end, causing civil war that results in those who crack the big end taking refuge on the nearby island kingdom of Blefuscu. From Cohen (Fig.14):

This is an attempt to stop a war. I hope it is not too late for peace to prevail again. Many believe that the central question of this war is, What is the proper byte order in messages? More specifically, the question is, Which bit should travel first - the bit from the little end of the word or the bit from the big end of the word?

Followers of the former approach are called the Little-Endians, or Lilliputians; followers of the latter are called the Big-Endians, or Blefuscuans.

The context was that by 1980 manufacturers (and users) were in entrenched positions. For example, Ethernet mandated a big-endian network byte-order, the IBM 360 and Motorola 68000 used a big-endian bit order for addresses and data in its instruction set and hardware, while RS-232C, PDP-11 and Intel x86 used little-endian orders.

Cohen sought clarity, his terminology stuck, and ordering became a subject for close attention and specification, and with that precise translation between orderings.

The homepage for this catalog is at: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/>
Click 'Accession Index' (1st column listed) for related folder, or 'About' for further guidance.
The items listed below are more properly part of the Literature category of this catalog, but are listed here for convenience.

Accession Index	Object with Identification
TCD-SCSS-V.20121208.568	The Choice Works of Dean Swift in prose and verse ..., Swift, D., Chatto & Windus: London, 1904.
TCD-SCSS-V.20121208.383	Letter dated 4 July 1986 to Prof.J.G.Byrne, TCD, from Universität Münster in relation to an enquiry about Swift's description of a computer in his Gulliver's Travels, Universität Münster, 1986.

References:

1. Wikipedia, *Jonathan Swift*, see:
https://en.wikipedia.org/wiki/Jonathan_Swift
Last viewed 5-Jan-2017.
2. Swift, D., *Travels into Several Remote Nations of the World, in Four Parts, by Lemuel Gulliver, first a surgeon, and then a captain of several ships*, aka *Gulliver's Travels*, in *The Choice Works of Dean Swift in prose and verse ...*, Chatto & Windus: London, 1904.
3. Wikipedia, *Alexis Clairaut*, see:
https://en.wikipedia.org/wiki/Alexis_Clairaut
Last viewed 5-Jan-2017.
4. Uni-Muenster, *Swift Studies*, see:
https://www.uni-muenster.de/imperia/md/content/englischesseminar/swift/swift_studies_contents.pdf
Last viewed 5-Jan-2017.
5. Dirk F.Passman, Heinz J.Vienken, *The Library and Reading of Jonathan Swift*, Peter Lang GmbH, 2003, see:
<http://www.bokus.com/bok/9783631419267/the-library-and-reading-of-jonathan-swift/>
Last viewed 18-Jan-2017.
6. Eric A.Weiss, *Jonathan Swift's Computing Invention*, IEEE Annals of the History of Computing, Vol.7, pp.164-165, IEEE Computer Society, Los Alamitos, CA, USA, 1985, see:
<https://www.computer.org/csdl/mags/an/1985/02/man1985020164.html>
Last viewed 19-Jan-2017.
7. Danny Cohen, *On Holy Wars and a Plea for Peace*, IEEE Computer, pp.48-54, Vol.14, No.10, October 1981, see:
<http://ieeexplore.ieee.org/document/1667115/>
Last viewed 20-Feb-2017.

the old forms, to live in the houses his ancestors had built, and act as they did in every part of life without innovation. That some few other persons of quality and gentry had done the same, but were looked on with an eye of contempt and ill will, as enemies to art, ignorant and ill commonwealthsmen, preferring their own ease and sloth before the general improvement of their country.

His lordship added that he would not by any further particulars prevent the pleasure I should certainly take in viewing the grand academy, whither he was resolved I should go. He only desired me to observe a ruined building upon the side of a mountain about three miles distant, of which he gave me this account : that he had a very convenient mill within half a mile of his house, turned by a current from a large river, and sufficient for his own family as well as a great number of his tenants. That about seven years ago a club of those projectors came to him with proposals to destroy this mill, and build another on the side of that mountain, on the long ridge whereof a long canal must be cut for a repository of water to be conveyed up by pipes and engines to supply the mill ; because the wind and air upon a height agitated the water, and thereby made it fitter for motion. And because the water descending down a declivity would turn the mill with half the current of a river whose course is more upon a level. He said that, being not then very well with the court, and pressed by many of his friends, he complied with the proposal ; and after employing an hundred men for two years the work miscarried, the projectors went off, laying the blame entirely upon him, railing at him ever since, and putting others upon the same experiment with equal assurance of success as well as equal disappointment.

In a few days we came back to town, and his Excellency, considering the bad character he had in the academy, would not go with me himself, but recommended me to a friend of his to bear me company thither. My lord was pleased to represent me as a great admirer of projects, and a person of much curiosity and easy belief ; which indeed was not without truth. for I myself had been a sort of a projector in my younger days.

CHAPTER V.

The author permitted to see the Grand Academy of Lagado. The academy largely described. The arts wherein the professors employ themselves.

THIS Academy is not an entire single building, but a continuation of several houses on both sides of a street, which growing waste was purchased and applied to that use.

I was received very kindly by the warden, and went for many days to the academy. Every room hath in it one or more projectors, and I believe I could not be in fewer than five hundred rooms.

The first man I saw was of a meagre aspect, with sooty hands and face, his hair and beard long, ragged, and singed in several places ; his clothes, shirt, and skin were all of the same colour. He had been eight years upon a project for extracting sunbeams out of cucumbers, which were to be put into vials hermetically sealed, and let out to warm the air in raw, inclement summers. He told me he did not doubt in eight

Figure 1: Dean Swift's Works, page 104

years more he should be able to supply the governor's gardens with sunshine at a reasonable rate ; but he complained that his stock was low, and entreated me to give him something as an encouragement to ingenuity, especially since this had been a very dear season for cucumbers. I made him a small present, for my lord had furnished me with money on purpose, because he knew their practice of begging from all who go to see them.

I went into another chamber, but was ready to hasten back, being almost overcome with a horrible stink. My conductor pressed me forward, conjuring me in a whisper to give no offence, which would be highly resented, and therefore I durst not so much as stop my nose. The projector of this cell was the most ancient student of the academy. His face and beard were of a pale yellow ; his hands and clothes daubed over with filth. When I was presented to him he gave me a very close embrace (a compliment I could well have excused). His employment from his first coming into the academy was an operation to reduce human excrement to its original food by separating the several parts, removing the tincture which it receives from the gall, making the odour exhale, and scumming off the saliva. He had a weekly allowance from the society of a vessel filled with human ordure about the bigness of a Bristol barrel.

I saw another at work to calcine ice into gunpowder, who likewise showed me a treatise he had written concerning the malleability of fire, which he intended to publish.

There was a most ingenious architect who had contrived a new method for building houses by beginning at the roof and working downwards to the foundation, which he justified to me by the like practice of those two prudent insects the bee and the spider.

There was a man born blind who had several apprentices in his own condition. Their employment was to mix colours for painters, which their master taught them to distinguish by feeling and smelling. It was indeed my misfortune to find them at that time not very perfect in their lessons, and the professor himself happened to be generally mistaken. This artist is much encouraged and esteemed by the whole fraternity.

In another apartment I was highly pleased with a projector who had found a device of ploughing the ground with hogs to save the charges of ploughs, cattle and labour. The method is this : in an acre of ground you bury at six inches distance, and eight deep, a quantity of acorns, dates, chestnuts, and other mast or vegetables whereof these animals are fondest ; then you drive six hundred or more of them into the field, where, in a few days, they will root up the whole ground in search of their food, and make it fit for sowing, at the same time manuring it with their dung. It is true, upon experiment, they found the charge and trouble very great, and they had little or no crop. However, it is not doubted that this invention may be capable of great improvement.

I went into another room where the walls and ceiling were all hung round with cobwebs, except a narrow passage for the artist to go in and out. At my entrance he called aloud to me not to disturb his webs. He lamented the fatal mistake the world had been so long in of using silkworms, while we had such plenty of domestic insects who infinitely excelled the former, because they understood how to weave as well as

Figure 2: Dean Swift's Works, page 105

spin. And he proposed farther that, by employing spiders, the charge of dyeing silks should be wholly saved, whereof I was fully convinced when he showed me a vast number of flies most beautifully coloured, wherewith he fed his spiders, assuring us that the webs would take a tincture from them; and as he had them of all hues he hoped to fit everybody's fancy as soon as he could find proper food for the flies of certain gums, oils, and other glutinous matter to give a strength and consistence to the threads.

There was an astronomer who had undertaken to place a sun-dial upon the great weather-cock on the town house, by adjusting the annual and diurnal motions of the earth and sun so as to answer and coincide with all accidental turnings by the wind.

I was complaining of a small fit of the cholic, upon which my conductor led me into a room where a great physician resided, who was famous for curing that disease by contrary operations from the same instrument. He had a large pair of bellows with a long, slender muzzle of ivory. This he conveyed eight inches up the anus, and drawing in the wind he affirmed he could make the guts as lank as a dried bladder. But when the disease was more stubborn and violent he let in the muzzle while the bellows were full of wind, which he discharged into the body of the patient; then withdrew the instrument to replenish it, clapping his thumb strongly against the orifice of the fundament; and this being repeated three or four times, the adventitious wind would rush out, bringing the noxious along with it (like water put into a pump) and the patient recover. I saw him try both experiments upon a dog, but could not discern any effect from the former. After the latter the animal was ready to burst, and made so violent a discharge as was very offensive to me and my companions. The dog died on the spot, and we left the doctor endeavouring to recover him by the same operation.

I visited many other apartments, but shall not trouble my reader with all the curiosities I observed, being studious of brevity.

I had hitherto seen only one side of the academy, the other being appropriated to the advancers of speculative learning, of whom I shall say something when I have mentioned one illustrious person more, who is called among them the universal artist. He told us he had been thirty years employing his thoughts for the improvement of human life. He had two large rooms full of wonderful curiosities, and fifty men at work. Some were condensing air into a dry tangible substance, by extracting the nitre, and letting the aqueous or fluid particles percolate; others softening marble for pillows and pincushions; others petrifying the hoofs of a living horse to preserve them from foundering. The artist himself was at that time busy upon two great designs: the first, to sow land with chaff, wherein he affirmed the true seminal virtue to be contained, as he demonstrated by several experiments which I was not skilful enough to comprehend. The other was by a certain composition of gums, minerals, and vegetables outwardly applied, to prevent the growth of wool upon two young lambs; and he hoped in a reasonable time to propagate the breed of naked sheep all over the kingdom.

We crossed a walk to the other part of the academy, where, as I have already said, the projector in speculative learning resided.

The first professor I saw was in a very large room with forty pupils

Figure 3: Dean Swift's Works, page 106

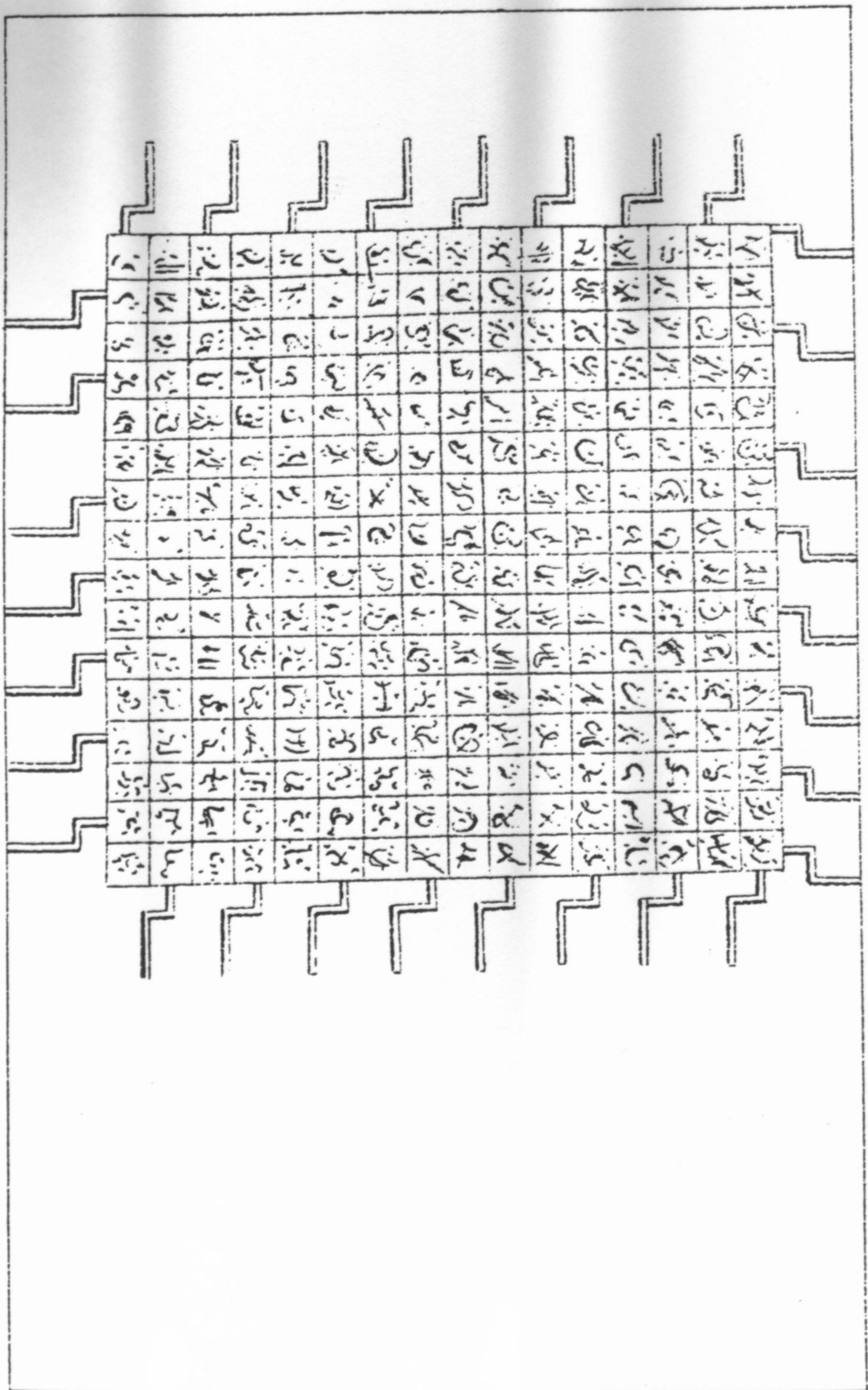


Figure 4: Dean Swift's Works, page 106-facing

about him. After salutation, observing me to look earnestly upon a frame, which took up the greatest part of both the length and breadth of the room, he said perhaps I might wonder to see him employed in a project for improving speculative knowledge by practical and mechanical operations. But the world would soon be sensible of its usefulness, and he flattered himself that a more noble, exalted thought never sprung in any other man's head. Every one knew how laborious the usual method is of attaining to arts and sciences; whereas, by his contrivance, the most ignorant person, at a reasonable charge, and with a little bodily labour may write both in philosophy, poetry, politics, law, mathematics, and theology, without the least assistance from genius or study. He then led me to the frame, about the sides whereof all his pupils stood in ranks. It was twenty foot square, placed in the middle of the room. The superficies was composed of several bits of wood about the bigness of a dye, but some larger than others. They were all linked together by slender wires. These bits of wood were covered on every square with paper pasted on them, and on these papers were written all the words of their language in their several moods, tenses, and declensions, but without any order. The professor then desired me to observe, for he was going to set his engine at work. The pupils, at his command, took each of them hold of an iron handle, whereof there were forty fixed round the edges of the frame, and giving them a sudden turn the whole disposition of the words was entirely changed. He then commanded six and thirty of the lads to read the several lines softly as they appeared upon the frame; and where they found three or four words together that might make part of a sentence they dictated to the four remaining boys who were scribes. This work was repeated three or four times, and at every turn the engine was so contrived that the words shifted into new places, or the square bits of wood moved upside down.

Six hours a day the young students were employed in this labour, and the professor showed me several volumes in large folio already collected of broken sentences, which he intended to piece together, and out of those rich materials to give the world a complete body of all arts and sciences; which however might be still improved and much expedited if the public would raise a fund for making and employing five hundred such frames in Lagado, and oblige the managers to contribute in common their several collections.

He assured me that this invention had employed all his thoughts from his youth, that he had employed the whole vocabulary into his frame, and made the strictest computation of the general proportion there is in the book between the numbers of particles, nouns, and verbs, and other parts of speech.

I made my humblest acknowledgment to this illustrious person for his great communicativeness, and promised if ever I had the good fortune to return to my native country that I would do him justice as the sole inventor of this wonderful machine, the form and contrivance of which I desired leave to delineate upon paper as in the figure here annexed. I told him, although it were the custom of our learned in Europe to steal inventions from each other, who had thereby at least this advantage, that it became a controversy which was the right owner, yet I

Figure 5: Dean Swift's Works, page 107

would take such caution that he should have the honour entire without a rival.

We next went to the school of language, where three professors sat in consultation upon improving that of their own country.

The first project was to shorten discourse by cutting polysyllables into one, and leaving out verbs and participles, because, in reality, all things imaginable are but nouns.

The other was a scheme for entirely abolishing all words whatsoever; and this was urged as a great advantage in point of health as well as brevity. For it is plain that every word we speak is in some degree a diminution of our lungs by corrosion, and consequently contributes to the shortening of our lives. An expedient was therefore offered that, since words are only names for things, it would be more convenient for all men to carry about them such things as were necessary to express the particular business they are to discourse on. And this invention would certainly have taken place to the great ease as well as health of the subject, if the women in conjunction with the vulgar and illiterate had not threatened to raise a rebellion unless they might be allowed the liberty to speak with their tongues after the manner of their ancestors; such constant irreconcilable enemies to science are the common people. However, many of the most learned and wise adhere to the new scheme of expressing themselves by things, which hath only this inconvenience attending it, that if a man's business be very great, and of various kinds, he must be obliged in proportion to carry a great bundle of things upon his back unless he can afford one or two strong servants to attend him. I have often beheld two of those sages almost sinking under the weight of their packs like pedlars among us, who, when they meet in the streets, would lay down their loads, open their saddles, and hold conversation for an hour together; then put up their implements, help each other to resume their burthens, and take their leave.

But for short conversations a man may carry implements in his pockets and under his arms enough to supply him, and in his house he cannot be at a loss. Therefore, the room where company meet who practise this art, is full of all things ready at hand requisite to furnish matter of this kind of artificial converse.

Another great advantage proposed by this invention was, that it would serve as an universal language to be understood in all civilized nations, whose goods and utensils are generally of the same kind, or nearly resembling, so that their uses might easily be comprehended. And the ambassadors would be qualified to treat with foreign princes or ministers of State, to whose tongues they were utter strangers.

I was at the mathematical school, where the master taught his pupils after a method scarce imaginable to us in Europe. The proposition and demonstration were fairly written on a thin wafer, with ink composed of a cephalic tincture. This the student was to swallow upon a fasting stomach, and for three days following eat nothing but bread and water. As the wafer digested the tincture mounted to his brain, bearing the proposition along with it. But the success hath not hitherto been answerable, partly by some error in the quantum or composition, and partly by the perverseness of lads, to whom this bolus is so nauseous

Figure 6: Dean Swift's Works, page 108

that they generally steal aside, and discharge it upwards before it can operate ; neither have they been yet persuaded to use so long an abstinence as the prescription requires.

CHAPTER VI.

A further account of the academy. The author proposes some improvements which are honourably received.

IN the school of political projectors I was but ill entertained, the professors appearing in my judgment wholly out of their senses, which is a scene that never fails to make me melancholy. These unhappy people were proposing schemes for persuading monarchs to choose favourites upon the score of their wisdom, capacity, and virtue ; of teaching ministers to consult the public good ; of rewarding merit, great abilities, and eminent services ; of instructing princes to know their true interest by placing it on the same foundation with that of their people ; of choosing for employments persons qualified to exercise them, with many other wild impossible chimæras that never entered before into the heart of man to conceive, and confirmed in me the old observation that there is nothing so extravagant and irrational which some philosophers have not maintained for truth.

But, however, I shall so far do justice to this part of the Academy, as to acknowledge that all of them were not so visionary. There was a most ingenious doctor who seemed to be perfectly versed in the whole nature and system of government. This illustrious person had very usefully employed his studies in finding out effectual remedies for all diseases and corruptions, to which the several kinds of public administration are subject by the vices or infirmities of those who govern, as well as by the licentiousness of those who are to obey : for instance, whereas all writers and reasoners have agreed that there is a strict universal resemblance between the natural and the political body ; can there be anything more evident, than that the health of both must be preserved, and the diseases cured by the same prescription ? It is allowed that senates and great councils are often troubled with redundant, ebullient, and other peccant humours, with many diseases of the head and more of the heart ; with strong convulsions, with grievous contractions of the nerves and sinews in both hands, but especially the right ; with spleen, flatus, vertigos, and deliriums ; with scrofulous tumours, full of foetid purulent matter ; with sour frothy ructations, with canine appetites and crudeness of digestion, besides many others needless to mention. This doctor therefore proposed, that upon the meeting of a Senate, certain physicians should attend at the three first days of their sitting, and at the close of each day's debate, feel the pulses of every Senator ; after which, having maturely considered and consulted upon the nature of the several maladies, and the method of cure, they should on the fourth day return to the Senate House, attended by their apothecaries stored with proper medicines, and before the members sate, administer to each of them lenatives, aperitives, abstersives, corrosives, restringents, palliatives, laxatives, cephalalgics, icterics, apophlegmatics, acoustics, as their several cases required, and according as these medicines should operate, repeat, alter, or omit them at the next meeting.



*Figure 8: Hoey's Court, birthplace of Jonathan Swift (now demolished)
Painted in 1971 by Flora H.Mitchell*



*Figure 9: St.Patrick's Cathedral, Dublin
Left: interior of St.Patrick's
Right: south aisle and Swift's tablet
Painted by Flora H.Mitchell*



*Figure 10: Marsh's Library, built in 1702 behind St.Patrick's Cathedral in Dublin
just before Jonathan Swift became Dean of St.Patrick's Cathedral
(Narcissus Marsh was Archbishop of Dublin, previously Provost of Trinity College Dublin)
Painted in 1958 by Flora H.Mitchell*

WESTFÄLISCHE WILHELMS-UNIVERSITÄT MÜNSTER
ENGLISCHES SEMINAR

Universität Münster — Englisch Seminar
Johannisstraße 12-20, 4400 Münster

Professor Hermann J. Real
Dr. Heinz J. Vienken

Professor J.G. Byrne
Department of Computer Science
Engineering School
Trinity College

D-4400 Münster July 4, 1986
Johannisstraße 12-20
Tel. (0251) 83-

Dublin 2
Eire/Ireland

Dear Professor Byrne,

Thank you very much for your enquiry of 23 June. Since there is a great deal of material, interpretative rather than explanatory, alas, on the specific problem you raise, it has taken us some time to check our files. The result may be somewhat disappointing, but here is what we have assembled at Münster. We do not think that there is any evidence, if you take that word seriously, as to where Swift exactly got the idea for the machine. One recent explanation is that he found the idea in Engelbert Kaempfer's History of Japan and that he developed it further from there. Personally, we think that this is rather unlikely since Kaempfer's History was published after Gulliver's Travels had come out, and there is no evidence that Swift ever saw an advance copy of this work, or the manuscript, for that matter. Moreover, tables like Kaempfer's frequently occur in seventeenth-century travel accounts, so that Swift, if he was indebted to anybody for the idea, could have fallen back on Purchas, Olearius or de la Loubere, all of whom either were in his own library or easily accessible in Marsh's. We enclose copies of the relevant material which has recently been collected by our student Dirk Paßmann for a doctoral dissertation which we directed and which is due to be published early next year.

You might also find the following reference useful. A correspondent pointed out in the Athenaeum of 5 July 1845 (p. 669) that early in the eighteenth century there had been a treatise entitled "Artificial Versifying, Shewing any one, though of Ordinary Capacity, that can Read and Write, though he Unstandeth not a Word of

Figure 11: Letter from Prof.H.J.Real to Prof.J.G.Byrne, 4-Jul-1986, page 1

Latin, how to Make Thousands of Hexameter and Pentameter Verses ..." We have not yet seen this treatise, and it may not be easily available. Neither have we come across any evidence that Swift ever read it. But he may have seen it, of course, on one of his many outings to Duck Lane or Little Britain (see Jonathan Swift, The Complete Poems, ed. Pat Rogers, 1983, p. 852).

Hoping that you will not feel let down by all this rigmarole and that you will "try" us again,

Yours sincerely,

Herbert J. Real
Herz J. Real

cc: M. Pollard

Figure 12: Letter from Prof.H.J.Real to Prof.J.G.Byrne, 4-Jul-1986, page 2



Figure 13: Reconstruction of Schickard's Calculating Clock c.1623

Which bit should travel first? The bit from the big end or the bit from the little end? Can a war between Big Endians and Little Endians be avoided?

On Holy Wars and

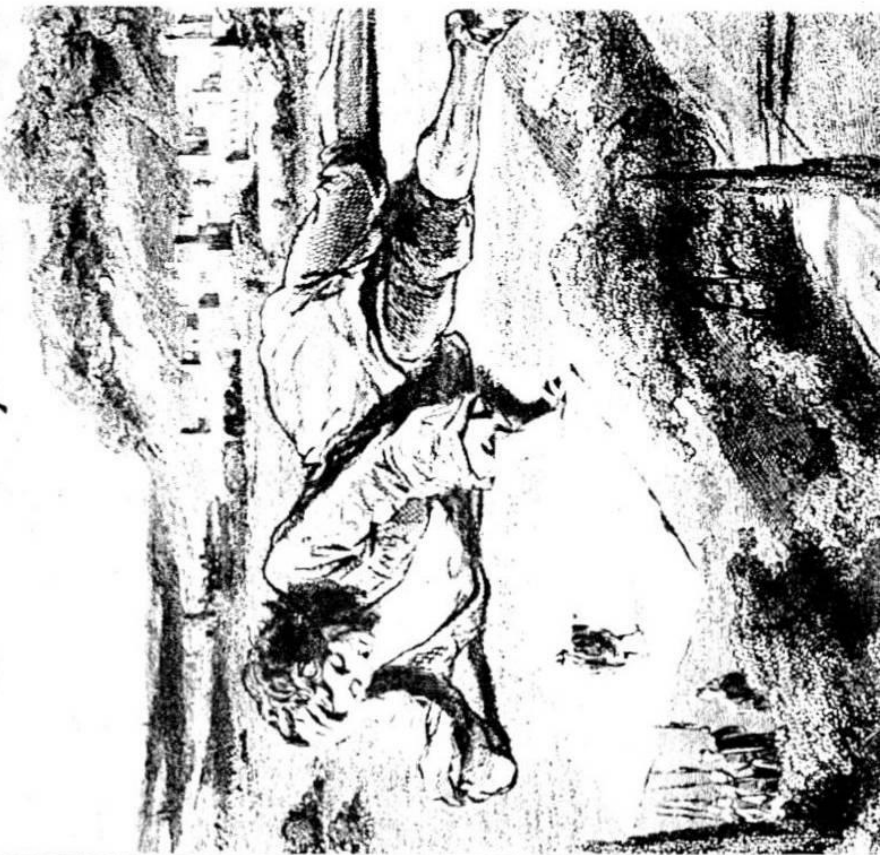


Figure 14: Danny Cohen's paper: 'On Holy Wars and a Plea for Peace', IEEE Computer, Oct-1981

a Plea for Peace

Danny Cohen
Information Sciences Institute

This article was written in an attempt to stop a war. I hope it is not too late for peace to prevail again. Many believe that the central question of this war is, What is the proper byte order in messages? More specifically, the question is, Which bit should travel first—the bit from the little end of the word or the bit from the big end of the word?

Followers of the former approach are called Little Endians, or Lilliputians; followers of the latter are called Big Endians, or Blefuscians. I employ these Swiftian terms because this modern conflict is so reminiscent of the holy war described in *Gulliver's Travels*.¹

Approaches to serialization

The above question arises as a result of the serialization process performed on messages to allow them to be sent through communication media. If the unit of communication is a message, this question has no meaning. If the units are computer words, one must determine their size and the order in which they are sent.

Since they are sent virtually at once, there is no need to determine the order of the elements of these words.

If the unit of transmission is an eight-bit byte, questions about bytes are meaningful but questions about the order of the elementary particles that constitute these bytes are not.

If the units of communication are bits, the atoms (quarks?) of computation, the only meaningful question concerns the order in which the bits are sent. Most modern communication is based on a single stream of information, the bit-stream. Hence, bits, rather than bytes or words, are the units of information that are actually transmitted over channels such as wires and satellites.

Footnote page: "Audience with the Emperor of Lilliput," Gavarni, 1850's. Courtesy Library of Congress.

Notes on Swift's *Gulliver's Travels*

Swift's hero, Gulliver, is shipwrecked and washed ashore on Lilliput, whose six-inch inhabitants are required by law to break their eggs only at the little end. Of course, all those citizens who habitually break their eggs at the big end are engaged by the proclamation. Civil war breaks out between the Little Endians and the Big Endians, resulting in the Big Endians taking refuge on a nearby island, the kingdom of Blefuscu. The controversy is ethically and politically important, for the Lilliputians, in fact, Swift has 11,000 Lilliputian rebels die over the egg question. The issue might seem silly, but Swift is satirizing the actual causes of religious or holy wars.

Swift's point is that the difference between breaking eggs at the little end and breaking them at the big end is trivial. He suggests that everyone do it in his own favored way.

Of course, we are making the opposite point. We argue that the difference between sending information in the little end first and the big end first is trivial, but in fact that everyone must do it in the same way to avoid anarchy.



Reproduced from *The Annotated Gulliver's Travels* by Isaac Asimov. Published by G. P. Putnam's Sons.

0018-9102/81/0005-0480\$01.50 © 1981 IEEE