

CORRESPONDENCE

EXACT THOUGHT AND INEXACT LANGUAGE

Sir,

Sir Arthur Eddington takes it 'that the aim of such books [of popular scientific exposition] must be to convey exact thought in exact language. The author has abjured the technical terms and mathematical symbols which are the recognized means of securing exact expression, and he is thrown back on more indirect means of awakening in the mind of the reader the thought which he wishes to convey.' To this Mr. E. W. F. Tomlin in your current issue replies that inexact thought is error.

I believe that Mr. Tomlin's statement reveals a complete lack of understanding of scientific method and scientific practice ; that physicists invariably employ inexact language (even when they express their ideas with mathematical symbols) and that they commonly arouse ideas in each other's minds by talking to each other in inexact terms. To say that the whole of physics is error may have some meaning within a prescribed domain of definitions, but to say it at large is very silly.

Let me give a few illustration. I draw a sketch of a bicycle. It will awaken the thought of a bicycle in the onlooker's mind even if it is an inexact sketch indeed. Next, I draw a blue print of a bicycle. This will awaken the thoughts of the pure detail of bicycle construction so powerfully in the mind of an engineer that he will be able to construct an actual bicycle from the print. Yet the print is an inexact picture of the bicycle—if we go down to the ten thousandth of an inch. Incidentally, a blue print is not a work of art and will arouse the emotion 'bicycle' in nobody but an engineer. Next, let us think of the lunar theory. There is no doubt that Newton's law of gravitation is approximately obeyed by the Moon, yet when one attempts an analysis of the lunar motion *as precise as the observations allow* one is faced with small but definite discrepancies. We are able to say that the law of gravitation observed in Nature approaches Newton's exact law within certain limits: and all our arguments about the lunar motion are inexact. Newton's original data were much less exact than those obtainable by modern measurements. Exactness in physics is unobtainable.

How about exactness in argument? It is clear that in the final exposition of his reasoning the physicist endeavours to use an exact argument which contains implicit if not explicit reference to the inexactness of the data. Nevertheless the essential feature of an argument may often be contained in an analogy or in a simplified argument, and physicists commonly employ simplifications and analogies in driving home points to their colleagues. The statement 'the surface of Sirius is much hotter than that of the Sun and therefore radiates much more violet light per square centimetre' is inexact but correct, and might be employed in a verbal argument in a laboratory any day. The reply might be 'why more *violet* light?' to which a legitimate but inexact method of provoking the attitude in the objector would be: 'You know that red-hot bodies are cooler than white-hot bodies, and that white-hot bodies radiate more violet light per square centimetre than red-hot bodies, and in general the hotter the body the more violet light.' The inexact argument reproduces the essential features of an exact one with which I will not trouble your readers.

The dividing line between inexactitude and error may be hard to draw in some difficult cases, but happily common sense nearly always comes to the rescue.

Turning back to expositions of popular science, the justification for publishing books of inexact arguments ought to be that every simple argument in the book is a rough parallel of some technical argument published elsewhere which is as exact as the nature of the problem will allow. It is my own opinion that Eddington is remarkably successful in producing admirable parallels, the beauty of which can only be realized by those who are acquainted with the 'exact' arguments which they represent. His *Space, Time and Gravitation* is a popular representation of the very difficult Relativity theory for which no adjective seems too high praise, and it led at least one reader to a comprehension of the subject which was filled out rather than altered by subsequent study of Eddington's own 'exact' treatise.

Yours faithfully,

RICHARD WOOLLEY.

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MR. TOMLIN replies :

Mr. Woolley objects to my statement that 'inexact thought is error'; but he will recall that, in making it, I was criticizing Eddington's implication that 'exact thought' could be conveyed in 'inexact language.' What seems to me ambiguous here is the word 'convey.' Reference to a dictionary shows that, when the object to be conveyed is an idea or meaning, 'convey' is equivalent to 'communicate'; and it seems to me evident that you cannot communicate something with exactitude when the medium you employ—in this case, language—is admitted to be inexact. I would push this further. For what, in the case of language, do we mean by 'inexact'? Language can presumably be inadequate in many ways, according to the purpose for which you intend to employ it; and language admittedly can have more purposes than one. But the primary purpose of language—and this is the purpose in which a thinker such as Eddington is clearly most interested—is to express thought. But if such language is inadequate, it cannot adequately express it.

Again, if it is true, as Eddington suggests, both that the scientist's aim is to express thought, and that, in spite of the handicap of having to employ 'inexact language,' he does actually succeed in getting this across—*i.e.*, in 'awakening in the mind of the reader the thought which he wishes to convey'—then, assuming that the process of 'awakening' is identical with comprehension, it is clear that he has done exactly what he intended to do. It follows that if such language is still to be termed 'inexact,' the inexactitudes must refer to something distinct from its capacity to express thought. What this something is, I confess to be unable to say.

I think, too, that Mr. Woolley reads into my argument an assumption about the nature of scientific thinking which it does not contain. My object, whether misguided or not, was to show that Eddington's statement was contradictory; and one of my reasons for supposing it to be so was the implication which it encouraged that all science is error. Mr. Woolley objects to my objection by accusing me of accepting the implication which led me to make it. His next move is to put forward the view that exactness in physics, even where mathematical symbols are concerned, is unattainable; and he justifies books of 'inexact arguments' (inexact from the

point of view of the thought or of the language?) on the ground that they provide a 'rough [*i.e.*, not exact] parallel' to technical arguments published elsewhere. This is to abandon the claim to be 'awakening' exact thought in the mind of the reader. Nevertheless, he continues to speak of Newton's 'exact law,' to which the 'law of gravitation observed in nature' approaches 'within certain limits' (I doubt if this reference to two 'laws' is a very successful 'simplification' with which to 'drive home' the argument); of a statement about the surface of Sirius as 'inexact but correct'; and finally of language as an 'inexact method' of 'provoking' the 'correct attitude.'

Such statements do not seem to me too happy. In what way, we ask, is Newton's law 'exact' (we suspect that 'exact' here is equivalent to 'tidy' or, in the mathematical sense, beautiful); and what is the criterion of correctitude as opposed to exactitude? To say, as Mr. Woolley does at the beginning, that physicists 'commonly arouse ideas in each other's minds by employing inexact terms,' is very likely true (it is certainly true of others) as a description of their workaday behaviour; but are we to suppose that, in the last resort, they are satisfied with such rough approximations, and is 'what is commonly done' the ultimate standard by which they seek to regulate their behaviour? Finally, are we to trust so delicate an operation as the tracing of the 'dividing line' between inexactitude and error to the most nebulous—and I should have thought unscientific—of all criteria, common sense? All this, we are tempted to feel, may be very good pragmatism, but it is not what we mean by the method of exact science.

But pragmatism is only an attempt to state philosophically something which belongs to the essence of all scientific thinking. And I believe that some of the oddities to which we have referred would be removed if it were made clear that scientific thinking is by nature hypothetical. To say this is not to belittle science. On the contrary, it is to render its method intelligible. Otherwise, we have no alternative but to resign ourselves to the ambiguities to which we have drawn attention.

E. W. F. TOMLIN.

COMMENTS AND REVIEWS

GISSING AND THE ENGLISH NOVEL

STORIES AND SKETCHES, by George Gissing (*Michael Joseph*, 7/6).

These stories, which mistaken piety must have induced Mr. A. C. Gissing to publish, will unfortunately persuade no one to read George Gissing who is not already interested in him. They exhibit chiefly his weaknesses and give no indication of his virtues. This is nothing like as interesting a volume of stories as the better of his other two collections, *The House of Cobwebs*, which ought by now to have been put into one of the pocket libraries together with the interesting long 'Introductory Survey' Thomas Seccombe wrote for the 1906 edition. But if this new volume had persuaded reviewers to look up Gissing's novels, re-estimate his achievement, and demand for *New Grub Street* recognition as a classic, its publication would have been justified. There have been no such signs of a reviewer's conscience. It is odd that the Gissing vogue—subsequent to the Meredith vogue and much less widespread—has faded even out of literary history.

This is discouraging, but let us disinter Gissing nevertheless. He wrote twenty-two long novels but only one that posterity would want to read, two books of reminiscence (one the extremely popular *Private Papers of Henry Ryecroft*), two (now three) volumes of short stories, and the best existing critical introduction to Dickens, in twenty-six years of authorship (he died in 1903, aged only forty-six). He has already received adequate biographical and critical attention in *George Gissing: A Critical Study* by Frank Swinnerton, a capital piece of work which looks like remaining the last profitable word on Gissing as a man and a writer. [Nevertheless academic theses have since been excogitated on the same subject in English, German and American].

Gissing's life and temperament, with the problems that they raise, are the key to both his many failures and his single success as an artist. He made a false start in life, it is true (a blasted academic career, a spell in prison, a spell in America, an impossible marriage), but on the literary side his sending a copy of his first novel (*Workers of the Dawn*, 1880) to Frederick Harrison resulted