Science & Politics –

a century after Bagehot

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SCIENCE AND POLITICS

A CENTURY AFTER BAGEHOT

In 1872 Walter Bagehot's Physics and Politics was published. In it he pointed out that new inventions, particularly the railway and the telegraph, together with the rapid acquisition of physical knowledge, were leading to, as he put it, "a new world of ideas"; and he set out to show how "the new ideas are modifying two old sciences - politics and political economy"[1]. A century later, this is still an appropriate theme for a talk by a man of science addressing a political conference; but I am broadening it from Physics and Politics to Science and Politics, despite Rutherford's famous gibe that "all science is either physics or stamp collecting", because the whole spectrum of the natural sciences is affecting the world in which politicians have to work.

For a long time this fact was ignored by politicians, and even by many writers of political history, despite the efforts of men of science to awaken them. Of these, an outstanding example was Francis Bacon who in 1605 addressed his Advancement of Learning to the King and Parliament, stressing the benefits to society, both material and intellectual, which should arise from the pursuit of Science. A skilled political operator, he timed the publication of his book to coincide with the opening of Parliament, so that it could arouse the maximum political discussion; unhappily he had his thunder literally stolen because the attention of Parliament was distracted that very day by Guy Fawkes[2].

The successes of natural philosophy in the seventeenth century, above all by Newton and his contemporaries in the early Royal Society, led Adam Smith to believe that there should be some basic principles underlying the practice of political economy, which would therefore benefit if these principles could be elucidated as clearly as Newton's Laws of Motion in Mechanics. This is what he set out to do in The Wealth of Nations: and for a practical example of how developments in science and technology could react on civilized society, there is none better than the invention of the condensing steam engine by James Watt in the 1760's. For it was this more than anything else which led to Britain recovering from the disastrous war

of American Independence to become the workshop of the world, with all that this meant for our national prosperity - and its consequent problems of an industrialised society. As H A L Fisher put it, "A small handful of remarkable Scots and Englishmen, fewer than would be required for a football match, succeeded by their ingenuity in transforming the economic life of the country".

In this talk, though, I do not wish to labour history too much, even though it has been said with some justice that history is philosophy teaching through examples. In the main, I propose to discuss two topics: the first of these, rather following Adam Smith, will deal with some principles which I have encountered in science which are of analogic interest to politics, while the second will ponder how scientists and politicians may best interact, having regard to the differences in their aims and backgrounds.

As for discoveries in sciences which have their analogies in politics, let me start light-heartedly by recalling that Lord Cherwell once told me of a biologist who trained a worm to find its way unerringly through a maze to some food at its centre. Being an experimenter and wishing to discover which part of the worm contained its memory, he then cut off its head. To his surprise the worm could still find its way through the maze - until it grew a new head, when it became completely lost, and had to learn all over again. "And that", observed Lord Cherwell, "is exactly like a Government Department!"

One of the first facts that we all learned in physics and chemistry is that there are some basic quantities such as energy which are conserved, and that you cannot get more out of a closed system than what is already there, unless you yourself are prepared to put something more into it. If you do try to take more out of it, sooner or later you will run the system down and you will find out the hard way that perpetual motion is impossible. As befits its name, members of the Conservative Party do have a sense of these fundamental conservation laws: but I fear that some members of the opposition appear to think that the welfare state can be run on the political equivalent of perpetual motion; and this is as forlorn a hope in the political world as it is in the mechanical.

Another lesson from science, and this is rather humiliating, is that even when you think you know all the relevant facts, the result can sometimes be the opposite of what you predict. For example, would you expect a smooth ball or a rough ball to have the smaller air resistance, and hence go further when you drive it with a golf club? Most of us would say that of course the smooth ball will have the lower resistance. And indeed the early golf balls, like the old gutty, were in fact smooth; but then someone found that old golf balls could be driven further than new ones. The reason turned out to be that old balls had their surfaces nicked through having been repeatedly struck. Wind tunnel experiments showed that the nicks set up tiny eddies in the air flowing round the ball, and these eddies served as it were as ball bearings to ease the flow of the bulk of air round the ball, so that it did not break away into the larger and energy-consuming eddies behind the ball as quickly as it did with the smooth ball. It is as though allowing a little turbulence early in life is a safeguard against catastrophic turbulence later. So golf balls have long been made with a dimpled surface. And an extension of the theory incidentally will explain why a new cricket ball can be swung much more easily than an old one.

I could give you many other examples where things in science turn out differently from what we expected - and if this can happen in such a seemingly cut-and-dried field of experience as science, how much more likely is it to happen in everyday life? The railways in Lapland, for example, were plagued with reindeer straying on to the lines. Someone had the bright idea of mounting public address systems on the trains and playing records of wolf calls to scare the reindeer. The idea worked well enough - in fact too well; the reindeer were scared off, but the lines were then infested with wolves. This ironic outcome of plans can occur in many fields, and in security particularly. When, for example, you visit a government establishment, it is a help to have a pass. Each establishment has its own pass, easily recognizable by its guards on the gate. If you are at a high level, you may well have to have several such passes, one for each establishment you have to visit. And if you are at the highest level you might need so many passes that the security authorities try to ease your problem by giving you a single pass that will admit you to any government establishment. Naturally such a pass must be well looked after, and even its appearance must be kept a secret, and it will be issued to only a few people. And it then turns out to be almost useless, because most guards at government establishments will refuse to accept it because

they have never seen its like before. Burns was indeed right when he observed that "the best laid schemes of mice and men gang aft agley".

Some political measures have been similarly futile. The well-meant anti-profiteering legislation of World War II was an example. So that wicked manufacturers should not make the huge profits of World War I, the government would allow them only a fixed percentage of seven and a half on their costs. Apart from the fact that this figure was unrealistically low, and so civil servants administering the contracts had to come to unofficial agreements with manufacturers to accept large contingency allowances, the fact that a manufacturer's profit depended directly on his costs gave him the incentive to inflate these costs by all means in his power. The more he paid for his material and his labour, the more his profit; and so costs soared. I believe that this was a factor that set us on our downhill road of inflation after the war - and I am reminded of what Dean Inge said about the Gadarene swine - "No doubt they thought the going was good for the first half of the way". So the lesson for us all, politicians and scientists alike, is to think things out as deeply as possible in advance, because although it may be impossible to foresee all the factors, there is sometimes an element of self-frustration patently built into our original schemes.

One of the greatest influences of science on political and other fields of thought is the use of numbers. Its successes in physics led Lord Kelvin in the 1880's to say: "When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind"[4]. The influence of that philosophy has been profound. Almost everyone tries to put his arguments into numbers whether he be scientist, psychologist, sociologist or politician, thinking that he is thereby being scientific. And once you have a number you can play with it. But how can you express such matters as morale in bare numbers? And it is salutary to record that Kelvin lost a celebrated argument with T H Huxley about the age of the Earth because Kelvin relied on numbers alone, and Huxley rejected them because he felt that there must be a vital factor missing:

> "Mathematics may be compared to a mill of exquisite workmanship, which grinds you stuff of any degree of fineness; but, nevertheless, what you get out depends on what you put in; and as the grandest mill in the world will not extract wheat flour from peascods, so pages of formulas will not get a definite result out of loose data"[5].

Huxley proved right: there was a missing factor from Kelvin's calculations - it was radioactivity, whose discovery lay thirty years in the future. So if a great physicist could be led astray in physics by undue reliance on numbers, is it surprising that politicians, too, can be led astray by the use of numbers to measure social problems when the basic factors are not well enough understood to provide a sound basis of measurement? Numbers should not, of course, be rejected utterly, but they should always be used with George Canning's caution: "nothing is so fallacious as facts except figures"[6]. And what Kelvin should more advisedly have said was that only when you are sure that you know, not merely something, but a very great deal, about what you are observing, should you try to put it into numbers.

And if anyone wants an example of how misleading figures can be, he need only look at what was hailed at the time - 1963 - as a triumph of statistics, the Robbins Report on Higher Education. Both figures and mathematics were called upon by Lord Robbins to support the proposal for expansion. "Now I think it can be shown", he said in the House of Lords, "and can be done mathematically, that once an expansion of this kind is well under way, it will feed itself"[7]. Well, in the twenty years since, we have seen how the expansion fed itself - so disastrously in fact that much of the Robbins edifice has had to be painfully dismantled. And the so-called Robbins Principle by which so much store is rightly set, was formulated not in 1963 by the Robbins Committee, but in 1943 by Winston Churchill, who in a speech looking forward to the post-war period, stated[8] very clearly, "no-one who can take advantage of higher education should be denied this chance. You cannot conduct a modern community except with an adequate supply of persons upon whose education whether humane, technical, or scientific, much time and money have been spent". To which he added, "The future of the world is to the highly educated races who alone can handle the scientific apparatus necessary for pre-eminence in peace or survival in war".

As with so many of his statements, that world broadcast, which Churchill addressed informally to listeners "around your firesides tonight", is eminently worth reading again today. In the light of current controversy it is interesting to recall his intention "we must establish on broad and solid foundations a National Health Service": and he made another call relevant to our problems of today: "After school-time ends, we must not throw our youth uncared-for and unsupervised on to the labour market, with its "blind alley" occupations which start so fair and often end so foul. We must make plans for part-time release from industry so that our young people may have the chance to carry on their general education, and also to obtain a specialised education which will fit them better for their work." And in the same broadcast he specifically named the United Nations and the Council of Europe as institutions that should be set up after the war.

Reverting to T H Huxley, I would also recall his Romanes Lecture of 1893 at Oxford on 'Evolution and Ethics, where he pondered the contradiction which he had observed as a result of Darwin's survival of the fittest:

> "The practice of that which is ethically best - what we call goodness or virtue - involves a course of conduct which, in all respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect, but shall help his fellows - its influence is directed, not so much to the survival of the fittest, as to the fitting of as many as possible to survive. It repudiates the gladiatorial theory of existence . . . "

Has anyone since ever summarized better the differences between the extremes of "Dries" and "Wets"? And Huxley also saw that the welfare state imposed obligations on those whom it benefited:

> "It demands that each man who enters into the enjoyment of the advantages of a policy shall be mindful of his debt to those who have laboriously constructed it - and shall take heed that no act of his weakens the fabric in which he has been permitted to live".

So politicians have to bear in mind the principles both of evolution and of welfare, and to work out the best compromise in a particular set of circumstances. Even in physics we have something rather similar: we find that we need to combine the seemingly contradictory concepts of waves and particles if we are to understand the properties of elementary matter and of light. This we know as the Principle of Complementarity, where conflicting but complementary views of nature have to be reconciled. And one Nobel prizewinner, Max Born, followed Halifax, the Great Trimmer, who stated[9] that the object of our laws was to keep the balance "between the excess of unbounded power and the extravagance of liberty not enough restrained", Max Born's formulation[10] being that there must exist a balance between the latitude of regulation and the latitude of freedom in a well-run state analagous to the balance of complementarity that the physicist has to find. He concluded, "The world which is so ready to learn the means of mass destruction from physics would do better to accept the message of reconciliation contained in the philosophy of complementarity".

But no scientist would suppose that this reconciliation is easy, because even when the main factors are known, the balance between them changes with scale. Whether, for example, a combustible material will smoulder or explode depends on the ratio of its mass, and hence its heat capacity, to its surface area which will enable the oxygen in the air to react with it. Now the relation between these two factors depends on physical size. A lump of coal or wood will burn slowly, and indeed may be difficult to ignite. But if we chop the wood into thin sticks they burn easily because we have increased the surface area that is exposed without changing the total mass. And if we further break the wood or coal into small particles, making a dust, this can burn so rapidly that a coal dust explosion, so feared in mines, can result. And thus we learn that applying the same principles on one scale can produce a very different result if they are applied on another scale; risks that may safely be taken at one scale can be fatal at another. A dramatic example was pointed by Napoleon. In conflicts between his cavalry and the horsemen of Asia Minor, the

Mamelukes, the latter were so skilful that two Mamelukes would beat three French cavalrymen: but, Napoleon said, a thousand French cavalry would defeat fifteen hundred Mamelukes. Small scale encounters were decided by individual horsemanship, large scale by the disciplined and directed application of force. Both factors were involved at both scales, but their relative importance changed with scale. And we all know how differently men can behave as individuals and in a crowd.

I could continue on the theme of the food for political thought to be found in science, but I must divert to the relations between politicians and scientists. And I do not want you to feel that I take the patronizing view that scientists should run the world. As well as recognizing the force of Sir John Hackett's comment (or should it be Bernard Shaw's?) that if all the professors in the United Kingdom were laid end to end they would never reach a conclusion, I have seen enough both of government and of universities to applaud Edmund Burke's observation:[11]

> "A statesman differs from a professor in a university; the former, the statesman, has a number of circumstances to combine with these general ideas, and to take into his consideration. Circumstances are infinite; are variable and transient; he who does not take them into consideration is not erroneous but stark mad. The statesman, never losing sight of principles, is to be guided by circumstances; and judging contrary to the exigencies of the moment he may ruin his country for ever".

And despite his warmth towards science, Winston Churchill would never have allowed the government of the country or of the world to be handed over to scientists. A movement in this direction which had been prompted by the increased effect of science on world and national affairs as shown by the atomic bomb was deplored by him in a Parliamentary speech of November 1945:

> "There have been theocratic governments, military governments and aristocratic governments. It is now suggested that we should have scientistic - not scientific - governments. It is the duty of scientists, like all other people, to serve the State and not to rule it because they are scientists. If they want to rule the State they must

> get elected to Parliament or win distinction in the Upper House and so gain accss to some of the various administrations which are formed from time to time."

The question then arises of how politicians can draw on the advice and talents of scientists when these wish not to rule, but to serve the State in the best way they can. Churchill had, of course, his own method, through his friendship with Professor F A Lindermann, later Lord Cherwell. But before I speak of that relationship, let me look at its very few precedents.

Almost the only one which comes readily to mind is that of Lyon Playfair, who was born in 1818. By 1842 he was such an outstanding chemist that he was prevailed upon by Robert Peel to stay in England rather than take up a chair in Toronto, and Peel quickly came to depend on him for scientific advice, as did also Prince Albert: and the characteristic of that advice was its honesty. When Peel sent him to Ireland to investigate the potato famine, Playfair reported that the prospect for Ireland was starvation unless the Corn Laws were repealed. Peel replied, "I am indeed sorry that you are compelled to make so unfavourable report, but the knowledge of the whole truth is one element of security"[12]: and he proceeded to repeal the Corn Laws.

After much work with Prince Albert, particularly over the Great Exhibition of 1851 and its aftermath, in which both the Prince and Playfair did their utmost to awake the nation to the importance of science to its future, Playfair became Professor of Chemistry at Edinburgh and in 1868 entered Parliament as a university member. He spoke particularly on matters of science, engineering and education, with such sparkling observations as, "You must not judge of other Universities by Oxford and Cambridge, for they are exceptional. The old English universities have not the same function as the Scotch and Irish Universities. The former teach men how to spend a thousand a year, while the latter aim at showing men how to make a thousand a year"[13].

Although Playfair became Chairman and Deputy Speaker of the House of Commons, and Vice-President of the Council in Gladstone's Government of 1886, no other man of science followed his example for many years. In fact, when in 1916 the results of the British failure to apply science to warfare became apparent in the face of German developments of

Zeppelins, U-boats and poison gas, a meeting under Lord Rayleigh's chairmanship deplored the absence of scientific experience among our legislators and Government officials, stating that, "In the whole history of British Governments there has only been one Cabinet Minister who was a trained professional man of science - the late Lord Playfair"[14]. It would be diverting to speculate on the reasons why such examples are so rare, but I would suggest that they are not simply that a scientist is temperamentally unsuited to government because he is a scientist, even though I largely agree with Burke and Sir John Hackett. One factor, I would submit, is that the quality of statesmanship is a rare one, and so is great ability in science. To find these two rare qualities embodied in one individual, like Lyon Playfair or Benjamin Franklin, is thereforeexceedingly rare. Happily we ourselves can now point to an outstanding example in our present Prime Minister.

During World War II Churchill solved for himself the problem of bringing science into his personal outlook, and was quite conscious of the way he did so. From World War I he had observed that, "The temptation to tell a chief in a great position the things he most likes to hear is the commonest explanation of mistaken policy. Thus the outlook of the leader on whose decisions fateful events depend is usually far more sanguine than the brutal facts admit". Whenever possible, therefore, Churchill preferred to see the situation in the front line for himself. When he could not do this, for example on the front line of science, his solution was to forge the shortest possible link with that front line. Afterwards he explained[16],

> "A wit wrote ten years ago: "The leaders of thought have reached the horizons of human reason, but all the wires are down, and they can only communicate with us by unintelligible signals". Yet upon the discerning of these signals, and upon the taking of right and timely action on the impressions received, depended our national fate and much else. I knew nothing about science, but I knew something of scientists, and had had much practice as a Minister in handling things I did not understand . . . . .
> There were no doubt greater scientists than Frederick Lindemann, though his credentials and genius command respect. But he had two qualifications of vital consequence to me. First, as these pages have shown, he was

> my trusted friend and confidant of twenty years. Together we had watched the advance and onset of world disaster. Together we have done our best to sound the alarm. And now we were in it, and I had the power to guide and arm our effort. How could I have the knowledge?
>
> "Here came the second of his qualities. Lindemann could decipher the signals from the experts on the far horizons and explain to me in lucid, homely terms what the issues were . . . What I had to grasp were the practical results, and just as Lindemann gave me his view for all it was worth in this field, so I made sure by turning on my power-relay that some at least of these terrible and incomprehensible truths emerged in executive decisions."

Churchill's dependence on Lindemann has been criticized, and certainly not without reason. But it is doubtful whether he could have made any arrangement that would have worked better: the main danger it involved was that Lindemann's advice would be coloured by personal prejudice or by insufficient acquaintance with the particular branch of science that was the subject of his advice. Neither of these dangers was merely hypothetical, but I must also mention that on one vital occasion when Lindemann was going to advise in one sense, he also told Churchill that he ought also to listen to my opinion even though he knew that I was going to advise in the opposite sense. What was essential to the relationship, and all great leaders have found this, was that the adviser should not "bend" his advice to make it acceptable. The admonition of King James I/VI to his son in 1599 still sounds the keynote: choose counsellors who are "speciallie free of that filthy vice of flattery, the pest of all Princes"[17].

As for what has happened in relations between scientists and politicians since the days of Churchill and Cherwell, many arrangements have been tried. They have been described by Dr Philip Gummett in Scientists in Whitehall[18], published in 1980, and more recently by the reports of the House of Lords Select Committee on Science and Technology. Reviewing these in Minerva, Lord Ashby[19] has commented, "There is no lack of capacity for giving scientific advice. What is lacking is initiative in asking for advice and a capacity for receiving and using it".
Despite every arrangement that has been tried, the position was, if

anything, worse in 1981 than it was in 1971, according to the Royal Society, and the general criticism has been that scientists have not been brought in sufficiently intimately by ministers before political decisions are formulated. There have of course been exceptions, among them Mr Julian Amery, who brought in his external scientific advisers, of whom I was one when he was Minister of Aviation, in a uniquely informal and effective way. Lord Ashby concludes his review by saying, "The Whitehall village has many virtues and charms: high integrity among the inhabitants; a tradition of civility and a record of loyalty and responsibility unmatched elsewhere in the world. But it has not yet learnt how to make the best use of the nation's wealth and talent in science and technology". There is no easy solution, as the many attempts of the last forty years have shown. If we are to continue to pursue our uneasy compromise between the more dirigiste methods of the French and Japanese, and the broader freedom of industry fostered in America and Germany, it is essential that scientists and politicians should appreciate one another's problems - just as our success in the Battle of Britain depended on the intimate understanding between serving officers and scientists which was only brought about by the direness of our situation.

Ultimately, when Churchill became Prime Minister that situation brought not only scientists and serving officers together, but it brought them jointly to the Cabinet Table with the responsible ministers whenever Churchill thought the situation required it, as with the Blitz, the U-boat war, the Bomber offensive and the V-weapons campaign. Perhaps the same kind of thing happens today, but the House of Lords Report suggests not: I can only say that in war it worked well; and while different arrangements may be better suited to today's problems, they would almost certainly benefit from the closeness and informality of contact between politicians and scientists that was forced upon us by the problems of war. The initiative would best come spontaneously from both sides.

Only after I had chosen the title for this talk did I realise that it was the same as that of the book which Lord Hailsham published in 1963, and to which I would refer you for much wisdom. For my own parting thought, I would recall the age-old question of whether science is a force for good or ill in its impact on humanity, and here I would return to Francis Bacon who gave an ageless answer[20] at the beginning of the scientific revolution:

> "Lastly, let none be alarmed at the objection of the Arts and Sciences becoming depraved to malevolent or luxurious purpose and the like, for the same can be said of every worldly Good: Talent, Courage, Strength, Beauty, Riches, Light itself, and the rest. Only let mankind regain their rights over Nature assigned to them by the gift of God, and obtain that power whose exercise will be governed by right Reason and true Religion."

And that still sets the aim for us all.

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