energy will be carried off by the products of dissociation. Consequently the line spectrum will show strong lines originating from atoms in *S* or *D* states, and these lines will be characterized by the absence of continua. Lines originating from atoms in *P* states will be relatively weak, since stable excited molecules may radiate and fall to the ground-state before dissociation takes place.

Moore and Garth have made a careful investigation of the relative intensities of the lines in the afterglow spectrum and note all these features. Their calculation of the rate of direct excitation into each atomic level shows that the number of excited atoms (formed directly by molecular dissociation) in the *D*, *S* and *P* states are approximately in the ratio 80 : 20 : 1. This is in good agreement with the suggestion given here.

The quenching produced by electrons having a few volts energy may be due to the dissociation of the molecular ion into an atomic ion and a normal atom, a process which requires an energy of 0.87 volts. The accompanying increase in the intensity of the resonance radiation is not so readily explained. This production of atoms in the 2^3P states may, however, account for the recovery of the glow beyond the quenched region, since fresh molecular ions may be formed in the streaming vapour by the process (1) given above.

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¹ Moore, G. E., and Garth, R. C., *Phys. Rev.*, **60**, 208, 216 (1941).

² Arnot, F. L., and Milligan, J. C., *Proc. Roy. Soc., A*, **153**, 359 (1936).

³ Arnot, F. L., and M'Ewen, M. B., *Proc. Roy. Soc., A*, **165**, 133 (1938).

The Relations between Science and Ethics

I AM sorry that Dr. Waddington (*NATURE*, Sept. 6) allows the word 'good' to be spelt with a capital, even if only once. The use of a capital letter makes an adjective appear to be a noun, that is, a thing, which has an independent existence, and this leads to endless confusion, such as that involving "Eternal Values", etc.

A more serious lapse (especially from one who has written on the scientific attitude) is the lack of definition of the terms used. Clear definition is essential to the progress of science, for the facts upon which its theories are built cannot be verified unless they are expressed in clearly defined terms which enable other research workers to establish similar conditions for observation or experiment. Now when we consider the subject of ethics we find at once that the words 'good' and 'evil' have never been clearly defined, and consequently the application of scientific method is impossible. Words are, of course, only symbols, and unless we know clearly how they are related to events in our actual lives, that is, their meaning, the use of them in sentences is mere word-spinning and leads only to confusion.

As regards the intimate connexion between science and ethics, I should like to repeat, in a more pertinent form, a point of view which I put forward in an essay-review of the Bishop of Birmingham's Gifford Lectures (*Science Progress*, **116**, 729; 1935):

(1) We strive for the greatest mental and bodily well-being, that is, happiness (fact of experience).

(2) This is greatest when others are also happy (fact of experience).

(3) To achieve (1) we should therefore strive for "the greatest happiness of the greatest number".

(4) To achieve (3) we require knowledge of facts about the actual world, and what would be the results, or probable results, of given actions in it.

(5) This knowledge is most reliably obtained by the exercise of scientific method.

(6) In order, therefore, to distinguish between good and bad conduct (good conduct being defined as that which conduces towards the greatest happiness of the greatest number and vice versa), we require knowledge obtained by science. Thus science is intimately connected with ethics.

Sections (1) to (6) might be said, I think, to form a basis for a scientific ethic. This is not a static conception, for with the continual increase in our knowledge, it might happen that an act formerly thought conducive to the greatest happiness of the greatest number would be found not to be so. This is an advantage in a world in which the only certain thing we can say about the future is that it will be different from the past.

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DR. WADDINGTON, as I understand him, has merely defined the good as that which tends to promote the ultimate course of evolution¹. On what other basis can a man of science, or any adult for that matter, state that "the direction of evolution is good simply because it *is* good"? (The Dean of St. Paul's, in the same issue of *NATURE*, put his finger on this; what is defined cannot thereafter be deduced.) Dr. Waddington admits as much by his diffident, and somewhat belated, statement that his meaning of good is "not unrelated to the conventional meaning"². One may well ask what all the fuss is about; a definition is beyond argument. Dr. Waddington is fully entitled to take a word in common use and define it, for his own purpose, as he pleases. Most sciences contain examples of such licence, and it can usually, although not always, be said that the definition "is not unrelated to the conventional meaning of the word". One only wonders, first, why Dr. Waddington required eight columns for his definition and, secondly, what it has to do with ethics.

Dr. Needham is on very different ground when he identifies the good as defined by Dr. Waddington with the already defined Christian attributes³. When he boldly claims that these latter are the bonds which most effectively organize a community at the level of humanity, he must be asked to produce his evidence. He may conceivably find difficulty in indicating a representative community which has so much as tried the recipe. We can, on the other hand, point to the most highly organized community of modern times, based on quite other principles and methods. On Dr. Waddington's perfectly consistent statement that the good is that which is effective, these methods are good; does Dr. Needham say they are also those enjoined by Christ?

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¹ *NATURE*, **148**, 270 (1941).

² *NATURE*, **148**, 342 (1941).

³ *NATURE*, **148**, 411 (1941).