



Maintaining national ascendancy

Although this is an epoch of eclectically ramified international groupings and treaties [such as the Association of Southeast Asian Nations (ASEAN), the European Union (EU) and the North American Free Trade Association (NAFTA)], which differ from their predecessors in earlier epochs by being generally focused on economic, rather than military, aspects, it appears to us that the concept of national sovereignty—which, as Kemal Atatürk has remarked, is not given but must be taken—still has meaning. These economic groupings may well be more influentially binding than the military ones; and whereas loss of sovereignty by outright conquest seems to be a diminishing phenomenon—the last significant example perhaps being the conquest of Tibet by China in 1959—economic means seem to be just as, if not more effective in exerting control over a territory. Indeed, to continue with the example of Tibet, faced with the continuing antipathy of the Tibetans towards their conquerors, the Chinese government has embarked on a massive programme of economic infiltration, including the construction of railways, hitherto unknown in that country, and the encouragement of large-scale immigration, despite the rigours of the Tibetan climate.

At least military action is associated with the deeply rooted human notion of fair play, however unequal the two sides in some battles. Sport, at least amateur sport, would not be the enjoyable activity it is without that notion, and sport can be thought of as military play. Even in the darkest hour of conquest some dignity has usually been preserved (and if the conqueror did not allow the conquered that privilege, it boded ill for the future). On the other hand, there is something shameful about the economic mismanagement that leads to loss of sovereignty. The most prominent example remains the bankruptcy (in all but name) of Egypt around 1876, which led to the country being *de facto* taken over by England and France. A contemporary example, very familiar to Europeans, is that of Greece. In all such cases, it appears that the mismanagement was at a high level, in some cases due to the actions of a small number of individuals, out of control of the great majority of honest and industrious citizens, who were all the more bemused, indignant and ashamed by the loss of sovereignty.

This somewhat lengthy preamble is merely intended to support the idea that the concept of national sovereignty—the ability of a nation to manage its own affairs without external interference—still has some meaning. And once one accepts the validity of sovereignty, one immediately comes to the concept of ascendancy. Indeed, one can hardly have one without the other: unless a nation excels in at least one sphere, how can it truly exercise sovereignty?

In the past, geography played a primordial role. The actual situation with respect to land and water determined ease or difficulty of communications. Valuable minerals are not distributed homogeneously; and both geology and climate determine the possibilities for agriculture. Thus we have the example of Portugal, whose position at the south-western margin of Europe enabled it to play a pioneering role in the exploration of other continents and build up a vast overseas empire as well as monopolize trade in a range of highly desirable commodities. Although over the course of centuries the trade monopolies were whittled away by European

rivals, it was the rather abrupt loss of nearly all the overseas territories in the 1970s that forced the country to reassess its position. The option of creating a commonwealth of Portuguese-speaking interests (along the lines of the (British) Commonwealth) does not seem to have presented itself, and in 1986 the country joined the European Economic Community (EEC, now the EU). Its fate in this alliance is, inevitably, rather dismal, like that of other small countries on the periphery of the continent. Especially for those in the currency union, geography now works to their disadvantage. Far from the “centre of gravity” of Europe, which is somewhere around the Ruhr valley in Germany, their commerce can never be competitive with those of countries at or near the centre, simply because of the very long lines of communication. These marginal countries are thus placed in a position of perpetual economic tutelage to the central ones, which, although they have to pay subsidies to the marginal regions, greatly profit through their commercial advantages.¹

Such considerations do not, however, apply to the large countries of Europe, which continue to be able to maintain a certain independence and for whom “maintaining national ascendancy” still makes some sense, even though it seems to be in opposition to their supranational treaty obligations: For example, applicants for research grants from the UK Engineering and Physical Sciences Research Council (EPSRC) are required to demonstrate how their proposal will contribute to “the economic competitiveness of the *United Kingdom*”, and are expected to “work in partnership with the Research Councils *for the benefit of the UK*”.²

In our present era, human factors seem to be of primordial importance. In the past, and contrary to Tolstoy’s view of history, certain key individuals—one thinks of Frederick the Great of Prussia—seem to have played a determining role, but nowadays it is rather the integral of the entire population that is important. The first parameter to consider is sheer size—the population of a nation, defined as an ensemble of people moving with a more-or-less common purpose.³ The larger a nation, the more likely it is that a particular talent or skill will be found. Nevertheless, this is by no means a determining factor, otherwise the order of ascendancy depending on human achievement would be strictly that of population, which it is clearly not.

Human factors, even population—as Mao Tse Tung found in China—can be much more readily controlled than geography. What, then, must a government do to promote ascendancy? Few governments appear to be willing to leave matters to the judgement of their citizens. Indeed, in most of the so-called representative democracies, the representatives, having been elected, feel they have a duty to be active. Accordingly citizens are taxed and the resulting revenue is used for education and defence, as well as “social security”—pensions for the retired and benefits for the indigent. Although politics is, alas, all too often dominated by venality and dreams of personal enrichment, one hopes that at least some members of a government long to

¹ In contrast to the *sauve qui peut* philosophy of the EU, at least within its erstwhile eastern European rival, the Council for Mutual Economic Assistance (Comecon), each country had its assigned task (e.g., Latvia made railway locomotives and large family cars in the style of the Renault “Scenic”; Bulgaria made hard drives for computers), albeit that the assignment often seemed arbitrary; and even the participation of far-flung members like Vietnam was not disadvantaged through geography.

² *Funding Guide*. Swindon: EPSRC (2013).

³ Language, wielding as it does considerable influence over mentality, plays a key role in maintaining such a purpose and it is no surprise that nearly all the nations of Europe have insisted on keeping their “national” languages, despite the immense burden this imposes on the administration of the EU; they are taught homogeneously throughout the territory enclosed by the state boundary, upon crossing which there is usually an abrupt change, at least officially.

find the “magic” formula that will enable their country to pull ahead of its rivals. What level of taxation is appropriate? Once the amplitude of available funds is fixed, what should have priority? Health? Infrastructure? The system is truly complex since nearly every factor influences nearly every other one. A healthy population will be able to work harder and feel less burdened by taxes; an educated population will know how to stay healthy; and so forth.⁴

The grand challenges facing humanity

It is not our present purpose to attempt to find a new solution to this old problem. Rather, we shall focus on a particular aspect: Our present era is marked by “grand challenges” facing humanity, concerning which there is a remarkable consensus.⁵ The three top themes appear to be health, education and environmental sustainability (including tackling fresh water shortage, climate change and pollution)—in order of descending importance, for ignorant people cannot tackle climate change, and it is hard to educate ill people. Given the very severe strain that these challenges are imposing on the world, how are the different nations placed to tackle them?

Our first task is to look at the data. We have selected ten of the largest and most important nations, taking due regard of history, and about a dozen primary parameters. To avoid making a tabulated presentation too unwieldy, we have split it into Table 1 (geophysical parameters) and Table 2 (factors rather depending on human endeavour).

Table 1. Physical attributes of selected countries.

Country	Land area /Mkm ²	Water /km ³ year ⁻¹	Geological resources (% GDP)	Forest and woodland area /Mkm ²	Arable crop land /Mkm ²	Insolation /kWh m ⁻² day ⁻¹
Brazil	8.5	8239	6.1	4.8	0.73	5.04
China	9.3	2830	4.5	2.0	1.06	3.92
Egypt	1.0	58.3	10.9	0.0	0.03	5.68
France	0.55	204	0.1	0.16	0.18	3.34
Germany	0.35	154	0.2	0.11	0.12	2.98 (Munich)
India	3.0	1897	4.9	0.68	1.56	5.10
Japan	0.37	430	0.0	0.25	0.04	4.00
Russia	17	4507	18.2	8.1	1.20	2.52
UK	0.24	147	1.0	0.03	0.06	2.61
USA	9.2	2071	1.2	3.0	1.55	3.58 (Detroit)
Notes	a	b	c	a, d, e	a, f	g

a From Wolfram Alpha. b “Total resources, actual” from the *Review of World Water Resources by Country* (Water Reports 23). Rome: FAO (2003). c “Total natural resources rents” equal to the sum of rents from oil, natural gas, coal, minerals and forest. Data from the World Bank based on the years 2010–4. d For 2005. e Egypt has just 670 km² of forest. f Data from 2002, 2005 & 2012. g These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center Surface meteorological and Solar Energy (SSE) web portal supported by the NASA LaRC POWER Project (year averages from the NASA Surface Meteorology and Solar Energy Data Set). Location is the capital city of the country, except where otherwise stated. No data for Russia is available, hence the figure for Hamburg, which has a similar latitude, has been taken.

⁴ A compounding difficulty is that outcomes are not necessarily proportional to spending.
⁵ Thus, we have the United Nations Millennium Development Goals, the US National Academy of Engineering Grand Challenges, the 8 Grand Challenges—all concerning high-technology—promulgated by T. Frey at World_Future 2011, those found on Internet fora such as Quora, and many others.

Table 2. Human attributes of selected countries.

Country	Popula- tion /10 ⁶	Mean life expectancy /year	Adult literacy (%)	No of books published /10 ³	No of patents	Energy consump- tion /J year ⁻¹	Military expendi- ture /G\$	Nominal GDP /T\$
Brazil	202	73.9	91.3	21.7 (18.7) ¹⁰	810 (680)	1.3×10 ¹⁹	27.8 (1.2)	2.35
China	1360	75.3	95.1	– M(189.3) ¹⁰ H(14.6) ⁰⁵ T(43.3) ¹⁰	18,040 (26,472)	1.1×10 ²⁰	115 (1.1)	10.4
Egypt	87	71.2	73.9	1.4 (9.0) ⁰⁰	79 (51)	3.7×10 ¹⁸	3.45 (1.2)	0.287
France	64	81.8	99	39.1 (63.7) ¹⁰	11,947 (12,873)	1.1×10 ¹⁹	55.3 (2.0)	2.83
Germany	82	80.7	99	78.0 (93.1) ⁰⁹	30,193 (31,647)	1.4×10 ¹⁹	41.8 (1.1)	3.85
India	1290	66.4	62.8	14.1 (82.5) ⁰⁴	7127 (1535)	2.5×10 ¹⁹	22.6 (1.0)	2.07
Japan	126	83.6	99	56.2 (78.6) ⁰⁹	86,691 (48,657)	2.1×10 ¹⁹	35.5 (0.8)	4.60
Russia	142	68	99.7	36.2 (123.3) ⁰⁸	1007 (967)	3.3×10 ¹⁹	29.8 (1.6)	1.86
UK	64	80.5	99	110.0 (206.0) ⁰⁵	13,157 (6823)	9.1×10 ¹⁸	53.4 (1.8)	2.94
USA	322	78.9	99	68.2 (328.3) ¹⁰	285,096 (71,745)	1.0×10 ²⁰	503 (2.9)	17.4
Notes	a,b	a	a,c	a,d	e	a,f	a,g	a

a From Wolfram Alpha. b For 2010–4. c For adults aged 15 to 65. d Data from a is the average from 1995–9. In parentheses, from <http://www.worldometers.info/>, with the year indicated by the super-scripted number (00 signifies 2000, 04 signifies 2004 etc.). For China, no data is available from a, and from worldometers.info it is divided into M, mainland China; H, Hong Kong and T, Taiwan. e Number of utility patent applications to the US patent office in 2014 (from the US Patent and Trademark Office, Patent Technology Monitoring Team, PTMT) and, in parentheses, to the European patent office (from the 2014 Annual Report). f “Total primary energy” (estimates from 2010–2). “Primary energy” is defined in a paper by S. Øvergaard (Statistics Norway; Oslo, 2008): it is extracted or captured directly from natural resources. g In parentheses, as a percentage of GDP.

The examination of various products and quotients of these numbers is left, by and large, for the reader to undertake. Given the very large number of possible combinations, the best approach is likely to be using the data to test hypotheses that may come to mind, such as “GDP is correlated with ingenuity as measured by the number of patent applications”.⁶ Based on the premiss that the challenges transcend national boundaries, one proposed solution is to solve them by setting up a plethora of international committees and commissions.⁷ This cannot, however, be considered to be realistic. The problems involved in setting up such organizations and getting them to work effectively seem greater than the problems they are designed to solve.

⁶ Since the data expressed as a percentage of GDP are, essentially, reduced to a per capita measure, consideration should be given to which other parameters should be reduced to this form.

⁷ P.R. Ehrlich and A.H. Ehrlich, Can a collapse of global civilization be avoided? *Proc. R. Soc. B* **280** (2013) 20122845.

Furthermore, in the shape of the United Nations and its various agencies, since 1945 we already have such supranational committees and commissions, but their work has, on the whole, been limited to documenting degradation rather than proposing, let alone implementing, concrete measures to tackle it. In fact, the premiss that the challenges are all supranational is incorrect. The boundaries of many countries are roughly based on natural watersheds, hence water is under their control; as is education, forest area, energy consumption and health. When one looks at the main health problems of our time—obesity, allergies, mental health problems such as autism, diabetes and dementia—one feels that they are surely national, rather than international problems.

Justification for the choice of parameters in Tables 1 and 2

Land area is obviously basic, as are natural resources (minerals, including fossil fuels), insolation, water and cropland. There is, nevertheless, some possibility of substitution between these parameters. Provided energy is available, fresh water may be supplied from the sea by desalination, crops can be grown in multistorey greenhouses,⁸ solar energy converters may be used to make up for a deficiency in fossil fuel, and so forth. Parameters from Table 2 may be particularly revealing regarding the innate ability of the people of different countries. Buckle was perhaps the first to introduce the idea that geography plays the primordial role, both in quickening potential activity and in dampening it⁹ but, 150 years later, this view no longer seems tenable because of the overwhelming importance, and ease, of knowledge exchange. If, then, not nowadays geography, what else might play role? History?—a strong cultural tradition of excellence tends to beget its continuation. Genetics?—probably much too complex to permit any conclusions and, besides, there has been a lively exchange, especially of the most inventive minds, between countries during the past several hundred years.

Regarding education, there is intentionally no column giving expenditure on it, because it is well known that education spending is poorly correlated with results. Hence, only a results-focused parameter is given, the adult literacy rate.

Some of the parameters are probably unsatisfactory portmanteaux. Mean life expectancy gives no information about the quality of life. The bare number of books published says nothing about their quality and ability to elevate society. The number of patent applications might not well represent inventive activity—some of the most creative inventors hold, for cogent reasons, that the patent system actually dampens innovation (I.K. Brunel was a notable exponent of this viewpoint).

Of considerable ambiguity is the figure for military expenditure. In earlier epochs, when military conquest was the most obvious way to establish ascendancy, this would doubtless have been important. But during the last 150 years or so, territorial conquests were increasingly often removed from the conqueror by subsequent treaty negotiations, hence a strong army came to serve other purposes, such as national prestige, a way to impose a certain discipline on the nation's youth, and as part of an armaments industry which, for some countries, is a major source of revenue through export.

⁸ See *Technologist* No 5 (July 2015) pp. 36–37 for an up-to-date survey of the current status.

⁹ H.T. Buckle, *History of Civilization in England*. London: Longmans, Green and Co. (1869).

International and national grand challenges

To recapitulate, the challenges can be grouped under the rubrics of health, education and environmental sustainability. Health challenges include:

- The rise of microbial resistance to antibiotics—international, because nowadays resistant microbes can very easily spread around the world) enabling infectious diseases to spread.
- Obesity: although there are some indications that it may be infectious (a consequence of the spread of certain viruses),¹⁰ which would make it potentially international, most public health agencies believe that it is due to lack of exercise and overeating, which is clearly a national problem.
- Allergies¹¹ are rising fast throughout the world, but this appears to be a parallel development; it is hard to conceive an international dimension to the phenomenon.
- Autism and other mental diseases. A possible international component is given by the global electronic dissemination of most cultural media nowadays; if the content of such media has a negative effect on the mind,¹² the extraordinary rise of such diseases finds a ready explanation. This phenomenon seems to be partly international and partly national. Nowadays it is fairly difficult to restrict access to global media, and the chances of reaching international consensus on a matter that is, for some exporting countries, highly profitable, seems fairly remote. Perhaps only through education could a desire for more wholesome mental fare be inculcated.
- Diabetes, especially type 2 (insulin resistance). Similarly to obesity, there is some evidence for the involvement of certain gut microbes.¹³ Provisionally national rather than international.
- Dementia. Sometimes seen as an inevitable result of longer life expectancy, there seems to be no strong empirical evidence for that view. Excessive exposure to aluminium might be a contributing factor, coupled with the disappearance of natural scavengers from our diet. If allowed to progress unchecked, it would become an intolerable emotional and healthcare burden on most countries. Clearly national, and the recent statement of the UK Prime Minister, David Cameron, affirming Britain's desire to become the leading centre of progress on the issue,¹⁴ at least demonstrates that its importance is recognized by politicians.

Thus, the major health problems are national rather than international in scope, and one indeed wonders why we have a World Health Organization (WHO), an agency of the United Nations Organization (UNO).

Education challenges are rather subtle. The market is, remarkably enough, solving some of its problems through private initiative, especially the rise of “one dollar a day” private schools. These have the potential to make a high impact on countries with low literacy and numeracy

¹⁰ N.V. Dhurandhar, P.R. Kulkarni, S.M. Ajinkya, A.A. Sherikar and R.L. Atkinson, Association of adenovirus infection with human obesity. *Obesity Res.* **5** (1997) 464–469.

¹¹ A.W. Frankland, 100 years of immunotherapy. *J. Biol. Phys. Chem.* **13** (2013) 53–60.

¹² J.J. Ramsden, Computational aspects of consciousness. *Psyche: Problems, Perspectives* **1** (2001) 93–100.

¹³ E.g., J. Qin et al., A metagenome-wide association study of gut microbiota in type 2 diabetes. *Nature* **490** (2012) 55–60; J. Sun et al., Pancreatic β -cells limit autoimmune diabetes via an immunoregulatory antimicrobial peptide expressed under the influence of the gut microbiota. *Immunity* **43** (2015) 304–317.

¹⁴ Speech on 26 March 2012. Presumably a successful solution could be exported from one country to another.

rates. For most developed countries, matters are more firmly in the hands of the state but beyond maintaining the excellence of a small number of élite institutions—in which the role of the state is noninterference¹⁵—there seems to be little clear understanding of how to improve the general standard of education, raising it to a level appropriate for the 21st century.

Environmental challenges are dominated by climate change. Whether the cause of global warming is anthropogenic activity or not—there is no real consensus on the matter¹⁶—it is certainly a global phenomenon, and tackling it is meaningless without the agreement of all major nations to forge a common policy. Trying to negotiate such a policy must be one of the most difficult and frustrating activities known to man. As things stand at present, among the major trading blocs only the European Union has remained firmly wedded to the idea of limiting carbon emissions, regardless of the burden imposed on the economies of individual member states, among certain of which there is growing dissent from the policy.

But the *consequences* of global warming are more local than might be generally imagined. Of course, large-scale melting of the Arctic and Antarctic ice sheets would provoke a significant general rise in sea level and, without measures to combat it, the inundation of many major coastal cities, including much of London, Shanghai and Tokyo. Nevertheless, there are certainly *local* measures that could be taken against such a consequence, ranging from the erection of huge sea walls to the abandonment of the most low-lying parts of the cities.

Most of the other consequences would be local. Even the warming is not universal, some regions of the globe currently suffering cooling.¹⁷ In order to tackle such local changes, little more than some adjustment of land use may be necessary. Given the impracticability of negotiating an adequately effective global limitation of carbon emissions, it would be wise to devote finite national resources to accommodating the local consequences of global warming.

All of the other aspects of the environmental challenges appear to be local—and, accordingly, can be solved by local action.¹⁸ Essentially they are concerned with limiting pollution. It is trite to say that pollution is caused by man, whose population has grown so much that his global impact on the planet now perhaps even exceeds that of major volcanic eruptions. It is surprising, in discussions of the challenges, how little attention is paid to population. One encounters glib statements like “we must soon feed 10 billion people” and it is gaily mentioned that “there are 1 billion motor-cars on the planet”. Most people cannot really conceive the magnitude of such very large numbers. One piece of evidence for this is the very ambiguity in the word “billion”, originally meaning 10^{12} but in the USA a meaning of 10^9 has become established, leaving the original meaning to persist in European languages; in the USA many people prefer simply to say “zillion”, a very large number whose precise magnitude is undefined, and it is probably more honest to say simply that there are the zillions of people and motor-cars and chickens on the planet rather than clothe the statement with a precise number

¹⁵ Almost by definition, alumni of these institutions are well represented among national government members, which may create a certain buffer against adverse change.

¹⁶ S. Galam, Global warming: a social phenomenon. In: *Complexity and Security* (eds J.J. Ramsden and P.J. Kervalishvili), pp. 237–245. Amsterdam: IOS Press (2008).

¹⁷ G.C. Holt and J.J. Ramsden, Introduction to global warming. In: *Complexity and Security* (eds J.J. Ramsden and P.J. Kervalishvili), pp. 147–184. Amsterdam: IOS Press (2008).

¹⁸ A few problems, such as acid rain, are transnational, but they have been solved by bilateral action and it was not necessary to create something like a World Pollution Organization as an agency of the UN.

that implies one has it within one's grasp or power. All environmental problems are correlated with population, at least when measured globally, and therefore it seems obvious that reducing the Earth's population is the first priority. This is not a problem requiring international committees and commissions; some countries have, indeed, been very successful in reducing birth rate and their native populations are diminishing. This diminution is, however, in many cases being vitiated by large-scale immigration. Governments actually welcome immigration, because for them the insuperable short-term problem posed by population decline is the bankruptcy of the exchequer due to ever-increasing social security payments (old age pensions),¹⁹ a problem already exacerbated by increasing life expectancy. Immigrants are young and virile and it is supposed that they will work hard to provide pensions for the ageing native population. This is overall surely an administrative problem and it is disappointing that no major government seems to have the creativity and ability to solve the problem. This brings us to the next section.

Refining human factors

An aspect inadequately captured by Table 2 is the potential of a nation's people to solve challenges by observation, contriving and understanding. As has been well summarized by Polanyi,²⁰ these abilities correspond to the natural sciences, technology and mathematics. While a nation's ability to contrive may be adequately represented by the number of patent applications, we need to expand our data and have chosen the number of papers published in science and in mathematics. They are given in Table 3. We have also expanded information on healthcare, giving data on the most prevalent illnesses (obesity and diabetes) and on expenditure.

As an illustration of the complexity of the issues, we have looked at the association between healthcare expenditure (as a percentage of GDP) and the prevalence of obesity. Apart from two outliers (Egypt and Japan) there is a fairly clear positive association, one possible interpretation of which is that healthcare spending actually promotes obesity. Given that the causes of this illness are still obscure—candidates include overeating generally, eating poor quality food, infection of the gastrointestinal tract, and inadequate exercise—it would, of course, be premature to jump to conclusions, but these kinds of association must make governments despair of formulating an effective policy. Very likely obesity could be eliminated with no healthcare expenditure at all. It could be argued that the data rather reflects the high healthcare costs of people already suffering from obesity. What, anyway, is the role of government in the matter? Whatever the precise cause it would appear that obesity is above all a matter of personal lifestyle choice and state healthcare systems should surely focus on accidents and occupational diseases, the occurrence of which, despite efforts to minimize them, is really inevitable in a complex, highly technological society.

One further comment on Table 3—although the per capita production of scientific and mathematical papers is rather low in some of the countries, this is not necessarily a weakness

¹⁹ They are already the largest category of government expenditure. For example, in the UK the percentages in 2014 were: pensions 19, healthcare 18, welfare 15, education 12, interest 7, defence 6, miscellaneous smaller categories 23. Total expenditure was about $£735 \times 10^9$.

²⁰ M. Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy*. Chicago: University Press (1958).

Table 3. Other human factors.

Country	Number of citable documents (all sciences) /1000	Number of citable documents (mathematics) /1000	Health expenditure (% GDP) and trend	Obesity (%)	Diabètes (%)	GDP per capita /\$	Prison population (%)	Births to teenage mothers
Brazil	56	3.1	9.7↑	14.7	8.7	11,634	0.0219	67
China	439	34	5.6↑	4.1	9.3	7647	0.017	7
Egypt	13	0.77	5.1↑	32	15.4	3299	0.0070	52
France	96	9.6	11.7↑	16.9	7.2	44,219	0.0056	9
Germany	137	11	11.3→	23.6	11.5	46,951	0.0074	7
India	106	6.3	4.0→	2.1	8.6	1605	0.0032	26
Japan	107	6.3	10.3→	3.6	7.6	36,508	0.0065	4
Russia	49	5.3	6.5↓	16.0	6.2	13,099	0.0613	24
UK	141	8.9	9.1↓	24.9	5.4	45,938	0.0106	15
USA	495	29	17.1↓	34.6	11.4	54,037	0.0762	24
Notes	a	a	b	c	d	e	f	g

a Source: SCImago (2014). b Source: World Bank (2013). c Average for men and women. Source: <http://www.worldobesity.org/>. d Source: International Diabetes Federation. e From Tables 1 and 2. f From S. Harrendorf, M. Heiskanen and S. Malby (eds), *International Statistics on Crime and Justice*. Helsinki: European Institute for Crime Prevention and Control (2010). Note that the data within this report is not always consistent and that some data is missing without comment. The figure for China is from the Institute of Criminal Policy Research, Birkbeck College, University of London. g Number of births per 1000 women ages 15–19. Source: World Bank.

since discoveries can be rapidly spread. The vital thing is to maintain at least a core of excellence in these matters. This is nevertheless doubtless easier if there is a high level of scientific and mathematical education throughout the country, ensuring that exceptional talent can be found even when it emerges in relatively remote rural areas. mathematic

Individual approaches

Given international impotence, or irrelevance, vis-à-vis the grand challenges, and the hitherto feeble national responses, is there perhaps a growing place for *individual* action? The rise of the Internet has reversed millennia of steadily increasing state influence.²¹ How can the individual play a role? Firstly, as a source of ideas. Good ideas, and the people producing them, are typically rare. One recalls Bragg's estimate of one good physicist (capable of independent thought with a flair for his subject) bred per year per million inhabitants.²² Tolstoy's view of history as the integral of the mass may be basically correct, but it is a weighted integral. No nation can afford to overlook talent, which may arise anywhere in society. The history of education, which is about finding and nurturing talent, seems to have been dominated by individuals.²³ Some of their initiatives were

²¹ With the possible exception of some of the empires of antiquity (e.g., Egypt), in which state power appears to have been very strong.

²² L. Bragg, Physicists after the war. *Nature* (Lond.) **150** (1942) 75–80.

²³ For an excellent account of this history in England, see W.H.G. Armytage, *400 Years of English Education*. Cambridge: University Press (1964).

adopted by the state, but usually by those individuals managing to obtain influential posts in the relevant ministry or agency.

Secondly, by reducing personal consumption. As with the problem of pensions discussed above, governments are faced with the dilemma that the “health” of the economy on which their revenues depend demands strong business activity. This is, ultimately, dominated by consumer spending, which is therefore generally encouraged, although it is inimical to countering many of the environmental challenges. The socialist economies of the USSR and eastern Europe up to 1991 provided an alternative model of economic organization and it is ironical, given their rapid conversion to the “western” system, that some of the measures now being proposed for the sake of environmental conservation resemble things that were normal within that alternative model. It may be that the answer to the dilemma is to promote the consumption of far smaller quantities of consumables of much greater quality. Business thereby retains its turnover and the environment benefits too. This new, third,²⁴ way forward may be greatly assisted by the advanced technologies with which this journal is concerned.²⁵

Thirdly, by being well-informed. When we first introduced the “grand challenges”, we put health ahead of education, but that presupposed the State taking care of the former. It is, however, possible for the individual to do a great deal for his or her health—provided he or she is sufficiently well educated (the foundation for which is literacy) to be able to make use of the plethora of available information.

An educational divide

The increasingly widespread abrogation of the duties—which are, primarily, to serve the public interest—assigned to various official agencies and authorities places a new onus on the importance of good literacy skills, for the general public can no longer rely on the previously valid assumption that what is offered for sale is officially authorized and, therefore, safe, but must now make its own assessments. In principle there is no difficulty in accessing the basic information needed for doing so. This information is no longer confined to university libraries and the like, accessible only to members, but is available on the Internet. The new problem is that there is too much information available and that the ratio of “chaff” to “wheat” is rather high. Typically, a proper discrimination can only be made by the kind of person who would anyway have had access to the specialist libraries under the old system.

But, unless this problem can be solved, we shall see a growing divide in society between a relatively uneducated “mob” and a relatively small “élite”. Kant’s definition of “enlightenment”²⁶ presupposes a certain sophistication in literacy. It is not clear exactly where the adult literacy rates given in Table 2 come from. They are probably what national governments have declared to be the outcomes of some standardized test applied to elementary school leavers. It is very unlikely that this level of ability is sufficient to enable a proper appraisal of the evidence for and against a certain measure concerned with health, for example. In order to prevent complacency among governments, imagining that there is no problem with literacy, a more advanced test should

²⁴ The first being the presently prevailing system and the second the socialist system.

²⁵ R.A. Freitas, Jr, Economic impact of the personal nanofactory. *Nanotechnol. Perceptions* 2 (2006) 111–126.

²⁶ I. Kant, Beantwortung der Frage: Was ist Aufklärung? *Berlinische Monatsschrift* 4 (1784) 481–494.

be inaugurated that specifically tests the ability to understand reasonably sophisticated texts and to perceive fallacies in the argumentation, such as inconsistencies and unqualified assertions.

Some of the most important work ostensibly carried out by official regulatory agencies is to determine the safety of consumer products, of which food and drink are the most widely consumed. It has been shown that the work of the European Food Safety Authority (EFSA) is almost wholly unreliable due to the conflicting interests of its staff²⁷ and, therefore, it is essential for the consumer to undertake his or her own appraisal. By definition, the “mob” is unable to do so and, hence, becomes condemned to eating food of dubious quality with short-, medium- and long-term consequences for health.

The State

What, anyway, is the State? According to Stein,²⁸ its purpose is to reconcile a *Gemeinschaft* (community) of equal individuals with a *Gesellschaft* (society or company) of unequal individuals; to guarantee social stability at the same time as individual freedom. This purpose could presumably be achieved with quite minimal means; the growth of the state is perhaps merely a manifestation of Parkinson’s law, although in the early days of many administrative departments, peopled by well-intentioned and enthusiastic officials, they must naturally have sought ways to do more, and do their job better, in the best spirit of human endeavour.

Nowadays, evidently the whole matter has got completely out of hand and the mass of machinery used to reconcile *Gemeinschaft* with *Gesellschaft* seems to far exceed the mass of what it reconciles.

At a time when governments (e.g., in the United Kingdom) are forced to significantly reduce expenditure, for they simply cannot afford to continue at the levels prevailing until recently, the machinery appears to be the last thing to be cut. Indeed, it appears to be felt that it is needed in order to oversee the reduction in expenditure. One of the great merits of the work of Stein is that he seeks to base public administration on a fundamental concept of the State. A return to fundamentals would appear to be very necessary in order to end up with an improved system of public administration at the same time as much reduced public expenditure. Once one has a clear conception of the purpose and functions of the State, one can then determine what are the minimum practical matters which it should be concerned.

Clearly the State is closely linked with civilization; and yet civilization is ultimately rooted in our individual values. Schweitzer clearly saw²⁹ that unless we can get these values in some way “right”, civilization has little future. Education without the cultivation of values is largely meaningless.

Civilization

The Ehrlichs cast their paper⁷ on the grand challenges in terms of a collapse of civilization, echoing the thoughts of Lovelock,³⁰ who recommended *inter alia* the preparation of

²⁷ C. Robinson, N. Holland, D. Leloup and H. Muilerman, Conflicts of interest at the European Food Safety Authority erode public confidence. *J. Epidemiol. Community Health* 67 (2013) 717–720.

²⁸ L. Stein, *Handbuch der Verwaltungslehre*, pp. 4–7. Stuttgart: J.G. Cotta (1870).

²⁹ A. Schweitzer, *Civilization and Ethics*. London: Adam & Charles Black (1946).

³⁰ J. Lovelock, *The Revenge of Gaia. Why the Earth Is Fighting Back—and How We Can Still Save Humanity*. London: Allen Lane (2006).

indestructible records of our scientific and technological knowledge to facilitate reconstruction after a general collapse. We could, indeed, cast the problem of meeting the grand challenges in terms of the resilience of civilization. This begs the question, what are the markers of civilization? For some, it is merely prosperity (for which GDP per capita would be the marker); for others it is the quality of our creative output (for which the number of scientific and mathematical papers, and the number of books, at least gives an indication of *quantity*); for yet others it is something as elusive as happiness (for which we forbear to give a marker). The reality is, doubtless, some combination of these and probably other factors. At any rate, a certain level of prosperity is needed in order to be able to afford some of the huge infrastructural investment (such as sea walls) that may be needed to combat some of the consequences of global warming, but equally the technical competence to design the infrastructure must be available. Prosperity can actually be inimical to creative achievement; there might be a temptation to spend one's days in indolent gluttony rather than mathematical study, and indeed a plot of the prevalence of obesity vs GDP per capita (which has been inserted into Table 3 to facilitate the comparison) shows a good association, with Egypt and Japan again as outliers. At the same time the number of mathematical papers per capita (data from Tables 2 and 3) is also well associated with GDP per capita, this time with a cluster of three outliers, namely France, Germany and Great Britain. The preeminence of these three countries is presumably related to many centuries of past achievement, suggesting that a snapshot of the kind offered by Tables 1, 2 and 3 can only offer a very superficial indication of resilience.

The development of mathematical ability is also presumably related to education but it may well be that the first three years of a child's life, during which no formal education is given, are of crucial importance (and not only for mathematics), and this period can only be influenced very indirectly by official policy.

Before concluding, there is one final aspect of civilization that must be examined, namely what might be called sociability. It is particularly difficult to find an appropriate parameter with which sociability can be measured, but we have chosen the size of the prison population as its inverse (Table 3). A further possibly relevant parameter is the number of births to teenage mothers. Both are, of course, fraught with difficulties; people are incarcerated for a variety of reasons, including political ones. Regardless of the reason, however, it is pertinent to recall Kropotkin's dictum: "prisons are universities of crime";³¹ this is one establishment of higher education that the State would do well to do without.

Conclusions

Our starting point was the "grand challenges" facing humanity. We found that the only practical way to tackle most of them is at a local (at most national) level; hence we looked at the natural givens of representative nations and at a snapshot of their human achievements in an attempt to extract some guide to national policy.

This paper is above all an invitation to look at the data and attempt to reach one's own conclusions, fully in the spirit of enlightenment.²⁶ Regarding most of the areas touched by the

³¹ P. Kropotkin, *In Russian and French Prisons*. London: Ward and Downey (1887); P. Kropotkin, *Prisons: universities of crime* (paper read before the British Medical Association) (October 1913).

challenges, the onus is very much on the individual to make appropriate choices regarding lifestyle; the State can at best play a coordinating role, and self-coordination requires only the maintenance of a very basic national framework.

Ensuring a high level of literacy is extremely important. The need for such relative sophistication in language ability has become glaringly apparent with the abrogation of the responsibility of official agencies to undertake proper appraisals for the safety and benefit of the general public. A well documented recent example of such abrogation is the case of the European Food Safety Authority (EFSA).²⁷ It is clear that no reliance can be placed on the output of this EU agency and, given the extremely feeble and slow attempts at reform, this will not change in the foreseeable future, if ever. Therefore, in the important and wide-ranging area of food for human consumption, Europe's citizens cannot assume that what is sold is safe; they are compelled to make their own assessment, and this may apply to many other agencies and authorities.

In the past, it was generally clear enough what advanced civilization and what did not; now that the human presence on Earth has reached the point of significantly influencing its vitality we also need to ask what promotes our survival and what is inimical to it. This opens up a new dimension for the space of our existence.

Given the very wide uncertainty regarding what is appropriate in order to promote survival, for each nation to maintain its independence in seeking viable solutions to that problem while still advancing civilization has the great advantage of allowing diversity to flourish; in contrast, a single, globally coordinated solution (were that ever achievable) would run the great danger of resulting in extinction were it to be wrong.

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