engine and boiler particulars and average consumption of fuel; wages paid for every class of work; contracts in hand and price and quantities of material required. These formalities had to be complied with every week. 'It practically amounted to a separate staff having to be maintained to satisfy the ravenous desire for information by this and other departments; the others including similar statistical particulars demanded by the Ministry of Labor which had become entirely subservient to the Soviet of the People's Property; also fortnightly returns of all wages paid had to be dispatched to the work-people's insurance bureau, and the fortnightly tale of financial status to the so-called "financial-control" office.' Lest it should be supposed that any of these burdens produced a beneficial result, it may be stated that a month's pay was the maximum granted by the state insurance for permanent disablement.

Nor is all this negation of personal freedom restricted to industrial matters. Politically the enslavement of the people is as complete. The National Assembly, as the choice of free Russia, is a fraud. 'Elections, of a sort, were held in due course under conditions laid down by the new powers, placing all manner of restrictions on electors and elected alike, so that a great proportion of the population went on strike, in the sense that they refused to vote one way or the other. None the less, the result of the elections did not apparently give satisfaction to those in control, and in any case there was no intention to allow so much as one member of another party to raise his voice in the affairs of the future of the nation. Hence, as we all know, the futile attempt of the few who eventually assembled in Petrograd to meet for a discussion of the situation.'

Looked at from any standpoint, Bolshevism is seen to be a futile tyranny which can only exercise authority over a cowed, famished, and prostrate people. It is detested by all who are subjected to it and are held in check by the primitive lure of food. Bolshevism will end like a bad dream as soon as some adequate counter-force arises to oppose it. At present, as Mr. Daniel says, there are 'but the ashes of a great nation. Russia has again to be reborn from amidst these ruins, and in this great task the British nation will no doubt bear an honorable part in nursing the infant republic to maturity.'

The Outlook

THE ENCOURAGEMENT OF SCIENTIFIC RESEARCH

THE latest epidemic of influenza has caused men to search for strange specifics and remedies at other times unthought of. There have appeared in the press many proposals as to how the spread of the disease should be hindered, and, finally, a suggestion that a power to whose nature the public at other times shows a somewhat marked indifference, research, should be called in to determine the nature of the malady and a sure cure. None of the papers that we have chanced to see gave its readers any idea as to the nature of the research which it demanded, or as to what body or individuals were to undertake it, or who would pay for it. For them, apparently, research was a kind of quinine, a substance of complicated and uninteresting structure for which, in the ordinary way, the Englishman had no need, but of which there must be a store lying about somewhere, to be drawn on in cases of emergency.

There is, however, a great danger in this way of looking at things. If scien-

tific research — that is, a critical study of natural processes undertaken to obtain deeper insight into the principles which govern them — is to be regarded merely as a method of obtaining results which may alleviate the disease of the moment, or may cheapen or facilitate some manufacturing process — if the immediate achievement of some such end is to be made the criterion by which researches are to be valued and encouraged, then by far the greater and more valuable class of researches will be left to look after itself, which it is ill able to do. There should be some realization of the double importance of researches undertaken by scientists of ability in order to extend the bounds of knowledge, and not to gain information of *demonstrated and obvious* practical value. The desirability of knowledge for its own sake is a cardinal principle with most educated men (but not, alas! with such people as Cabinet Ministers and popular journalists; men who hold Edison for a model of what a scientist should be), and on this ground alone, investigations in pure science are worthy of support, but they have a more direct and material claim. It is the knowledge won in the laboratory and study by the student of natural philosophy (to use the dignified old term for pure science) that the inventor and technical scientist applies in his work; all electrical machines and devices are based on principles won in pursuit of no practical end, and it is to the discovery of fresh principles that advances in applied science are ultimately to be traced. These things are best made clear in an example, and the evolution of wireless telegraphy furnishes an excellent illustration of the way in which inquiry, philosophic rather than practical in its spirit, leads to results of the greatest material use to humanity.

The first link of the chain of thought which led to wireless telegraphy may be said to have been a purely philosophical difficulty felt by Faraday. When two electrically-charged bodies are suspended in a vacuum — that is, with no material substance between them — they attract (or repel) one another. How is the force conveyed from one body to the other? Many older physicists, or, as Faraday would have preferred to have called them, natural philosophers, found no difficulty in the conception of action at a distance: they were as content to take it as a fact as the gunner is to accept the propulsion of his shell by the cordite without inquiring as to the exact mechanism of explosion. In the matter of gravity, however, Newton had already found a difficulty in admitting that it should act across empty space without anything to carry the force; in his own words, 'that a body may act upon another at a distance through a vacuum and without the mediation of anything else, by and through which this action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly, according to certain laws, but whether this agent be material or immaterial, I have left to the consideration of my readers.' This passage was familiar to Faraday, and the idea of action at a distance between electrified bodies vexed him in a similar way. To enable him to reason about the laws of this action, and plan fresh experimental investigations to elucidate these laws, he had to invent a mechanism which should give him a clear mental picture of what was happening. He imagined that surrounding the bodies was an immaterial medium, the ether, which was set in a state of strain by the electrified state of the bodies; be-

tween them in this ether stretched 'tubes of force,' which were in a state of tension and, tending to shorten, tried to bring the bodies together. All electrical phenomena involving an ac tion across a space ordinarily called empty he completed in his mind in terms of this ether and the stresses set up in it. Thus, consider the case of an electrical condenser — that is, two parallel plates of metal not connected by any conductor. When this is charged a certain amount of electricity runs into one plate and out of the other, but the current cannot flow from one plate to the other, so that, on the older theories, the circuit was incomplete. Faraday imagined that the ether between the plates was put into a state of strain, the setting up of this strain being a 'displacement current' in the ether. When the condenser is discharged, the ether returns to its unstrained state. The straining of the ether can be considered analogous to the extending and holding fast of a spring; when the spring is released it shortens, and gives up its energy, just as when the condenser is discharged it gives up its electrical energy. But it is well known that when a spring is released it swings backward and forward in prolonged vibration before it returns to its position of rest. How does the condenser behave in this respect? Experiment has shown that the analogy holds; in general the electricity swings from one plate to the other, at any instant one plate being positively charged, and the other negatively, the state of each plate alternating. An electrical oscillation is set up; the whole discharge occupies only a fraction of a second, so that the detection of the oscillation is a matter of refined experiment, but it has been established beyond all doubt.

Faraday's theory was taken up by another man who devoted his life to pure science, James Clerk Maxwell, who gave to it a definite mathematical form. He followed to their logical conclusions equations expressing Faraday's assumptions, and showed that if indeed the ether carried stresses of the kind imagined by Faraday, then it must be able to convey waves of electric and magnetic force, just as an ordinary solid conveys sound-waves. A general idea (which must not be pressed too far) of the process can be obtained by considering the ether as an elastic substance, like a block of india rubber, filling all space. If charging two near bodies does indeed set up a strain in this ether, then the sudden release of this strain must set the ether between the bodies vibrating like a released spring, and this vibration will spread out in all directions from the neighborhood of the bodies through the elastic medium just as a ripple spreads from the disturbance caused by dropping a stone into a pond. Clerk Maxwell was able to calculate what would be the velocity of such an electro-magnetic wave in space, and found a value approximately the known velocity of light. Light had long been supposed to be a vibration of the ether, this medium being assumed in order to provide a seat for the energy of light vibrations on their way hither from the sun. Hence, Maxwell supposed that light was of the nature of an electric disturbance (or rather an electro-magnetic disturbance, since Faraday had shown that a change of electric force was always accompanied by a change of magnetic force, and *vice versa*), a supposition known as the electro-magnetic theory of light. An actual propagation of an electric disturbance from a discharge of electrified bodies had, however, so far never been demonstrated.

The next link in the chain was provided by Heinrich Hertz. A disciple

of Maxwell, he set himself to produce an experimental confirmation of his theory. The discharge of strongly electrified bodies, such as on Maxwell's theory should lead to electric waves, is, under ordinary circumstances, accompanied by a spark. Hertz set up, in the special form known as a Hertzian oscillator, apparatus for the production of a spark, and succeeded in producing, consequent on a spark in this circuit, a spark in a second circuit, or resonator, not connected to the oscillator, and in showing that this was due to an electro-magnetic disturbance passing out from his spark. He demonstrated the wave nature of this disturbance and, further, was able to bend the path of his waves with a huge prism of pitch, just as light waves are bent by a prism of glass, and to demonstrate that in many other ways they behaved, though invisible, as light waves. In short, Hertz produced a source and a detector of electro-magnetic waves, and he succeeded in showing their passage across a large room. Wireless telegraphy within this limited space had been achieved.

It was reserved for Marconi, by devising new forms of radiator and detector, to make it possible to employ electric waves for signaling across distances large enough to give to wireless telegraphy the practical importance which it has to-day. His work showed the utmost ability and ingenuity, and it is with no desire to detract that it is emphasized that his task was merely to improve what had already been achieved in the laboratory by the labors of men who were striving to satisfy an intellectual thirst, to obtain information as to the nature of the forces displayed in electricity and light, and to confirm theories born of long trains of thought followed with no object of the kind usually called practical.

It is often put forward as an excuse for starving science and its devotees that, since such men as Faraday will be impelled to carry out their labors, however unfavorable conditions may be, it is a waste of money to reward them. Quite apart from the meanness of this attitude, and the somewhat humiliating thoughts aroused by the fact that the only material reward an English scientist is likely to receive for any great achievement is a small prize from the French Academy or a large prize from the Swedish Nobel Fund, it cannot be too often insisted that science is not advanced by the unaided efforts of a Faraday appearing once a century. Such men crystallize the scientific thought of their time, and put the labors of many into an ordered scheme; they look for support of their theories not only to their own work, but also to the experiments of many other comparatively undistinguished men who fasten upon particular points for proof or disproof. It should be recognized that, apart from the fact that to a great nation a certain encouragement of intellectual activity should be a source of pride, pure science is at the basis of all industrial research, and furnishes its motive power. It is as short-sighted a policy to encourage applied science and to neglect pure science as to devote every care to providing a ship with powerful engines and to forget to furnish her with fuel.

The New Statesman

TALK OF EUROPE

THE London première of an entirely new Russian ballet, *La Boutique Fantasque* was a huge success. The following review of the spectacle comes from the *Telegraph:*

'Not only as an addition to the many-sided repertory of the Russian ballet — it was actually the first performance on any stage — the production at the Alhambra of *La Boutique Fantasque* possessed a very special interest. For here we had a brand new ballet, with music by Rossini. The very thought of it piqued curiosity. That Mr. Diagilev should have pressed Rossini into the service of his wonderful dancers is no more strange, of course, than that he should have set them dancing and miming to strains of Chopin, Schumann, Rimsky-Korsakov, and many another dead and gone composer. But in this particular instance there was a difference, for the score of the new ballet was to bring nothing — if we except one single fragment — familiar to the ears even of those who know their Rossini intimately. How this seeming paradox came about has already been explained at length in these columns, and there is no necessity to set forth again how, for the purposes of *La Boutique Fantasque*, a pasticcio was fashioned of a number of little pieces written by the composer of *William Tell* after his public career had ended, and performed on various occasions for the entertainment of his guests at Passy.

'So much by way of preliminary. As for the ballet, it proved yet another adventure in the realms of the fantastic and the grotesque — the product in decorative design and choregraphic movement of André Derain and Leonide Massine — and as jolly a piece of fun and fantasy as you could hope to see. There was nothing to speak about or worry over in the way of a "plot" — merely a toy-shop frolic, with the quaintest and drollest of animated dolls in a bizarre Second Empire setting, the quaintest and drollest of customers in fashions that made one really fall in love with a style of dress that might well seem unlovely to the eyes of our generation, and all — dolls and their would-be purchasers in turn — cutting the oddest and wildest capers, though grace and fantasy were never far apart. And it all ended in the maddest revel, a riot of well-ordered movement, in which everybody seemed to be chasing somebody, until the curtain came down to a chorus of cheering.

'And what of the Rossinian trifles, as very deftly tricked out for the orchestra by the Italian composer — a disciple of modernity in his own works — Ottorino Respighi? Well, the music all sounds as much unlike the Rossini of *Tell, The Barber*, and the rest, as anything one could well imagine. It is Rossini in a vein of sheer playfulness, making merry now in one manner — the manner, say, of Chopin, as in one little waltz — now in another. There is a *Capriccio Offenbachique* — not strikingly Offenbachian, it is true — which serves for an irresistibly gay Can-Can, with a dissonance incidentally for the trumpets which was clearly Rossini making fun of something or someone. And, as a contrast to the wild riot of that Can-Can — danced by Mme. Lopokova and M. Massine with a wonderful sense of the *joie de vivre* — a charming little andante as graceful in its artless way as the ballet (in red and white) which comes later. The curious thing about it all is the comparative modernity of these mostly gay, unaffected tunes. Not modern are they, of course, as we apply the term to Ravel or Stravinsky, but in the sense that they sound much more like the kind of stuff a simple maker of ballet rhythms could have written now — or let us say a few years ago — than anything one would have expected from Rossini.

'The whole performance went with exhilarating spirit and snap, and, in addition to the two rarely-gifted artists referred to in passing, one should mention the inimitable dancing poodles of Madame Vera Clark and Mr. Kremneff, and the extraordinarily droll antics of Mr. Idzikovsky as a