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The granary of science

London, 22 February 1832 Amongst those works of science which are too large and too laborious for individual efforts, and are therefore fit objects to be undertaken by united academies, I wish to point out one which seems eminently necessary at the present time, and which would be of the greatest advantage to all classes of the scientific world.

I would propose that its title should be '*The Constants of Nature and of Art*'. It ought to contain all those facts which can be expressed by numbers in the various sciences and arts.*[1]

Numerical regularities about disease, unknown in 1820, were commonplace by 1840. They were called laws, laws of the human body and its ailments. Similar statistical laws were gaining a hold over the human soul. The analogy was close, for laws of behaviour aimed at sick souls. Medical men were able to claim new expertise in matters moral and mental. Before proceeding, however, we should briefly ask an elementary question: what does a law of nature look like?

Our most familiar law is still Newton's. It says that the force of gravitational attraction between two bodies is equal to the product of their masses divided by the square of the distance between them – all multiplied by the gravitational *constant*. Newton did not write it that way, for he expressed his analysis in terms of ratios, so that the constant that we call '*G*' is invisible. His work did imply a value for *G*. A 1740 French expedition to Mt Chimborazo in Ecuador made a fair experimental determination of it, but the observers thought of themselves as determining the mass of the earth. In 1798 Henry Cavendish obtained a superlative laboratory measurement, and he actually computed *G*, but he still described himself as 'weighing the earth'. The idea of an abstract fundamental constant – as opposed to a stable measurable property of a physical object, such as the weight of the earth – was not fully articulated until the nineteenth century.

Our fundamental constants are quantities such as the velocity of light,

* Charles Babbage, writing to the eminent experimentalist David Brewster.

Planck's constant, the charge on the electron and the mass/charge ratio of the electron, the Hubble constant, the rate of expansion of the universe – and *G*. Among these, only the properties of the electron can be thought of as properties of 'objects', and many philosophers would dispute even that. The numbers are called fundamental because they occur as parameters in the fundamental laws of nature. Many cosmologists of today entertain the following picture. The universe is constituted first of all by certain deep equations, the basic laws of everything. They are composed of variables for measurable quantities, and free parameters whose values are fixed by assigning constants – the velocity of light and so forth. Then various boundary conditions are added, conditions not determined by the equations and the fundamental constants – the amount of mass and energy in the universe, say.

Such a picture is implicitly hierarchical. First come the laws, then the constants that fix their parameters, and then a set of boundary conditions. It is not easy to combine such a cosmology with full blown positivism, for the original laws of nature, with parameters not yet fixed by constants, do not seem to 'describe' mere 'regularities'. They are constraints on physically possible universes, suggesting a necessitarian attitude to laws of nature. Such a cosmology is not far removed from Galileo's theism and his picture of God writing the Book of Nature. The Author of Nature writes down the equations, then fixes the fundamental constants, and finally chooses a series of boundary conditions.

How did our ideas about constants evolve? Even before Descartes, the celebrated algebrist Vieta did distinguish between variables and parameters of an equation. Despite this, geometrical rather than analytic ways of thinking long persisted. They do not lend themselves to the idea of a 'constant' in an equation, because constant proportions are expressed by ratios.[2] Lexicographers report that the French word *constant* was used for fixed parameters by 1699. The English seem not to have adopted it during the eighteenth century, doubtless because of the split between Newtonian and continental mathematical traditions. The word 'variable' was nevertheless standard in the doctrine of fluxions almost from the beginning. Thus even if 'constant' was not current, the idea was present. It is another thing, however, to transfer the mathematical use to the description of the world. The constants in algebra or analysis had to be identified with constant numbers attached to things.

The 'weight of the earth' might do as a constant of nature for abstract thinkers – as would, for example, the distances and periods of revolution of the planets – but industrial manufacture made more difference to the notion of a constant than facts about the solar system. In mundane matters relatively few things are constant except what we make constant. 'Stan-

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dards' begin with the coinage and other weights and measures of commerce. The US Bureau of Standards, now notable for its monitoring of many fundamental constants, was established only in 1901, even though, in my concluding chapter, we shall find C.S. Peirce begging for one in 1885. It was placed in the department of labor and commerce and was patterned on the English Board of Trade's standards department. That in turn replaced the chamberlains in the Exchequer, a type of office abolished in 1826. The chamberlains' first task had been the coinage, and then such units as pounds and feet, rods and chains. So many more things were being made and had to measure up, in 1826, that a need for vastly more comprehensive systems of standards was felt. The need was not to emulate the Napoleonic reform that had set the continent of Europe on the new and rational path of metric measurement, but merely to diminish English chaos in piecemeal ways.

Particular instances of what we *now* call fundamental constants had long been known: the velocity of light, for example. Yet that was just a number, of no universal or fundamental significance until the theory of relativity. Quite aside from an absence of thoughts about 'fundamental' constants, there was no category of physical constants or constants of nature until the 1820s. Babbage's letter to Brewster of 1832 was important not because it was influential (although Babbage was at his apogee in those years) but because it was representative.

Atomic weights had already been determined with some precision, especially by the Swedish analyst Berzelius. English chemists, distinctly less skilled, and moved by William Prout's guess in 1815 that the weights should be integral numbers, disagreed with European measurements. In 1831 one of the first acts of the newly formed British Association for the Advancement of Science was to direct Edward Turner to settle the matter. He concluded that Berzelius was right. There was, then, a conviction that there must be one true set of numbers for the elements, constants of nature. The issues were partly theoretical, partly practical. More straightforwardly pragmatic was a handbook of tables for mechanical and civil engineers published the same year.[3] It provided numbers for tensile strengths and the like, and called them constants, even on its title page. The *OED* cites this as the earliest use of the word in this sense. Babbage owned the book.[4]

Babbage was not the first to want to compile lists of constants. His indefatigable contemporary, Johann Christian Poggendorf, editor of *Annalen der Physik und Chimie* (and later creator of the definitive nineteenth-century biographical and bibliographical science reference work) had just published tables of what Babbage calls 'the constant quantities belonging to our [solar] system'[5] Babbage, characteristically, had something far grander in mind, to be undertaken by 'the Royal Society, the Institute of France, and the Academy of Berlin'.*[6] His list had nineteen categories of constants, which were to be updated every two years, each academy taking its turn every six years.

The list began tamely enough, with (1) constants of the solar system (the distances of the planets, their period of revolution, and the force of gravity on the surface of each – G, the universal gravitational constant, was *not* included); (2) atomic weights; (3) metals (specific gravity, elasticity, specific heats, conducting power of electricity, etc.); (4) optics (refractive indices, double refraction angles, polarizing angles, etc.); (5) the numbers of known species of mammalia, molluscs, insects, etc., the numbers of these in fossil state, and the proportion of fossils that are from existing species as opposed to extinct ones. (If it seems odd to take the number of species as a constant, we should recall that that was precisely the issue of the gathering storm of evolutionary theory. Babbage was not close to the biologists, but he was quite intimate with Charles Lyell, who devised the new geology.)

We then proceed in (6) to the mammals, and catalogue the height, weight of skeleton, pulse rate and breath rate while at rest, period of sucking etc. In (7) we turn to people (tables of mortality in various places, proportions of the sexes born under various circumstances, quantity of air consumed per hour, proportion of sickness amongst the working classes).

(8) is about the power of men and animals: 'a man labouring ten hours a day will saw ( ) square feet of deal – ditto ( ) elm – ditto ( ) oak – ditto Portland stone – ditto Purbeck – Days labour in mowing, ploughing – &c. &c. every kind of labour – Raising water one foot high – horse do. – ox or cow do. – camel.' In the next sentence we get the Industrial Revolution: 'Power of steam engines in Cornwall'.

And so on: (9) vegetable kingdom (natural and cultivated, crop production and profitability); (10) geographical distribution of animals and plants (including 'the weight of potass [potash] produced from each kind of wood, and proportion of heat produced by burning a given weight of each'); (11) atmospheric phenomena; (12) materials (strength of, but also 'weight of coal to burn 10 bushels of lime', 'tallow to make soap' and 'constants of all trades'); (13) velocities (arrow, musket ball, sound, light,

* The reference to the Prussian Academy arose from Babbage's continental travels following a period of family sadness. They marked him and to some extent British science, for his experiences in Berlin motivated his sensational onslaught on the Royal Society. In 1828 he attended the Berlin session of the Deutsche Naturforscher Versammlung, which had been meeting annually in various cities since 1822. His 'Account of the Great Congress of Philosophers at Berlin on the 18th September 1828' was propitious for the founding of the British Association for the Advancement of Science in 1831. He, his close friend John Herschel and his editor Brewster drafted the constitution for the Association, with its plan of movable annual meetings patterned on the German society.

birds, average passage Liverpool to New York). That most universal of twentieth-century constants, the velocity of light, was put in exactly the same box as the speeds of the various kinds of birds.

There follow (14) geography (lengths of rivers, areas of seas, heights of mountains); (15) populations; (16) buildings ('height of all temples, pyramids, churches, towers, columns, &c.', obelisks, lengths of bridges, breadth of their piers); (17) weights and measures (conversion tables into English money, areas, weights); (18) 'tables of the frequency of occurrence of the various letters of the alphabet in different languages, – of the frequency of occurrence of the same letters at the beginnings and endings of words, – as the second or penultimate letters of words'; (19) numbers of books in great public libraries at given dates, numbers of students at various universities, observatories and their equipment.

This is not so far away from our modern handbooks, gazetteers, compendia and cyclopedias all rolled into one, except for the utterly motley array of numbers of disparate kinds of things. The motley is not a sign of madness but of eccentric enthusiasms. Aside from the 'respectable' sections that we find in our modern scientific handbooks – atomic weights or specific heats – many other numbers sought are signs of bees in Babbage's notorious bonnet.

For example, corresponding to (8) we find that fourteen days before his letter to Brewster Babbage had signed the preface to his marvellous inventory of recent British industrial invention, with careful studies of the efficiency of various modes of production.[7] Section (18) on the frequency of letters matches a communication to Quetelet, who published it in his journal, and recalled it affectionately in his eulogy of Babbage some 40 years later. Joseph Henry was moved to add, at that time, that if one were to protest that 'this question is never asked by the student of nature', we must recall that 'every item of knowledge is connected in some way with all other knowledge'.[8] Babbage's exercise, he suggested, would be useful when ordering type fonts. The letter frequencies had more to do with Babbage's ingenious but bizarre interests in cryptography.[9]

The 'sex ratios under various circumstances' in (7) referred to a letter to T.P. Courtenay, his Tory MP, and chairman of the Select Committee on Friendly Societies.[10] The letter was published by Brewster. Drawing primarily on Prussian statistics Babbage argued that the ratio of females to males among illegitimate births exceeded that for births in wedlock.*[11]

* Babbage was a witness before the Select Committee. In studying life tables, he had become fascinated by a phenomenon noted long ago by Laplace and others: there is always a proportional excess of male over female births, but this excess decreases for illegitimate births. Laplace showed that the excess is significant, and offered the following explanation: all children in foundling homes are registered as illegitimate, and parents have a tendency to abandon legitimate female but not male newborn, and in particular country families will

Section (6) on mammals harks back to a 'list of those facts relating to mammalia, which can be expressed by numbers [and which] was first printed in 1826. It was intended as an example of one chapter in a great collection of facts which the author suggested under the title of 'The Constants of Nature and of Art'.[12] Babbage proposed some 142 numbers measuring different parts of the bodies of mammals, followed by a more modest requirement for fishes.

The letter on constants of nature and of art is thus a more personal document than at first appears. Nevertheless this odd letter epitomizes the moment, 1832. The British Association printed Babbage's letter as a separate pamphlet. The first of the great Quetelet-organized statistical congresses republished it in 1853, as did the Smithsonian Institution in 1856. Joseph Henry, in his secretarial report to the Smithsonian as late as 1873, referred to Babbage's letter as the model for tables of specific gravities, boiling points and melting points.[13] Babbage's odder items were passed by. He remained a symbol of a new way to think about nature and our works: numerically.

Babbage's list is a powerful reminder that the numbering of the world was occurring in every branch of human inquiry, and not merely in population and health statistics. An early paper of T.S. Kuhn's has the rather startling title, 'The Function of Measurement in Modern Physical Science'.[14] Is not measurement so integral to physical science that one can hardly ask what its function is ? Kuhn thinks not, but here I am concerned not with his argument but with an observation that is central to the paper. He begins with Kelvin's dictum that you know precious little about something if you cannot measure it.[15] That was commonplace at the end of the nineteenth century, but it became so, in general, and for all fields, only in that span of a hundred years. And it was as much a dogma for Francis Galton the biometrician as for Kelvin, the physicist.[16]

Kuhn's interest is in what he calls the Baconian sciences, what we now think of particularly as physics and chemistry, as opposed both to the life

abandon their daughters at city orphanages. Babbage added differential infanticide. During his stay in Berlin Babbage met with Hoffmann, the professor-director of the Prussian statistical bureau. He obtained the results of the Prussian census of 1828 and the ratios of male and female births for the preceding decade, cross-classified as illegitimate and legitimate. Among the legitimate, males exceed females by 10.6 births to 10, as opposed to less than 10.3 to 10 for the illegitimate. He may have had some eugenical thoughts, for he recalled a paper from the 1823 Paris Academy of Sciences, claiming that the sex ratio of ovine births can be immensely influenced by selection and diet of the parents. He also noted that in Prussia the Jewish birth rate exceeds the Christian one (5.35 live births per Jewish couple, as opposed to 4.78 for Christians). Moreover the disproportion of male over female births is substantially greater for Jewish families than for Christian ones (11.2 to 10 as opposed to 10.6 to 10). We shall return to the Prussian concern for Jewish numbers in chapter 22.

sciences and to the traditional mathematical sciences (e.g. astronomy, mechanics, geometrical optics, music). He puts the matter strongly: 'Sometime between 1800 and 1850 there was an important change in the character of research in many of the physical sciences, particularly in the cluster of research fields known as physics. That change is what makes me call the mathematization of Baconian physical science one facet of a second scientific revolution.'[17]

This revolution is thought of as second to the first, the scientific revolution of the seventeenth century. Kuhn is here speaking of a global event running across a large number of disciplines, at least those comprehended under physics, and including thermodynamics, electricity, magnetism, radiant heat and physical optics. He is not using the term 'scientific revolution' in the way he does in his famous book, *The Structure of Scientific Revolutions* (published a year after his paper on measurement). In that book a revolution occurs in a limited arena, a disciplinary matrix whose researchers might number fewer than 100. I have elsewhere stated some general characteristics of 'big' revolutions (such as the supposed second scientific revolution) as opposed to the little ones of Kuhn's *Structure*.*[18] Social and institutional determinants of such big revolutions are not hard to list, but more important is what Herbert Butterfield called the new feel that the ordinary person, living in those times, acquires for the world.[19] The first half of the nineteenth century generated a world becoming numerical and measured in every corner of its being. In our own 'information age' quirky Charles Babbage has become posthumously famous for elaborating the general principles of the digital computer. Instead I single him out as the self-conscious spokesman for what was happening in his times.

I described fundamental constants in terms of their role as fixing parameters in basic laws of nature. That is a conception more recent than Babbage. His constants were used in stating many a 'law'. He meant by law only a rule, a regularity, a uniformity, as when he wrote, for example, 'if the income of the voters follow a similar law [...]'.[20] Call him Baconian,

* New institutions are characteristic of 'big' revolutions. Just as in England the Royal Society and the scientific revolution went hand in hand, so in Britain the British Association and the supposed second scientific revolution were closely connected. I remarked above that Babbage played a great part in founding the British Association. The establishment often scoffed at it, with *The Times* thundering on about the 'British Ass', but it was a haven for the new generation of industrial technocrats and experimental scientists. Dickens's malicious accounts of it are fun: see his *Reports* of the meetings of the *Mudfog Association for the Advancement of Everything* in *Sketches by Boz*, complete with a section on 'Umbugology and Ditchwateristics', corresponding to the British Association's Section F, for statistics, founded in 1833 by Babbage, Quetelet and others. Babbage also was also a chief founder of the London Statistical Society in 1834.

positivist, in his conception of law. His was an attitude shared with the vast majority of French and English writers whom I shall mention. We have it in caricature with Quetelet's study of the law of blooming of lilacs in the springtime of Brussels. He discovered that Belgian lilacs burst into bloom when the sum of the squares of the mean daily temperature since the last frost adds up to $(4264°C)^2$.[21] That number is one which Babbage might cheerfully have included among his constants of nature and art. The number 4264 and the 'law' in which it occurs are about as nonfundamental as any that could be imagined but that did not diminish their interest for astronomer Quetelet.

Near the end of his essay on measurement, Kuhn emphasizes his 'paper's most persistent thesis: '*The road from scientific law to scientific measurement can rarely be traveled in the reverse direction.* To discover quantitative regularity one must normally know what regularity one is seeking and one's instruments must be designed accordingly.'[22] That applies excellently to many of the great triumphs of nineteenth-century physics: say Joule's determination of that new constant of nature, the mechanical equivalent of heat. But it quite misses the vast enthusiasm for measurement for its own sake that so marks Kuhn's period, 1800–50. Kuhn is a profound admirer of theory and has little use for positivists. But it was they, I propose, who made that second scientific revolution. In so saying, I in no way diminish the magnificent architecture erected at the same time by theoreticians. Nor need we pause to debate the point here. In the human and social arena, and more generally in the whole domain of the nascent concept of statistical law, it was the Baconian generalizers who did the work. They were ready and willing to produce 'laws' when they had no more theoretical understanding than Quetelet had of Belgian lilacs. Moreover they saw their task, in accumulating numerical data, in terms that conform to the most simple-minded and demeaning of readings of the original (and subtle) Francis Bacon. The more numbers that we have, the more inductions we shall be able to make. Babbage notes that not only is his list of nineteen categories incomplete, but also that

> Whoever should undertake the first work of this kind [viz. 'A Collection of Numbers, the Constants of Nature and of Art'] would necessarily produce it imperfect . . . partly from the many facts, which, although measured by number, have not yet been counted.
>
> But this very deficiency furnishes an important argument in favour of this attempt. It would be desirable to insert the heads of many columns, although not a single number could be placed within them – for they would thus point out many an unreaped field within our reach, which requires but the arm of the labourer to gather its produce into the granary of science.[23]

What then are laws? Any equations with some constant numbers in them. They are positivist regularities, the intended harvest of science. Collect more numbers, and more regularities will appear. Now it is time to see how the empty silos of human behaviour began to overflow with laws of human nature.

7 The granary of science

1 Charles Babbage, 'On the advantage of a Collection of Numbers, to be entitled the Constants of Nature and of Art [. . .] in a letter to Dr. Brewster,' *The Edinburgh Journal of Science*, new series **6** (1832): 334.

2 For a careful study, see H.J.M. Bos, 'Introduction', in *Christiaan Huygens' The Pendulum Clock or Geometrical Demonstrations Concerning the Motion of Pendula as Applied to Clocks*, ed. R.J. Blackwell (Ames, Iowa, 1986): xxi-xxv.

3 William Turnbull, *A Treatise on the Strength, Flexure, and Stiffness of Cast Iron Beams and Columns, shewing their fitness to resist Transverse Strains, Torsion, Compression, Tension, and Impulsion; with Tables of Constants* [etc.] (London, 1831). The *OED* cites the much enlarged 2nd edn of 1832.

4 *The Mathematical and Scientific Library of the Late Charles Babbage*, a catalogue compiled by R.T. (London, 1872).

5 *Annalen der Physik und Chimie* **21** (1824): 609.

6 Babbage's attack on the Royal Society is *Reflections on the Decline of Science in England and Reflection on Some of its Causes* (London, 1830). His German trip was reported in *Edinburgh Journal of Science* 10 (1829): 225–34.

7 *On the Economy of Machinery and Manufactures* (London, 1832).

8 'Sur l'emploi plus ou moins fréquent des mêmes lettres dans les différentes langues', *Correspondance mathématique et physique* 7 (1831): 135–7. Extracts from Quetelet's *éloge* in the *Annuaire de l'Observatoire Royal de Bruxelles* of 1873 are translated with a comment by Joseph Henry in *Annual Report of the Board of Regents of the Smithsonian Institution* (Washington D.C., 1873): 183–7.

9 Ole Immanuel Franksen, *Mr. Babbage's Secret: The Tale of a Cypher – APL* (n.p., n.d; IBM, Strandberg, Denmark, 1984?).

10 'A Letter to the Right. Hon. T.P. Courtenay, on the Proportionate Number of Births of the two Sexes under Different Circumstances', *Edinburgh Journal of Science*, new series **1** (1829): 85–104.

11 Babbage became a witness to the Select Committee on the strength of his study, *A Comparative View of the Various Institutions for the Assurance of Lives* (London, 1826).

12 Babbage, 'On Tables of the Constants of Nature and Art', *Annual Report of the Board of Regents of the Smithsonian Institution*, (Washington, D.C., 1856): 294. His 1826 proposal was summarized in *Edinburgh Journal of Science*, new series **1** (1829): 187.

13 See *Compte Rendu des Travaux du Congrès Général de Statistique* (Brussels, 1853); for Henry, see the Smithsonian *Annual Report* for 1873, p. 25.

14 T.S. Kuhn,'The Function of Measurement in Modern Physical Science', *Isis* **52** (1961): 161–90; references are to the reprint in T.S. Kuhn, *The Essential Tension* (Chicago, 1977): 178–224.

15 Statements, origins and formulations of Kelvin's end-of-the-nineteenth-century saying are given in R.K. Merton *et al.*, 'The Kelvin Dictum and Social Science: an Excursion into the History of an Idea', *Journal of the History of the Behavioral Sciences* **20** (1984): 319–31.

16 See. K. Pearson, *The Life, Letters and Labours of Francis Galton* (4 vols., Cambridge, 1914–30): **2**, 347f.

17 Kuhn, *Essential Tension*, 220.

18 On institutions and 'big' revolutions, see Ian Hacking, 'Was There a Probabilistic Revolution 1800–1930?', in *The Probabilistic Revolution* 1, 45–58. For an account of the English statistical societies and their networks, see Michael Cullen, *The Statistical Movement in Early Victorian Britain: The Foundations of Empirical Social Research* (London, 1975).

19 Herbert Butterfield, *The Origins of Modern Science* (Cambridge, 1957): 1.

20 *Thoughts on the Principles of Taxation*, (London, 1848): 21.

21 This was part of a large investigation for studying diurnal and seasonal rhythms in plants and animals. A. Quetelet, *Bulletins de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles* 9 (1842): 65–95.

22 Kuhn, *Essential Tension*, 219.

23 Babbage, 'Constants', 340.

8 Suicide is a kind of madness

1 George M. Burrows, 'Observations on the Comparative Mortality of Paris and London in the Year 1813', *The London Medical Repository* 4 (1814): 457.

2 Laurent Haeberli, 'Le Suicide à Genève au XVIIIe siècle' in *Pour une histoire qualitative: études offertes à Sven Stelling-Michaud* (Geneva, 1975): 115–29.

3 For a full study, see Jan Goldstein, *Console and Classify: The French Psychiatric Profession in the Nineteenth Century* (Cambridge, 1987).

4 J.-E.-D. Esquirol, 'Suicide', *Dictionnaire des sciences médicales* **53** (1821): 213. There are references to Burrows on p. 276.

5 Agatopisto Cromaziono, *Storia critica filosofica del suicidio ragionato* (Lucca, 1759).

6 In Esquirol's dictionary article, and in the summing up of his life work, *Des maladies mentales, considérées sous les rapports médical, hygiénique et médico-légal* (Paris, 1838).

7 G.M. Burrows, *An Inquiry into Certain Errors Relative to Insanity and their Consequences, Physical, Moral and Civil* (London, 1820): 87.

8 By George Cheyne (London, 1732). The work is largely a reply to those who queried diet as a cure for madness; for the diet itself, see p. 163 of the 2nd edn (London, 1734).

9 Anne-Charles Lorry, *De melancolia et morbis melancolicis* (Paris, 1765).

10 J.-P. Falret, *De l'hypochondrie et du suicide. Considérations sur les causes, sur le siège et le traitement de ces maladies, sur les moyens d'en arrêter le progrès et d'en prévenir le développement* (Paris, 1822). Falret eulogized Esquirol: *Discours sur la tombe de M. Esquirol le 14 décembre 1840* (Paris, 1841).

11 G.M. Burrows (unsigned), *The London Medical Repository* 18 (1822): 438–46.

12 G.M. Burrows, 'A Reply to Messieurs Esquirol's and Falret's Objections to Dr. Burrows' Comparative Proportions of Suicides in Paris and London', *ibid.*, 460–4.

13 It was widely understood that pellagra had suicide as one of its consequences. Burrows, in his *Inquiry*, said that 'intellectual derangement, with a propensity to suicide, is also consequent on the endemics [e.g.] the pellagra of Lombardy . . .' (p. 84). Pellagra was horrible and mysterious, a seasonal and regional disease of degeneration, known to be endemic in the maize-eating localities of Italy. It was apparently a disease of recent origin. As late as 1910 it was thought

CONTEXT

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THE TAMING OF CHANCE

IAN HACKING
Institute for the History and Philosophy of Science and Technology, University of Toronto

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