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THE STABILITY OF BELIEFS [1]

by

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1. THERE are two ways of holding beliefs. Some are held by the explicit profession of certain articles of faith, as the Apostles' Creed when recited in the words of the Book of Common Prayer. The other form of belief is held implicitly by reliance on a particular conceptual framework by which all experience is interpreted.

The process of philosophic and scientific enlightenment has shaken the stability of beliefs held explicitly as articles of faith. To assert any belief uncritically has come to be regarded as an offence against reason. We feel in it the danger of obscurantism and the menace of an arbitrary restriction of free thought. Against these evils of dogmatism we protect ourselves by upholding the principle of doubt which rejects any open affirmation of faith. For the past three centuries the principle of doubt has been continuously at work on the elimination of all uncritical affirmations of faith.

Unfortunately, the protracted application of this cure has had results rather similar to those experienced recently in the therapeutic use of penicillin. The first dramatic successes could not be repeated in subsequent cases, for the diseases to which penicillin was applied have shown a tendency to transform themselves into forms that are resistant to the drug. Indeed, the net results of a continued process of anti-biotic and chemical therapy may be merely to breed out a new race of germs completely resistant to all drugs known to man. Similarly, the continued application of doubt seems to have converted all forms of faith into implicit beliefs, ensconced in our conceptual framework, where they elude the edge of our scepticism.

2. Examples of these modern highly doubt-proof beliefs are Marxism and the Freudian doctrine, both of which are especially protected against doubt by the fact that they themselves claim to be embodiments of scepticism. I shall quote two passages to illustrate the adhesive power of these modern interpretative frameworks by which they retain the allegiance of their followers.

> My party education had equipped my mind with such elaborate shock-absorbing buffers and elastic defences that everything seen and heard became automatically transformed to fit a preconceived pattern.[2]

> The system of theories which Freud has gradually developed is so consistent that when one is once entrenched in them it is difficult to make observations unbiased by his way of thinking.[3]

The first of these statements is by a former Marxian, the second by a former Freudian writer. At the time when they still accepted as valid the conceptual framework of Marx or of Freud - as the case may be - these writers would have regarded the interpretative powers of this framework as evidence of its truth; only when losing faith in it did they feel that its powers were excessive and specious. We shall see the same difference reappear in our appraisals of the interpretative power of different conceptual systems, as part of our acceptance or rejection of these systems.

3. In this paper I shall try to illustrate the elementary principles by which a conceptual framework retains its hold on the mind of a person believing in it. I shall mention magical beliefs and Soviet doctrines, both of which I reject, and align them with scientific beliefs which I accept. I thus examine the same or similar mental operations in the one case from the outside critically, and in the other from the inside, uncritically.

This is a conscious affront on my part to the critical tradition of modern thought and is bound to shock some readers. It may be proper therefore to define briefly the general grounds on which I stand and mention previous writings in which they are explained.

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1 Paper read to the Philosophy of Science Group on 6 March 1952.

2 A. Koestler, The God that Failed, London, 1950, p.68

3 Karin Horney, New Ways in Psychoanalysis, London, 1939, p.7

I hold that the propositions embodied in natural science are not derived by any definite rule from the data of experience, and that they can neither be verified nor falsified by experience according to any definite rule. Discovery, verification and falsification proceed according to certain maxims which cannot be precisely formulated and still less proved or disproved, and the application of which relies in every case on a personal judgment exercised (or accredited) by ourselves. These maxims and the art of interpreting them may be said to constitute the premises of science, but I prefer to call them our scientific beliefs. These premises or beliefs are embodied in a tradition, the tradition of science. The continued existence of science is an expression of the fact that there exists a group of people (customarily described as scientists) who are agreed in accepting one tradition, and that they trust each other to be informed by this tradition. But for the continued coherence of scientific opinion which governs scientific life, the meaning of such terms as a 'scientific statement' or 'a scientist' would lose most of their present connotations and find their meaning reduced to little or nothing. The whole idiom of science in which its interpretative framework is expressed would lose its character of a living and authoritative language. [1]

Holding, as I do, this conception of science and accepting science as true, I must call science a belief which I share. This accreditive expression can be expanded indefinitely by giving my reasons for believing in science and elaborating the nature of this belief; but it can never be exhaustively justified by statements of fact.

I must pass over the epistomological problems which arise at this point, by merely mentioning that, contrary to the traditional usage, I propose to introduce the word 'belief' in place of the word 'knowledge', with the intention of keeping always open in our minds a broad and patent access to the personal origins of our convictions. By this conceptual reform I hope eventually to eliminate the difficulties inherent in the various theories of truth, whether they rest on correspondence, coherence or utility. I trust this general statement of my position may induce readers to bear with this discourse a little longer, as I proceed with it now.

4. The several ways in which different people comprehend the world are reflected in the variety of languages in which they express themselves. Of course language manifests a belief only if we use its words with the implied acceptance of their appositeness. People who do not believe in oracles, witchcraft or magic may yet speak of oracles, witchcraft and magic, but they mean so-called oracles, witchcraft and magic, putting these words mentally in inverted commas. The use of a language expresses belief in a conceptual framework only if its words are used confidently, without any implied qualifications of unbelief, such as the quotation marks would stand for. The language may then be said to form an idiom of belief.

The fact that primitive people hold distinctive systems of beliefs by practising peculiar modes of interpretation which are inherent in their conceptual framework and are reflected in their language, was first stated with emphasis by Levy-Brühl earlier in this century. The more recent work of Evans-Pritchard on the beliefs of Azande [2] has borne out and has given further precision to this view. The author is struck by the intellectual force shown by the primitive African in upholding his belief against evidence which to the European seems flagrantly to refute them. An instance in point is the Zande belief in the powers of the poison-oracle. The oracle answers questions through the effects on a fowl of a poisonous substance, called benge. The oracle-poison is extracted from a creeper gathered in a traditional manner, which is supposed to become effective only after it has been addressed in the words of an appropriate ritual. Azande - we are told - have no formal and coercive doctrine to enforce belief in witch-doctors and their practice of the poison-oracle, but their belief in these is the more firmly held for being embedded in an idiom which interprets all relevant facts in terms of witchcraft and oracular powers. Of this Evans-Pritchard gives various examples.

Suppose that the oracle in answer to a particular question says 'Yes', and immediately afterwards says 'No' to the same question. In our eyes this would tend to discredit the oracle altogether, but Zande culture provides a number of ready explanations for such self-contradictions. Evans-Pritchard lists no less than eight secondary elaborations of their beliefs by which Azande will account for the oracle's failure. They may assume that the wrong variety of poison had been gathered or a breach of taboo committed, or that the owners of the forest where the poisonous creeper grows had been angered and revenged themselves by spoiling the poison; and so on.

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1 Most of these statements are to be found in my Science, Faith, and Society, 1946. For their elaboration, see Logic of Liberty, 1951 and "Scientific Beliefs", Ethics, 1951.

2 E. E. Evans-Pritchard, Witchcraft, Oracles and Magic among the Azande, Oxford, 1937.

Evans-Pritchard describes further the manner in which Azande resist any suggestion that benge may be a natural poison. He often asked Azande what would happen if they were to administer oracle-poison (benge) to a fowl without delivering an address, or if they were to administer an extra portion of poison to a fowl which has recovered from the usual doses. The Zande - he says - does not know what would happen and is not interested in what would happen; no one has been fool enough to waste good oracle-poison in making such pointless experiments which only a European could imagine. Indeed, were a European to make a test which in his view proved Zande opinion wrong they would stand amazed at the credulity of the European. If the fowl died they would simply say that it was not good benge, the very fact of the fowl dying being proof of this.

This blindness of Azande to the facts which to us seem decisive is sustained by remarkable ingenuity. 'They reason excellently' (says Evans-Pritchard) 'in the idiom of their beliefs, but they cannot reason outside, or against, their beliefs because they have no other idiom in which to express their thoughts.'

5. With this illustration in mind, we may try to analyse more generally the power of language to embody and firmly to uphold a system of not explicitly asserted beliefs. A language may be defined as a collection of recurrent utterances which carry every time the same or a similar meaning. We may estimate that of the 2000 to 3000 English words in common usage today, each occurs on the average a hundred million times in the daily intercourse of people throughout Britain and the United States. In a library of a million volumes using a vocabulary of 30,000 words, the same words will recur on the average more than a million times. A particular vocabulary of nouns, verbs, adverbs and adjectives thus appears to constitute a definite theory of all subjects that can be talked about. It postulates that these subjects are all constituted of comparatively few recurrent features, to which the nouns, verbs, adverbs and adjectives refer. The theory is somewhat similar to that of chemical compounds. Chemistry alleges that millions of different compounds are composed of a small number - less than a hundred - of always identical chemical elements. Since each element has a name and characteristic symbol attached to it, we can write down the composition of any compound in terms of the elements which it contains. This corresponds to writing down a sentence in terms of a certain language.

So long as we use a certain language, all questions that we can ask will have to be formulated in it and will thereby confirm the theory of the universe which is implied in the vocabulary and structure of the language. It follows that we cannot state without self-contradiction within a language any doubt in respect to the theory implied by the language. The only way to dissent from the theory of the universe implied in a language is to abandon some of its vocabulary and to learn to speak a new language instead. This does in fact happen when primitive people who believe in witchcraft, etc., are gradually converted to the European conception of universal causation.

6. The resistance of an idiom of belief against the impact of adverse evidence, which would impel it to modify its conceptual framework in favour of alternative conceptions, may be regarded under three headings, each of which is illustrated by the manner Azande retain their beliefs in the face of situations which in our view should invalidate them. Some analogous cases can be readily adduced also from other systems of beliefs.

The stability of Zande beliefs is due in the first place to the fact that objections to them can be met one by one. This power of a system of implicit beliefs to defeat valid objections one by one is due to the circularity of such systems. By this I mean that the convincing power possessed by the interpretation of any particular new topic in terms of such a conceptual framework is based on past applications of the same framework to a great number of other topics not now under consideration; while if any of these other topics were questioned now, their interpretation in its turn would similarly rely for support on the interpretation of all the others. Evans-Pritchard observes this for Zande beliefs in mystical notions. 'The contradiction between experience and one mystical notion is explained by reference to other mystical notions.'

The circularity of the theory of the universe embodied in any particular language is manifested in an elementary fashion by the existence of a dictionary of the language. If you doubt, for example, that a particular English noun, verb, adjective or adverb has any meaning in English, an English dictionary dispels this doubt by a definition using other nouns, verbs, adjectives and adverbs, the meaninfgulness of which is not doubted for the moment.

So long as each objection is defeated in its turn, its effect is to strengthen the fundamental convictions against which it was raised. 'Let the reader consider (writes Evans-Pritchard) any argument that would utterly demolish all Zande claims for the power of the oracle. If it were translated in Zande modes of thought it would serve to support their entire structure of belief.' Thus the circularity of a conceptual system tends to reinforce itself by every contact with a fresh topic.

7. Circularity operates by divided roles when a number of persons holding the same set of pre-suppositions mutually confirm each other's false interpretation of experience. Take the following story of a South African explorer, L. Magyar, collected by Lévy-Brühl who regards it as typical.[1] Two African natives, S. and K., go to the wood to gather honey. S. found four big trees full of honey, whilst K. could find only one. K. went home bewailing his ill luck, while S. had been so fortunate. Meanwhile S. had returned to the wood to bring away the honey, was attacked by a lion and torn to pieces.

The relatives of the lion's victim at once went to the soothsayer to discover who was responsible for his death. The soothsayer consults the oracle several times and declares that K., jealous of S.'s rich harvest of honey, assumed the form of a lion in order to avenge himself. The accused denied his guilt strenuously and the chieftain ordered the matter to be settled by the ordeal of poison. 'Matters then followed their usual course' - says the explorer's account - 'the ordeal was unfavourable to the accused, he confessed and succumbed to torture. . . . The accusation appears quite natural to the soothsayer who formulates it, the prince who orders the trial by ordeal, the crowd of bystanders and to K. himself who had been transformed into a lion, in fact to everybody except the European who happens to be present.'

It is clear to us that K. had not actually experienced turning into a lion and tearing S. to pieces, and so at first he denied having done so. But he is confronted with an overwhelming case against himself. The interpretative framework which he shares with his accusers does not include the conception of accidental death; if a man is devoured by a lion there must be some effective reason behind it, such as the envy of a rival. This makes him an obvious suspect and when the oracle, which he has always trusted, confirms the suspicion he can no longer resist the evidence of his guilt and he confesses having turned into a lion and having devoured S. This closes the circle of the argument and confirms the magical framework in which it was conducted, and it thus enhances the powers of this framework for assimilating the next case which will come under its purview.

Communists who have experienced the procedure which leads to confessions in Russian sabotage trials have described a similar circularity. A person, who according to Western conceptions is entirely innocent, will confess to acts of sabotage because he shares the fundamental assumption of his accusers that if a boiler explodes, or a train is derailed, somebody has been guilty of sabotage. As in the magical framework, the conception of accidental damage is excluded. The prisoner will usually resist the accusation to start with, but when it is persistently borne in upon him from all sides by the examining magistrate and by the evidence extorted from his former associates, he begins to give way to the convincing power of the case against himself. So he eventually connives in construing against himself any oversight he may have committed - or even any silent discontent he may have harboured - into an act of conspiracy, until he is so covered with guilt in his own eyes that he agrees to atone for it by signing a confession.[2] On the grounds on which he had habitually condemned others he must now condemn himself - and thus close the circle which once more confirms these grounds and makes them stronger than ever for the next occasion.

8. To the stabilising power of circularity we may add secondly the capacity of a well developed interpretative framework to supply secondary elaborations to its beliefs which will cover almost any conceivable eventuality, however embarrassing this may appear at first sight. Scientific theories which possess this self-expanding capacity are sometimes described as epicyclical, in allusion to the epicycles that were used in the Ptolomean and Copernican theory to represent planetary motions in terms of uniform circular motions. All major interpretative frameworks have an epicyclical structure which supplies a reserve of subsidiary explanations for difficult situations. The epicyclical character of Zande beliefs was shown above by the ready availability of eight different subsidiary assumptions for explaining a point-blank self-contradiction in two consecutive answers of an oracle. Again we may find analogies in contemporary affairs. The Polish underground leader Stypulkovsky who published his experiences in

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1 Cf. Lévy-Brühl, The "Soul" of the Primitive, London, 1928, p.44

2 Cf. Weissberg, Conspiracy of Silence, London, 1952, pp. 128, 202, 318, 352

Soviet Russia recalls that of twelve Poles accused together, he alone refused to confess. This contradiction, however, strengthened rather than weakened the Soviet case; for his denial of the charge was taken to confirm the genuineness of the confessions given by the other accused and thus made the evidence against him stronger than it would have been had he also confessed.

9. Thirdly, the stability of Zande beliefs is seen to rest on the fact that any new alternative conception would have to be built up on a series of supporting facts which can only be adduced one by one. A new conception like that of natural causation would require numerous relevant instances for its proper understanding. But these instances cannot accumulate in the minds of people if each of them is disregarded in its turn for lack of the concept which would lend significance to it. The behaviour of Azande whom Evans-Pritchard tried to convince that <u>benge</u> was a natural poison which owed none of its effectiveness to the incantations customarily accompanying its administration, illustrates the kind of contemptuous indifference with which we normally regard things of which we have no conception. 'We feel neither curiosity nor wonder' writes William James, 'concerning things so far beyond us that we have no concepts to refer them to or standards by which to measure them.' The Fuegians in Darwin's voyage, he recalls, wondered at the small boats, but paid no attention to the big ship lying at anchor in front of them.[1] This third defence mechanism of implicit beliefs may be called the principle of **suppressed** nucleation. It is complementary to the principle of circularity. Circularity protects an existing system of beliefs against doubts arising from any adverse piece of evidence, while suppressed nucleation prevents the germination of any alternative concept on the basis of any single new piece of evidence.

10. Circularity, combined with a readily available reserve of epicyclical elaborations and the consequent suppression in the germ of any rival conceptual development, lends a degree of stability to a conceptual framework which we may describe as the measure of its completeness. We may speak of the completeness or comprehensiveness of a language and the system of conceptions reflected by it - as we do in respect to Azande beliefs in witchcraft - without in any way implying approval of the system as a true belief.

11. We do not share the beliefs of Zande in the power of poison-oracles and we reject a great many of their other beliefs, by discarding mystical conceptions and replacing them by a naturalistic explanation. But we may question whether our rejection of Zande superstitions is the outcome of any general principle of doubt. If such a principle exists, it should be possible to detect it in the first place within science which the adherents of the principle of doubt regard as the best example for the operations of this principle.

Every important discovery affects the existing interpretative framework of science in two ways. It strengthens some hitherto accepted scientific beliefs by confirming them, and weakens, modifies or entirely replaces others, by the incorporation of new matter which contradicts or lies outside the scope of hitherto accepted conceptions. Thus science may be said to advance by the <u>assimilation</u> of fresh topics within its existing system and by the <u>adaptation</u> of its existing system to the nature of fresh topics; the first is a conservative act, the second a process of reform. Every scientific discovery is conservative in that it maintains and expands the system of science as a whole, and to this extent confirms the scientific view of the world and strengthens its hold on our minds; but no major discovery can fail also to modify the outlook of science, and some, like those of gravitation or the circulation of the blood, or like those of the genes, quanta, radio-activity, relativity have changed it profoundly.

Might it not be true then to say that the assimilative process merely conserves science, while the true innovations consist in the adaptive process by which the framework of science is reformed? This sounds plausible, but it is not true. The power to expand hitherto accepted beliefs far beyond the scope of hitherto explored implications is an eminent force of discovery. It is this force which sent Columbus in search of the Indies across the Atlantic. His genius lay in taking literally and as a guide to practical action that the earth was round, which his contemporaries held vaguely and as a mere matter for speculation. The ideas which Newton elaborated in his <u>Principia</u> were widely current in his time; his work did not shock any strong beliefs held by scientists, at any rate in this country. But again his genius was manifested in his power of casting these vaguely held beliefs into a concrete and binding form. As another example we may take the atomic theory of matter which was

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1 <u>Principles of Psychology</u>, vol. 2, p.110. A more recent instance of this occurred when Igor Guzenko, cipher clerk of the Soviet Embassy in Canada, tried in vain for two days in succession (5th and 6th September 1945) to attract someone's attention to the document of the Soviet Atomic Espionage which he was showing round in Ottawa at the risk of his life.

first introduced into modern science by John Dalton in 1805 for the explanation of the laws of chemical combination. The theory was soon universally accepted; yet 80 years later Van't Hoff met with considerable opposition by deriving from it the asymmetrical arrangement of the four different substituents attached to a carbon atom. Though he had thus merely envisaged in concrete terms what was implicit in notions generally accepted at his time, he was jeered at by the great Kolbe (1877) for having borrowed Pegasus from the stables of the Veterinary Academy at which he was then an instructor. The advent of modern atomic physics, starting with the discovery of the electron by J. J. Thompson, was due to repeated flights of scientific imagination which derived new aspects of Dalton's theory, far beyond its previously apparent perspectives. One of the greatest discoveries of this age, that of the diffraction of X-rays by crystals (in 1912) was conceived by a mathematician, Max von Laue, by the sheer power of believing more concretely than anyone else in the current theories both of crystals and X-rays.

The assimilative power of an existing scientific framework thus appears no less creative and offers no less scope for the application of scientific genius, than its capacity to sprout into new and entirely unexpected forms. Indeed the conservative and the reforming aspects of discovery remain always combined; we have assimilation to the extent to which new conceptions form an extension of the old and innovation in so far as the new stands in contrast to the old.

What room does such a picture leave for the operation of a principle of doubt? Is doubt perhaps a true guide to scientists in choosing whether to lean more towards 'assimilation' or 'innovation'? Does not the proverbial scientific caution teach scientists to be harder to convince than are other people?

The opinion is widespread. But the exercise of special caution is not peculiar to the scientist. The practice of every art must be restrained by its own form of caution. The precision of the lawyer, the poet's fastidiousness, the sculptor's touch, are as many restraints by which these various professions are guided. Naturally, the scientist is also trained to exercise his own manner of restraint, as part of his distinctive art which is the art of discovery. Caution is commendable in science, but only in so far as it does not hamper the boldness on which all progress in science depends. And there is no rule to tell us at the moment of deciding the next step in research what is truly bold and what merely reckless, and we can therefore have no rule either how to distinguish at such a moment between doubt which will curb recklessness and will qualify as true caution, and doubt which cripples boldness and will stand condemned as unimaginativeness or dogmatism.

We call 'caution' only that kind of doubt which we consider to be, or to have been, reasonable. Hence 'doubt' described as 'caution' acknowledges our appreciation of a successful operation of doubt, without telling us how to achieve such success. We call it true boldness on the part of Einstein that he accepted uncompromisingly Mach's critique of the concept of absolute motion while we praise his caution in rejecting Mach's critique of the reality of atoms. But no principle of doubt could have told him to accept the one and reject the other. 'Caution' is a form of approval, masquerading as a rule of procedure.

There is one instance on record - by which I may demonstrate this point - of a scientist who tried to apply the principle of doubt in an explicit form. This was the Swedish professor Cleve to whom Svante Arrhenius, then a student, first presented his theory of electrolytic dissociation. Arrhenius has told the story how Cleve said 'This is very interesting', and then 'Goodbye'. Later Cleve explained that there were so many theories formed and these were almost certain to be wrong, for after a short time they disappeared and therefore by reasoning on statistical lines he concluded that Arrhenius' theory would not exist long either.[1]

12. Resistance against the conceptual reform suggested by Arrhenius was widespread and violent among chemists, who thought it absurd to assume that free particles of highly reactive metals like sodium or potassium could float about in water without instantly decomposing it. Yet in a few years' time electrolytic dissociation became so firmly accepted, that its further history offers an excellent example for the extraordinary stability of scientific conceptions in the face of invalidating factual evidence. Arrhenius had postulated a chemical equilibrium between the dissociated and the undissociated forms of an electrolyte in solution. From the very start the measurements showed that this was true only for weak electrolytes like acetic acid, but not for the very prominent group of strong electrolytes, like common salt or sulphuric acid. For more than 30 years the discrepancies were

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1 E. N. da C. Andrade, Encyc. Brit. 14th ed., article on Arrhenius

carefully measured and tabulated in textbooks, yet no one thought of calling in question the theory which they so flagrantly contradicted. Scientists were satisfied with speaking of the 'anomalies of strong electrolytes', without doubting for a moment that their behaviour was in fact governed by the law that they completely failed to obey. I can still remember my own amazement when, about 1919, I first heard the idea mooted that the anomalies were to be regarded as a refutation of the laws postulated by Arrhenius and to be explained by a different theory. Not until this alternative conception (based on the mutual electrostatic interaction of the ions) was successfully elaborated in detail, was the previous theory generally abandoned.

Contradictions to current scientific conceptions are often disposed of by calling them 'anomalies'. This is among the most handy assumptions in the epicyclical reserve that is available for the adaptation of any theory, in the face of adverse evidence. We have seen how Azande make use of similar adaptations to meet the inconsistencies of poison-oracles. In science this process has often proved justified by subsequent re-interpretations of the original theory which explained the anomalies.

13. Another example may illustrate the reverse case, namely when a series of observations which at one time were held to be important scientific facts, were a few years later completely discredited and committed to oblivion, without ever having been disproved or indeed newly tested, simply because the conceptual framework of science had meanwhile so altered that the facts no longer appeared credible.

Towards the end of the last century numerous observations were reported by H. B. Baker[1] on the power of intensive drying to stop some normally extremely rapid chemical reactions and to reduce the rate of evaporation of a number of commonly used chemicals. Baker went on publishing further instances of this drying effect for more than thirty years.[2] A large number of allegedly allied phenomena were reported from Holland by Smits[3] and some very striking demonstrations of it came from Germany.[4]

H. B. Baker could render his samples unreactive sometimes only by drying them for periods up to 3 years; so when some authors failed to reproduce his results it was reasonable to assume that they had not achieved the same degree of desiccation. Consequently, there was little doubt at the time that the observed effects of intensive drying were true and that they reflected a fundamental feature of all chemical change.

Today these experiments, which aroused so much interest from 1900 to 1930 are almost forgotten. Text-books of chemistry which thoughtlessly go on compiling published data still record Baker's observations in detail, merely adding that their validity 'is not yet certainly established'[5] or that 'some (of his) findings are disputed by later workers, but the technique is difficult'.[6] But active scientists no longer take any interest in these phenomena, for in view of their present understanding of chemical processes they are convinced that most of them must have been spurious, and that, if some were real, they were likely to have been due to trivial causes. This being so, our attitude towards these experiments is now similar to that of Azande towards Evans-Pritchard's suggestion of trying out the effects of oracle-poison without an accompanying incantation. We shrug our shoulders and refuse to waste our time on such obviously fruitless enquiries. The process of selecting facts for our attention is the same in science as among Azande, but I believe that science is more often right in its application of it.

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1 Journal of the Chemical Society of London, 1894, 65, 611

2 Cf. ibid., 1922, 121, 568; 1928, Pt. I., 1051

3 Smits, The Theory of Allotropy (1922). Baker's experiments are referred to (p. vii) as 'the most beautiful means of establishing the complexity of unary phases' postulated by the author.

4 Coehn and Tramm, Ber deutsch. Chem. Ges. 1923, 56, 456; Zeitsch. f. Phys. Chem. 1923, 105, 356; 1924, 110, 110; and Coehn and Jung, Ber. deutsch. Chem Ges. 1923, 56, 695. These authors reported the stopping of the photochemical combination of hydrogen and chlorine by intense drying.

5 F. A. Philbrick, Textbook of Theoretical and Inorganic Chemistry, revised edition, London, 1949, p.215

6 J. R. Partington, General and Inorganic Chemistry, 1946, p.483. Thorpe's Dictionary of Applied Chemistry, Article "Benzene and its Homologues" (1947) reports Baker's 'interesting discovery' without any qualification.

This last sentence may sound curious and yet it is meant to give you a serious sample of what I believe to be the correct way of reflecting on the difference between Zande magic and the teachings of science. Science and magic are both comprehensive systems of beliefs, possessing a considerable degree of stability, and a comparison of the two systems has shown that the convincing powers of both are derived from similar logical properties of their conceptual frameworks. Yet the two achievements of stability are not on par, but are mutually exclusive. If you accept one system you cannot hold the other, and we today overwhelmingly accept science. The critical movement of the last 300 years has tried to sanction the acceptance of science while avoiding any explicit declaration of faith, which was contrary to its basic programme. I believe that this attempt has failed because it is logically mistaken, and that, consequently, it can never succeed at all. I hold that we have good reasons for preferring science to magic or astrology, or (what is of greater practical importance) to the perversion of science imposed by Stalinism on the territories under Communist rule. But I suggest that these reasons can never be adequately stated without a personal affirmation of belief on the part of the speaker.

We may recognise this by reflecting on the foregoing analysis of the stability of beliefs. No extension of this preliminary sketch into further detail could break through its logical limitations: it would remain a study of other people's beliefs. It might describe in further detail the way beliefs are upheld in the face of occurrences which, to a person not holding these beliefs, would appear to contradict them, and perhaps it might explore also the historic and social antecedents which led to the establishment of certain beliefs within a particular society. But however far we pursued the study of other people's beliefs this would never indicate whether we held these beliefs to be true or illusory and, if so, on what grounds we decided this.

15. At any rate, there would be no possibility of indicating this if we refrained from smuggling into our description of the way beliefs are held, expressions which imply affirmations of our own beliefs. The confusion of the two is sanctioned by common usage. Phrases like 'it is commonly agreed' or 'it will hardly be doubted' are literally statements about what people are supposed to believe or not expected to doubt, yet they are commonly understood as declaring the certainty of the beliefs in question. Or take words like 'science' and 'scientist'. A neutral analysis of science as a system of beliefs should always use the word 'science' and 'scientist' in quotation marks, in the way the Soviet Academy refers to bourgeois 'science' and bourgeois 'scientists'. The confident use of any expressions including the word 'science', or its derivatives like 'scientific method', 'scientific observation', 'natural law', etc., convey the writer's belief in a certain body of allegations, in the rightness of a certain procedure for arriving at such allegations and of confirming them, without his ever having taken the responsibility for affirming this belief. The use of the scientific idiom by writers on scientific method establishes in fact from the start a tacit understanding between them and their readers on the trustworthiness of the method which they are setting out to analyse.

16. Writers on the nature of science who unquestioningly believe in science and may assume the same of their readers, will find no difficulty in carrying out an analysis of science in objective terms. They may define science as the simplest description of of the facts or the most economical survey of sense data; they may pretend that science is not concerned with the truth or that it only makes provisional statements so as to provide stimulus for new experiments. They may say that science is a free creation of the mind, forming part of a conventional game, or that its value lies entirely in its usefulness. As long as everybody is tacitly agreed about the nature of science and implicitly accepts the authority of science, it may not become apparent that statements of this kind only refer to certain formal aspects of science which do not account for its authority. I suppose there should be no difficulty for a positivistically inclined member of the Zande tribe to describe the system of magic accepted by Azande as the simplest description of the facts, or as the most economical survey of sense data, or as a conventional framework valued for its usefulness.

17. The situation is different once a system of beliefs is fundamentally challenged. It must then be defended on its true grounds. I suggest that for this purpose our beliefs, including our belief in science, will have to be declared explicitly, in fiduciary terms.

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