THURSDAY, NOVEMBER 13, 1890.

THE CURE OF CONSUMPTION.

WHEN we read the announcement of some fresh scientific discovery, the first impulse, perhaps, is to ask, "Who has made it?" and the second, to say, "Does it sound right?"

The amazing declaration that Prof. Koch had discovered the sure means of arresting the growth of the bacillus of tuberculosis, *i.e.* of "consumption" without further imperilling the lives of its countless victims, must have made many ask themselves these questions, and in all cases probably with unanimously satisfactory replies.

The man who has made this discovery has been known for more than the last decade as the foremost technologist in bacteriology. The discoveries and really infinitely wide generalizations of M. Pasteur had cleared the way and pointed out the broad path of investigation in this branch of pathology. When Dr. Koch began his remarkable research into the life-history of the bacillus of anthrax or splenic fever, the completeness and perspicuity of that work obtained for him the opportunity of devoting his whole energies and time to this department of pure science, and now not only its votaries, but the whole mass of mankind, will applaud the magnificence of what has been achieved by patient toil in a laboratory.

Many of us doubtless remember the eloquent account given by Prof. Tyndall in the *Times*, some eight years ago, of Koch's discovery of the direct cause or virus of consumption, viz. the *Bacillus tuberculosis*, and, possibly, some may remember the ignorant contempt with which this announcement was received by the enemies of science and truth—the anti-vivisectionists. In 1884, Koch published, in his customarily complete manner, the whole chain of his investigations into this, the most general of specific diseases, and it was in this paper that he set at rest, by final judgment and demonstration of the infective character of the disease, a debate of 40 years. On looking back to that time, it is easy to see (in answer to the first question) that the character of the man's work insured, if his health permitted, the accomplishment of a gigantic step forward, such as that which is now announced on the most trustworthy authority. Were we not in eager anticipation of the publication of Dr. Koch's experimental facts, it would be out of place to ask the second question. But, as is well known, the bearing which the general drift of bacteriological research possesses at the present time is, in this connection, of the utmost interest.

Already we have learnt that, as of course seemed necessarily the case, Koch early abandoned the search for an antidote among pharmacopœial remedies, and looked for the means of arresting the functional activity of the bacillus among the biological waste-products of the organism. Pasteur's fundamental discoveries in fermentation had established the law that every micro-organism produces, from the substances which it katalyzes as a result of its biological activity (and especially multiplication), a material or materials, which, on accumulation, inhibit its growth, and finally, indeed, arrest its vitality. The actual discovery that this principle is applicable in its entirety to micro-organisms which are pathogenic, *i.e.* causative of disease, is probably due to M. Charrin, whose investigations into the properties and growth of the *Bacillus pyocyaneus* have shed much light on this difficult area of investigation. But M. Pasteur's teaching has been productive of similar results in other terribly common diseases, notably in diphtheria, at the hands of Drs. Roux and Yersin. In all cases albuminous substances have been found, which, while toxic in certain doses, are nevertheless capable of giving immunity to animals from the disease which produced them. Such albumins, as was first shown by Wooldridge, are not only to be obtained as a result of the specific katalysis of artificial cultures by the pathogenic microbe, but exist already formed in some animal tissues. According to the latest investigations of Hankin in this direction, and according to the observations of Reichert and Weir Mitchell and Wolfenden on snake poisons, and of Martin on anthrax, &c., these toxic, and yet protective albumins seem to belong almost exclusively to the class known as globulins.

Should these generalizations prove to be true, one most important step alone will be gained, viz. a definite advance into the unknown desert of biological chemistry. But, to return to the arrest *intra vitam* of an infective virus, there is another factor in the successful extinction of a parasitic poison, such as the tubercular microbe, and that is the specific resistance of the tissues to their invasion by bacilli, which has been so strikingly elucidated by Metschnikoff and others.

This factor has a specially important bearing in tuberculosis, since the bacillus, as is well known, grows with vastly different rapidity in various individuals, and even in the same patients exhibits great differences of vigour according to the tissue it has attacked. This makes the practical application of Prof. Koch's discovery so much the more striking as well as important. Already it is stated that the most chronic forms of tuberculosis, viz. caries of bones and joints and lupus, yield most readily and rapidly to the preventive treatment, whereas a greater difficulty is experienced in dealing with advanced lung disease.

There are many instructive parallels which might be drawn between this last fruit of experimental science (absurdly called vivisection) and the direct application by M. Pasteur of his labours to the prevention of a far more horrible, if fortunately relatively much rarer, disease—hydrophobia; but the storm of incredulity and abuse with which Pasteur's single-minded labours were received are replaced in the present instance by respectful appreciation and admiration.

It may be that this is a sign of the wider public knowledge of the scientific facts concerning infectious disease, or it may be that the irresistible effect of the truth of M. Pasteur's labours is clearing away the obstruction of ignorance and folly. In either case it is a happy augury of the future. But we fear much of the very different feeling with which this last gift of pure science has been received is a sad testimony to the frightfully wide extent to which this distinctive disease, tuberculosis, prevails, and that really there is no family but feels what a priceless result Prof. Koch has attained if an extended trial should confirm his early successes.

Whatever be the explanation, we earnestly hope that the public interest which is thus awakened in a practical exposition of the extreme importance of supporting scientific research, although its objects may not be at first sight apparent, will receive no disappointment or check, but develop into a true appreciation of the great principles which underlie human happiness, health, and wealth.

CLERK MAXWELL'S PAPERS.

The Scientific Papers of James Clerk Maxwell. 2 Vols. Edited by W. D. Niven, Director of Studies at the Royal Naval College, Greenwich. (London: Cambridge University Press, 1890.)

THE gratitude with which we receive these fine volumes is not unmingled with complaint. During the eleven years which have elapsed since the master left us, the disciples have not been idle, but their work has been deprived, to all appearance unnecessarily, of the assistance which would have been afforded by this collection of his works. However, it behoves us to look forward rather than backward; and no one can doubt that for many years to come earnest students at home and abroad will derive inspiration from Maxwell's writings, and will feel thankful to Mr. Niven and the committee of friends and admirers for the convenient and handsome form in which they are here presented.

Under the modest title of preface, the editor contributes a sketch of Maxwell's life, which will be valued even by those who are acquainted with the larger work of Profs. Lewis Campbell and W. Garnett; and while abstaining from entering at length into a discussion of the relation which Maxwell's work bears historically to that of his predecessors, or attempting to estimate the effect which it had upon the scientific thought of the present day, he points out under the various heads what were the leading advances made.

In the body of the work the editor's additions reduce themselves to a few useful footnotes, placed in square brackets. Doubtless there is some difficulty in knowing where to stop, but the number of these footnotes might, I think, have been increased. For example, the last term in the differential equation of a stream-function symmetrical about an axis is allowed to stand with a wrong sign (vol. i. p. 591), and on the following page the fifth term in the expression for the self-induction of a coil should be $-\frac{1}{3}\pi \operatorname{cosec} 2\theta$, and not $-\frac{1}{3}\pi \cos 2\theta$.

To a large and enterprising group of physicists, Maxwell's name at once suggests electricity, and some, familiar with the great treatise, may be tempted to suppose that this book can contain little that is new to them. It was De Morgan, I think, who remarked that a great work often overshadows too much lesser writings of an author upon the same subject. In the present case it is true that much of the "Dynamical Theory of the Electro-magnetic Field" was subsequently embodied in the separate treatise. Nevertheless, there were important exceptions Among these may be noticed the experimental method of determining the self-induction of a coil of wire in the Wheatstone's balance. By adjustment of resistances, the steady current through the galvanometer in the bridge is reduced to zero; but at the moment of making or breaking battery contact, an instantaneous current passes. From the magnitude of the throw thus observed in comparison with the effect of upsetting the resistance-balance to a known extent, the self-induction can be calculated. The letter to Sir W. Grove, entitled "Experiment in Magneto-electric Induction" (ii. p. 121), will also be read with interest by electricians. It gives the complete theory of what is sometimes called "electric resonance."

There can be little doubt but that posterity will regard as Maxwell's highest achievement in this field his electromagnetic theory of light, whereby optics becomes a department of electrics. The clearest statement of his views will be found in the note appended to the "Direct Comparison of Electro-static with Electro-magnetic Force" (vol. ii. p. 125). Several of the points which were then obscure have been cleared up by recent researches.

Scarcely, if at all, less important than his electrical work was the part taken by Maxwell in the development of the Dynamical Theory of Gases. Even now the difficulties which meet us here are not entirely overcome; but in the whole range of science there is no more beautiful or telling discovery than that gaseous viscosity is the same at all densities. Maxwell anticipated from theory, and afterwards verified experimentally, that the retarding effect of the air upon a body vibrating in a confined space is the same at atmospheric pressure and in the best vacuum of an ordinary air-pump.

Besides the more formal writings, these volumes include several reviews, contributed to NATURE, as well as various lectures and addresses, all abounding in valuable suggestions, and enlivened by humorous touches. Among the most noticeable of these are the address to Section A of the British Association, the lectures on colour vision, on molecules, and on action at a distance, and, one of his last efforts, the Rede Lecture on the telephone. Many of the articles from the "Encyclopædia Britannica" are also of great importance, and become here for the first time readily accessible to foreigners. Under "Constitution of Bodies," ideas are put forward respecting the breaking up of but feebly stable groups of molecules, which, in the hands of Prof. Ewing, seem likely to find important application in the theory of magnetism.

A characteristic of much of Maxwell's writing is his dissatisfaction with purely analytical processes, and the endeavour to find physical interpretations for his formulæ. Sometimes the use of physical ideas is pushed further than strict logic can approve;[1] but those of us who are unable to follow a Sylvester in his analytical flights will be disposed to regard the error with leniency. The truth is that the limitation of human faculties often imposes upon us, as a condition of advance, temporary departure from the standard of strict method. The work of the discoverer may thus precede that of the systematizer; and the division of labour will have its advantage here as well as in other fields.

The reader of these volumes, not already familiarly

[1] "With all possible respect for Prof. Maxwell's great ability, I must own that to deduce purely analytical properties of spherical harmonics, as he has done, from 'Green's theorem' and the 'principle of potential energy,' seems to me a proceeding at variance with sound method, and of the same kind and as reasonable as if one should set about to deduce the binomial theorem from the laws of virtual velocities or make the rule for the extraction of the square root flow as a consequence from Archimedes's law of floating bodies."—Sylvester, *Phil. Mag.*, ii. p. 306, 1876.