agrees in this opinion, which is also the verdict of a commission appointed by the medical congress held at Paris. The results announced by the Paris doctors were not obtained, and often were replaced by directly opposite results. The experiments of all outside of Paris seem to be opposed to the alleged influence of the magnet on hypnotic sensations.

THE DREAMS OF THE DEAF. — In the course of an article on dreams, etc., Mr. J. M. Buckley (*Century*, July, 1888) mentions that he has at various times made inquiry as to the occurrence of sounds in the dreams of the deaf, and found no such instance when deafness set in before the fourth year of life. One correspondent mentions that deaf people dream of hearing, if they became deaf after learning to speak. The deaf are very sensitive to jars, waking up by the beating of a bass-drum, and this class of sensations is represented in their dream-life. These facts illustrate in a conclusive manner the dependence of the imaginative and constructive powers upon the sensations, as well as point to the existence of an era when this dependence is no longer necessary for the retention of dream-fancy.

ELECTRICAL SCIENCE.

Production of Light in the Future.

THE following very interesting extract from Prof. Oliver Lodge's 'Modern Views of Electricity,' that has appeared in *Nature*, is given in the *London Electrician*: —

"The conclusions at which we have arrived, that light is an electrical disturbance, and that light-waves are excited by electric oscillations, must ultimately and very shortly have a practical import.

"Our present systems of making light artificially are wasteful and ineffective. We want a certain range of oscillation, between seven thousand and four thousand billion vibrations per second (no other is useful to us, because no other has any effect on our retina); but we do not know how to produce vibrations of this rate. We can produce a definite vibration of one or two hundred or thousand per second: in other words, we can excite a pure tone of definite pitch, and we can command any desired range of such tones continuously by means of bellows and a key-board. We can also (though the fact is less well known) excite momentarily definite ethereal vibrations of some millions per second, but we do not at present seem to know how to maintain this rate quite continuously. To get much faster rates of vibration than this, we have to fall back upon atoms. We know how to make atoms vibrate: it is done by what we call 'heating' the substance; and if we could deal with individual atoms, unhampered by others, it is possible that we might get a pure and simple mode of vibration from them. It is possible, but unlikely; for atoms, even when isolated, have a multitude of modes of vibration special to themselves, of which only a few are of practical use to us, and we do not know how to excite some without also the others. However, we do not at present deal with individual atoms: we treat them crowded together in a compact mass, so that their modes of vibration are really infinite.

"We take a lump of matter, say a carbon filament or a piece of quicklime, and by raising its temperature we impress upon its atoms higher and higher modes of vibration, not transmuting the lower into the higher, but superimposing the higher upon the lower, until at length we get such rates of vibration as our retina is constructed for, and we are satisfied. We want a small range of rapid vibrations, and we know no better than to make the whole series leading up to them. It is as though, in order to sound some little shrill octave of pipes in an organ, we were obliged to depress every key and every pedal, and to blow a young hurricane.

"I have purposely selected as examples the more perfect methods of obtaining artificial light, wherein the waste radiation is only useless, and not noxious. But the old-fashioned plan was cruder even than this: it consisted simply in setting something burning, whereby not only the fuel, but the air, was consumed; whereby also a most powerful radiation was produced, in the waste waves of which we were content to sit stewing, for the sake of the minute, almost infinitesimal fraction of it which enabled us to see.

"Every one knows now, however, that combustion is not a pleasant or healthy mode of obtaining light; but everybody does not realize that neither is incandescence a satisfactory and unwasteful method, which is likely to be practised for more than a few decades, or perhaps a century.

"Look at the furnaces and boilers of a great steam-engine driving a group of dynamos, and estimate the energy expended; and then look at the incandescent filaments of the lamps excited by them, and estimate how much of their radiated energy is of real service to the eye. It will be as the energy of a pitch pipe to an entire orchestra.

"It is not too much to say that a boy turning a handle could, if his energy were properly directed, produce as much real light as is produced by all this mass of mechanism and consumption of material.

"There might, perhaps, be something contrary to the laws of nature in thus hoping to get and utilize some specific kind of radiation without the rest; but Lord Rayleigh has shown, in a short communication to the British Association at York, that it is not so, and therefore we have a right to try to do it.

"We do not yet know how it is true, but it is one of the things we have got to learn.

"Any one looking at a common glow-worm must be struck with the fact that not by ordinary combustion, nor yet on the steam-engine and dynamo principle, is that easy light produced. Very little waste radiation is there from phosphorescent things in general. Light of the kind able to affect the retina is distinctly emitted; and for this, for even a large supply of this, a modicum of energy suffices.

"Solar radiation consists of waves of all sizes, it is true; but then solar radiation has innumerable things to do besides making things visible. The whole of the energy is useful. In artificial lighting nothing but light is desired: when heat is wanted, it is best obtained separately by combustion. And so soon as we clearly recognize that light is an electrical vibration, so soon shall we begin to beat about for some mode of exciting and maintaining an electrical vibration of any required degree of rapidity. When this has been accomplished, the problem of artificial lighting will have been solved."

ENERGY ABSORBED BY DIFFERENT LIGHTS. — Mr. Preece, in his address before the British Association, gave some figures on the energy required to produce a light of one-candle power from different illuminants.

One	candle	light	maintained	by	tallow absorbs	124	Watts
"	"	"	"	"	wax absorbs	94	"
"	"	"	"	"	sperm absorbs	86	"
"	"	"	"	"	mineral oil absorbs	80	"
"	"	"	"	"	vegetable oil absorbs	57	"
"	"	"	"	"	coal-gas absorbs	68	"
"	"	"	"	"	cannel-gas absorbs	48	"
"	"	"	"	"	electricity (glow) absorbs	3	"
"	"	"	"	"	electricity (arc) absorbs	5	"

The relative amounts of heat given off may be estimated from these figures, tallow candle giving off 248 times as much heat as an arc-lamp for the same amount of illumination. As for the cost of production (Mr. Preece evidently does not include distribution), the following figures hold good in London. The cost of producing one candle light for one thousand hours is: —

	s.	*d.*
Sperm candles	8	6
Gas	1	3
Oil (petroleum)	0	8
Electricity (glow)	0	9
Electricity (arc)	0	1½

THE SHALLENBERGER ELECTRIC METER. — Among the numerous meters for electric currents that have been lately invented, that of Mr. Shallenberger is deserving of attention, from its ingenuity and apparent accuracy. It consists of a flat ring of soft iron mounted on an aluminium disk fixed on a spindle and surrounded by two coils, one of which is connected, either directly or through a small converter, with a circuit whose current is to be measured; the other of which is of an oval form closely surrounding the iron ring, and is short-circuited on itself. The meter is intended to measure alternating currents, and its action is briefly as follows. The alternating current in the first coil induces currents in both the

closed-circuit coil and the disk. These currents are in approximately the same phase. If the closed-circuit coil be placed at an angle with the main coil, then there will be a rotation of the disk, the rotary effort increasing until the angle between the coils is forty-five degrees. The shaft of the disk is geared to a train of counting wheels, which record the number of revolutions. On the lower part of the shaft are light air-vanes to resist the rotation. When the closed-circuit coil is set, and we have an alternating current passing through the main coil, there is a rotary effort on the disk proportional to the current; there is a resistance to the motion due to the air-vanes and the friction of the pivots. It is found that the result is a speed proportional, within narrow limits, to the current passing in the main coil. The following figures are taken from the test of a 40-ampère meter:—

Current in Ampères.	Reading of Meter.	Percentage of Error.
2.06	1.60	-
4.02	4.07	+1.2
5.00	4.95	−1.0
9 90	10.02	+1.2
15 00	15.10	+0 7
20.00	20 00	0.0
29.70	30.00	+1.0
37.40	37 00	−1.1
49 30	45.40	−7.9

In the last case the meter was overloaded. It would seem rather doubtful, however, even acknowledging the accuracy of the instrument tested, whether the friction of the moving parts will remain constant in use. Still experience must decide its practical value.

BOOK-REVIEWS.

A New English Dictionary on Historical Principles. Ed. by JAMES A. H. MURRAY. Part IV. Sections 1 and 2. Oxford, Clarendon Pr. f°. (New York, Macmillan, $3.25.)

WE noticed the first instalment of this great work in *Science* for April 25, 1884, and we are now glad to chronicle the appearance of the fourth part, completing the first volume (A and B) and beginning the second. It is superfluous to praise the work, especially after the high commendations it has everywhere received. It is generally acknowledged to be the best dictionary of any language, and when finished will be indispensable to every thorough student of English. Both its etymologies and its definitions are up to the standard of the best scholarship, while in spelling and pronunciation it is probably as satisfactory as any dictionary of English can be. The typography also is excellent; the definitions, quotations, and other items under each word being clearly distinguished by different kinds and sizes of type. The number of illustrative quotations taken from some five thousand writers of the past seven centuries is immense; and in this respect, as well as in others, the work will serve as the basis of all English dictionaries hereafter.

The number of words in the first volume is 31,254, of which 15,123 are under A, and 16,131 under B. Some of these, however, are merely variant forms or inflections of the main words, while others are special combinations explained under the main words; so that the number of main words alone is only 22,232, of which 12,183 are under A, and 10,049 under B. In a dictionary dealing with seven centuries of English literature there are necessarily many obsolete words; and yet it is found, that, "of the whole English vocabulary on record since the twelfth century (so far as A and B show), more than three-fourths is still in current use." The development of the language in recent times, however, has been great, owing chiefly to the progress of physical science and the consequent introduction of new scientific terms. Yet the dictionary does not contain by any means all the terms used in science, but only such as are used more or less as English words; the generic names in natural history, for instance, being mostly excluded.

In a dictionary based on historical principles, the subject of etymology is especially prominent; yet to ascertain the origin and derivation of some words has been found impossible, and the editor thinks that they are comparatively recent creations of the English-speaking peoples. Among such words he mentions 'bang,' 'blight,' 'blot,' 'blunder,' 'blunt,' 'bounce,' 'bunch,' and many others. One of the most valuable features of the work is the endeavor to trace, so far as possible, the derivation of the various meanings of a word from the original one. This subject is of great importance as illustrating the history of thought, and has been too much neglected by philologists hitherto. Sometimes the development of meaning is simple and easy to trace; but in some cases it is quite difficult, especially when the development takes place on divergent lines. For instance, the word 'canvas' is from the Latin *cannabis* ('hemp'), and the connection of most of its meanings with the original one can be readily traced; but, when used for the act of soliciting votes before an election, the affiliation is not apparent.

The difficulty of preparing such a work as this dictionary is immense. Its inception dates from a resolution of the English Philological Society passed in 1857, at the suggestion of the late Archbishop Trench. But before the composition of the dictionary could be begun, three and a half million quotations had to be made by some thirteen hundred readers; and the preparation of the work itself has proved much more difficult than the editors anticipated. Arrangements have been made, however, for more rapid progress hereafter; and Mr. Henry Bradley, who has been an assistant editor hitherto, is now engaged independently on the third volume, so that some of us, at least, may hope to see the completion of the work.

Facts and Opinions relating to the Deaf, from America. By ALEXANDER GRAHAM BELL. London. 8°.

THE above is the title of a pamphlet containing much valuable matter which Professor Bell collected in preparation of his report to the Royal Commission appointed by the British Government to inquire into the condition of the deaf. No one is so well fitted to be the spokesman of American activity in this direction as Professor Bell, and no one has proved himself more capable of increasing our knowledge of the deaf as a class, and the means of improving their condition. The report before us contains the answers of the superintendents of American schools for the deaf to a long circular letter drawn up by Professor Bell. Five general problems are discussed: (1) 'Visible Speech;' (2) the aural method; (3) intermarriage of deaf-mutes, and possibility of a deaf variety of the human race; (4) the self-supporting character of the education of deaf-mutes; (5) articulation-teaching.

(1) With regard to the use of 'Visible Speech,' the fact that o thirty-one institutions in which it has been introduced it has continued to be employed in only seventeen, argues against its universal applicability. The reasons for its dismissal are generally its difficulty of comprehension and tedium of learning. None the less, its hearty indorsement by so many superintendents shows that it has more in its favor than against it.

(2) The question of developing latent powers of hearing, and especially vocalization, in persons usually termed deaf but really only hard of hearing, is discussed at great length, with the general conviction that much more can be done in this direction than is usually understood. The good done in this way is not only a more or less questionable improvement of the physical hearing, but very markedly a direction of the attention to a class of sensations usually neglected, and thus increasing the accuracy of their perception. The mechanical aids to securing for the deaf a semi-hearing of their own articulations are various, and variously valued, though all seem susceptible of improvement.

(3) Doubtless the most important topic of the inquiry is that concerning the heredity of the deaf-mute class. Professor Bell, it is well known, has written a memoir urging that the tendency of the too close association of deaf-mutes with one another, as is now in vogue, is towards the formation of a deaf variety of the human race; his statistics proving that a constantly increasing proportion of the descendants of deaf-mute parents are deaf-mutes. The superintendents of schools, however, maintain that the bulk of their experience is against the truth of this thesis. Many recommend