tion of a wider appreciation of the value in industry of education of university rank; (2) the maintenance of a central bureau where parents and educationists can obtain accurate and comprehensive information relating to the industry, and the proper course to be pursued by boys entering it; and (3) the promotion of scholarships and other means by which the best talent may receive adequate educational opportunity.

In the ensuing discussion general approval of the proposals was expressed.

Among those who took part were Sir Dugald Clerk, Mr. Michael Longbridge (president of the Institution of Mechanical Engineers), Mr. C. H. Wordingham (president of the Institution of Electrical Engineers), Mr. W. H. Ellis (the Master Cutler), Mr. H. B. Rowell (president of the North-East Coast Institution of Engineers and Shipbuilders), Mr. R. T. Nugent (Federation of British Industries), Prof. W. E. Dalby, Lieut.-Commander C. F. Jenkin (Oxford University), Sir A. Selby Bigge (Board of Education), and Sir Wilfred Stokes (British Engineers' Association).

Finally, the following resolution was proposed by Sir John Wolfe-Barry, seconded by Dr. W. H. Hadow (principal of Armstrong College, Newcastle-upon-Tyne), supported by Mr. Arthur Dyke Acland, and carried unanimously:—"That this meeting of engineers and educationists is of the opinion that a need exists for improvement in and better co-ordination of engineering training, and considers that some form of central organisation is a desirable means to this end. It is therefore resolved that a representative committee, with powers to add to its numbers, be appointed to initiate means that will give effect to this principle of a central organisation." The first members of this committee are to be representative of twenty-six institutions and other bodies named.

Pending further developments, communications should be sent to Mr. A. Berriman (chief engineer, Daimler Co., Ltd., Coventry) or Mr. A. P. M. Fleming (British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, Manchester), who were appointed to act as hon. organisers of the meeting.

THE OFFSPRING OF DEAF PARENTS.

WE have received from Dr. Alexander Graham Bell an interesting publication by the Volta Bureau, Washington, entitled "Graphical Studies of Marriages of the Deaf." Under Dr. Bell's direction, Mr. A. W. Clime has prepared about a hundred pages of graphical index to the marriages reported in Dr. E. A. Fay's well-known work on "Marriages of the Deaf in America," and likewise 301 pedigree charts of the marriages of the deaf that resulted in deaf offspring. Mr. F. De Land contributes two pages of introduction, which might have been expanded to great advantage. From Fay's 4471 marriages Dr. Bell has eliminated 974 in regard to which there was no information as to offspring, 419 where the marriage had taken place within a year of the date of report to Dr. Fay, and 434 that were childless when reported. The removal of these 1827 marriages left 2644 marriages of a year's standing or more, and with children.

The number of children recorded was 6782, of which 588, or 8·66 per cent., were deaf. These 588 deaf children were the offspring of only 302 of the marriages. After deducting two marriages (which resulted in three deaf children and "several" hearing children) because the total number of children born was not stated, Dr. Bell was left with 300 marriages the offspring of which were in varying proportions affected by deafness. The total number of children born was 1044; the number of deaf children among these was 585. The proportion of deaf is thus more than half, 56 per cent.

Another result worthy of note is that of the 2642 marriages considered the average number of children per marriage in the 300 marriages that resulted in deaf offspring was 3·48, while an average of only 2·44 per marriage was reported in the 2342 marriages resulting in no reported deaf offspring.

It may be recalled that in 1883 Dr. Bell presented a memoir to the National Academy of Sciences entitled "Upon the Formation of a Deaf Variety of the Human Race." His recent graphical studies clearly show that although the total percentage of families with deaf children, out of 2642 marriages where deafness marked one or both parents, was not extremely high, being about 12 per cent., the proportion of affected members of the 300 families with deaf offspring was very high, about 56 per cent.

That all the children of two deaf parents are not deaf is probably because the two parents are deaf in different ways, but Dr. Bell has in this publication refrained from any interpretations. In looking over individual cases, one is struck to see some where there was deafness in the husband and wife and in the relatives of both, but none in the children; other cases where there was deafness on both sides of the house, but only in half of the offspring; others in which there was deafness in one parent and none in the offspring; and others again in which the defect was in one parent only, but in all the offspring, or, say, in six out of seven.

One would have liked some discussion of the very interesting variety of results, which must surely mean that even after we have set aside deafness due to otosclerosis and to catarrhal weakness, the kind of deafness called deaf-mutism is not a homogeneous physiological condition. But some discussion would have been very welcome. As one looks over the charts one is struck by the rarity of the symbol which stands for "partially deaf," and the suspicion arises that it has not been sufficiently differentiated in the printing from the symbol for "deaf."

There is much obscurity in regard to the inheritance of deafness, and Dr. Bell's painstaking presentation of different family histories will enable experts to study individual cases. It must be impossible in many cases recorded to get medical opinion as to the nature of the deafness, but in the present-day accumulation of more data like Fay's an endeavour should be made to sift out varieties of deafness more radically than is involved in merely distinguishing between adventitious and congenital.

THE UTILITY OF THE USELESS.[1]

FOR several reasons it is a profitable exercise to trace back a modern invention, or commercial appliance, to the fundamental discoveries from which it sprang. In the first place, the debt of commerce to pure science is thus demonstrated; for it is safe to say that none of the numerous inventions and devices which are of such immense commercial importance at the present day could have come into existence had it not been preceded by one, or possibly many discoveries arising out of research pursued in a purely academic spirit. But, as being of far more importance from the point of view of the ardent beginner in scientific research, the tracing of the germinal discoveries upon which an invention is based is of value as showing how all academic research, remote though it may appear from the service of mankind, may contain

[1] Presidential address delivered to the Royal Physical Society, Edinburgh, by Dr. O. Charnock Bradley. Reprinted from the Proceedings of the Society for March, 1917.

within it the germ from which is to develop an influence capable of tincturing the whole fabric of a nation's existence. A moving pebble may start an avalanche. . . .

Moreover, the history of scientific discoveries serves to remind us of those complex factors underlying our daily life and the research, remote or recent, from which they have originated. The detailed processes of every day are so familiar that few spare the time to remember that upon scientific discovery depend all the contrivances and appliances which make modern life what it is. Indeed, one is tempted to pen the paradox that it is of the most familiar we have least knowledge. In contemplating the lordly oak, or in enjoying its shade, we forget its origin; and, assuredly, the timber merchant wastes no thought on the acorn.

An interesting chapter in the history of science could be written on the opposition against which discoveries of fundamental importance and ultimate great commercial value have had to fight for general approval and acceptance. Galileo's telescope, the Darwinian hypothesis, the clinical thermometer, anæsthetics, and a host of other revolutionising introductions have been opposed with a greater or less degree of acerbity. In the light of its modern development, it is scarcely conceivable that the electric telegraph was neglected for years until its possibilities were foreshadowed in a dramatic fashion in connection with the arrest of a murderer. On the introduction of the electric telegraph the "practical man" would have none of it, and yet in the short space of about half a century the telegraph, and its young relative the telephone, have completely revolutionised everyday commercial and national life. However great their value may be in times of peace, in time of war it is infinitely greater. Regard for a moment the influence exerted by the wireless form of telegraphy on

> This precious stone set in the silver sea,
> Which serves it in the office of a wall,

and something of the power of applied science, the offspring of pure science, becomes apparent. No text could better serve for a thesis on the small and neglected scientific beginnings of great things.

Search for the reason for resistance to new ideas and new speculations is not without interest to the biologist and sociologist. The first reason which suggests itself is that matter-of-fact, rule-of-thumb people are always in the majority, and, therefore, anything out of the ordinary is bound to meet with opposition in excess of approval. Or we might agree with George Eliot in saying that the practical mind and the narrow imagination go together, and with H. G. Wells in asserting that few have been accustomed to respond to the call of a creative imagination. There are few—and these not men of action—who are capable of looking forward into the future. We might also point to the fact that the pursuit of knowledge does not follow a straight line. It zigzags hither and thither, frequently halts, and indeed often has to hark back. Such erratic progress cannot make a very urgent appeal to the practical mind.

But these explanations are probably not entirely just to that necessary member of the community, the "practical man." It must always be remembered that only those of the future shall see the present—see it steadily and see it whole. The ultimate goal of a scientific discovery is hidden from those who were present at its birth. Moreover, a truth new-wrested from Nature seldom carries with it an indication of future possibilities. 'In most cases, and especially if it is a germinal truth, it possesses few attractive features to the eye of him who seeks for signs of future utility. "Truth new-born looks a mis-shapen and untimely birth."

In all probability what the sociologist has come to call the "herd instinct" is an important factor in producing resistance to the reception of the new and unusual. The "herd instinct" may be briefly explained as follows:—Man being a gregarious animal and leading the communal life, it is essential that his actions should be co-operative. The homogeneity necessary for co-operative action results from an inherent impulse on the part of each individual to think and act in conformity with the thought and action of his fellows. There seems good reason for concluding that homogeneity is the result of natural selection. There appears to have been an accumulation of experiences which, unconsciously so far as the individual is concerned, have demonstrated the necessity for following custom if the safety of the community, or herd, is to be ensured.

Admitting the operation of the "herd instinct," it is not difficult to appreciate the reason of that opposition to innovation which is so well and so frequently illustrated in the history of scientific discovery. For our present purpose, however, it is not so much necessary to explain the cause of opposition as to recognise its reality. Realisation of its occurrence and effect in the past renders more easily borne its encounter in the present.

No department of science contains more mysteries for the layman than does electricity. And no department of physical science contains more striking examples of pure academic research paving the way for the introduction of enormously important instruments of applied science.

The discovery of the deflection of a magnet by the passage of an electric current along a wire in its vicinity a discovery which, as Faraday expressed it, "burst open the gates of a domain in science, dark till now, and filled it with a flood of light"—could not have been made had not Volta devised the means whereby a constant and steady current could be produced. Nor, without the same means, could François Arago have discovered that a bar of iron becomes a magnet when surrounded by a coil of wire through which an electric current is flowing.

If Volta's investigations made possible research capable of revealing the industrial applicability of electricity, it may be claimed that Volta, in his turn, was indebted to the old frictional machine for a basis upon which to found his inquiries. Tracing the chain of research still farther back, all the earlier discoveries depended upon an observation made by William Gilbert, of Colchester, one of the lesser sons of the Renaissance. If it is true to say that none of these inquiries was made in the utilitarian spirit, it is equally true to assert that Faraday's discovery of electro-magnetic induction was the product of research undertaken from purely academic motives. When Faraday's sacrifices to science are remembered, it is not difficult to realise that his work was not stimulated by a desire for personal profit. That mankind in general has profited, and that the wealth of nations has been augmented, are abundantly evident.

When Sir Anthony Carlisle and Mr. Nicholson made their extemporised Voltaic pile, and observed the decomposition of water by the current produced, they could not possibly have foreseen that by their speculative laboratory experiments they were laying the foundation of those enormous commercial industries which depend upon electrolysis. Much less is it conceivable that an enthusiastic youth of eighteen, endeavouring to make artificial quinine by the oxidation of aniline, could have foreseen that his accidental discovery would lead to the utilisation of what was formerly a wholly disagreeable nuisance in the shape of coal-tar, and thereby form the germ of the now more than ever famous aniline dyes industry.

Fascinating though it is to follow the fortunes of small discoveries in the physical sciences and see how they ultimately develop into great instruments of human service, it is, if anything, even more fascinating to trace the history of small discoveries in the biological sciences. And this is so, no doubt, because the contact of biology with daily existence is not so obvious and self-assertive as is that of physics or chemistry; consequently the ramifications of influence of biological research are more subtle, but none the less real.

Modern medicine—using the term to include surgery—it is safe to say, is that phase of biological science which has the most obvious effect upon daily human existence. Examined closely, it is clear that modern medicine is based upon a multiplicity of scientific discoveries; some of them of outstanding magnitude, many of them of minor consequence.

Fed upon descriptions of marvellous operations served up by a sensational Press, the layman is not slow to admit the wonders of modern surgery. Wonderful though the surgical stories of the lay Press may be, they are not really more marvellous than many of those stated in the cool, calculated, and technical language of the medical and surgical periodicals. Regard for a moment an operation recently described by an Army surgeon. "Somewhere in France" a soldier was shot. The bullet was located in the cavity of the left ventricle of the heart, and removed therefrom by operation. This feat was rendered possible by a long series of discoveries leading away back into regions far from the utilitarian. The determination of the position of the bullet depended upon the studies of Sir William Crookes on high vacua—a thing of yesterday—combined with the discovery of cathode-rays about two hundred years ago. The operation was rendered free from danger of sepsis by the development of the "germ theory"—now so familiar that we have almost forgotten that it originally bore this name—which reposed upon a long line of arduous research, including Pasteur's inquiries into fermentation, and, still more remotely, the peculiarities of tartrate crystals. These and many more academic inquiries placed the surgeon in possession of the means to perform an operation which, not many years ago, would have been regarded as daring in the extreme.

Frankly, this particular operation was chosen as an example of the triumphs of modern surgery because it was both sensational and topical. But equally wonderful work is done daily and far distant from the grim romance of the battlefield.

Instances of the application of scientific discovery to everyday problems and everyday needs might be multiplied almost without limit. But the foregoing must suffice to justify the contention that the fruits of academic research are not difficult to find in the appliances and contrivances which make the day's work what it is and that the commercial wealth and prosperity of the world are in no small measure dependent upon discoveries of seemingly small and trifling moment, and nearly always of little utilitarian complexion. He who wishes to demonstrate to the man of commerce that it is in his own interest to encourage and aid the man of science need experience no difficulty in adducing facts in support of his argument. It is easily possible to prove the benefits that accrue to commercial undertakings out of the employment of a scientific staff. The proof is perhaps not so necessary now as it was not many years ago; but the necessity still exists, though in a modified degree.

But, while science is of service to commerce, the complete subjection of science to commerce or the requirements of the State would not be productive of entirely good results. The bending of research to purely utilitarian ends would be fraught with grave danger in several directions, and not least in that it would discourage investigations instigated by a thirst for knowledge for its own sake—investigations which history has shown may develop into discoveries of surpassing moment.

After all, the business of the man of science is to discover truth regardless of possible monetary profit either to himself or to humanity at large. Let the inventor use the knowledge if he cares and can. "Your business, your especial business," said Pasteur once to his students, "must be to have nothing in common with those narrow minds which despise everything in science which has no immediate application." And Pasteur, apart from the inestimable work he did leading to modern surgery, taught the vinegar-makers of Orleans how to increase their output, instructed France how to prevent the souring of her wines, and helped the brewers of London by instructing them concerning the importance of the purity of their yeast.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. J. E. Marr, University lecturer in geology, has been elected to the Woodwardian professorship of geology in succession to the late Prof. McKenny Hughes.

EDINBURGH.—The Lord Rectorship of the University, vacant since Lord Kitchener met his tragic fate, falls to be filled up next month. As on the last occasion, the students have determined to have no contested election, but have invited Sir David Beatty, Admiral of the Fleet, to be their Lord Rector. The invitation was forwarded by Mr. J. A. Stirling, president, and Miss Helen I. Walker, secretary, of the Students' Representative Council, and Admiral Beatty replied in these words:—"I should be proud to become the Lord Rector of Edinburgh University, and greatly appreciate the honour which the students of the University confer on me in offering to elect me to that high office."

LONDON.—The cordial thanks of the Senate have been voted to the London County Council for the grant of 600*l*. a year for the salary of the holder of the professorship of Russian to be instituted for tenure at King's College, and to the Worshipful Company of Drapers for the renewal for a further year of the annual grant of 500*l*. for the biometric laboratory at University College.

The following doctorates have been conferred:—*D.Sc. in Chemistry:* Mr. Nilratan Dhar, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Catalysis: Some Induced Reactions and Temperature Coefficients of Catalysed Reactions." *D.Sc. in Psychology:* Mr. Shepherd Dawson, an external student, for a thesis entitled "The Experimental Study of Binocular Colour Mixture."

SHEFFIELD.—On October 25 General Smuts and Sir John Jellicoe visited the applied science department of the University to inspect work being carried on there in connection with the Ministry of Munitions. The distinguished visitors and party inspected the physical and metallurgical laboratories and alloys foundries, where many objects of interest were shown. The visit also included inspection of the shell shops and gauge and tool-room department. After inspection of the buildings, a conference was held with members of the Sheffield Committee on Munitions of War and other gentlemen.

THE Maria Mitchell Memorial Fellowship at Harvard Observatory, value 100*l*., is offered to a woman for the year beginning September 15, 1918. A competitive