

could obtain a continuous current in a closed circuit. These are two cases of perpetual motion. The principle of conservation of energy which is here apparently violated is inapplicable to such cases where the forces are so much smaller than any experimental results on which that principle rests.

The temperature effect of gravitation is a residual effect of gravitation which is itself apparently a residual effect so that we are dealing with forces of, say,  $10^{-12}$  dyne.

The fact that the forces involved in the above suggested cases (a) and (b) are far too small to render any perpetual effects observable, of course does not affect the argument, which is that the speculation does involve a theoretical continuous motion.

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#### Talbot's Observations on Fused Nitre.

SOME years ago in studying the position of the *solidus* curve in the binary system consisting of the nitrates of potassium and sodium, the present writer became well acquainted with the phenomena referred to by Lord Rayleigh in his interesting letter in NATURE of February 1. A number of photomicrographs were made of thin layers of the nitrates, crystallised from fusion, between crossed Nicols. and it was found very necessary in the work that the exposures should be made before the secondary change, the arrival of which, as Talbot observed, is hastened by scratching, had set in. There is, of course, now no mystery as to the cause of this secondary change upon cooling in the character of the crystals first formed from the melt, for potassium nitrate is known to be dimorphous, with a transition temperature at ordinary pressure about  $129^{\circ}$  C. A considerable degree of under-cooling often occurs, and the transition, initiated at Talbot's needle-point, spreads "like a wave" if the slide be cooler than  $129^{\circ}$ , as Lord Rayleigh found using a temperature near  $100^{\circ}$ .

If Wallerant is correct in supposing that there is a third, in all circumstances metastable, crystalline variety of potassium nitrate, still further entertainment from this interesting, if old-fashioned, salt is at least possible.

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#### POSITION AND PROSPECTS OF PROFESSIONAL CHEMISTS.

IN August, 1914, chemists, in common with other professional men, volunteered in considerable numbers for active service with the fighting forces. Many were already attached to the Officers Training Corps of their universities, or to Territorial units—the call was the same to them as to others. The need for fit men was the first consideration, and the need for chemists, as such, in other spheres directly connected with war was not at first recognised. Offers to the War Office of scientific assistance emanating from organised bodies and from individuals were politely acknowledged and pigeon-holed for future reference in case of necessity.

We possessed, fortunately, a number of chemists acquainted with the production of explosives, but as the magnitude of the task before us became better realised a much greater demand arose for chemists to control the operations of manufacture.

In the early months of the war lists of chemists available for the service of the country were prepared by the Institute of Chemistry, the Chemical Society, and other bodies interested in chemical science, with the result that when the Ministry of Munitions called for them a ready response was forthcoming from all parts of the country, from industrial concerns and private laboratories as well as from the universities and colleges, both at home and in the Overseas Dominions. The majority of chemists with experience in the explosives industry were already engaged on war work, and arrangements were made for the training of others to take charge of operations in new factories erected in various parts of the kingdom. Additional chemists were also needed for the increasing work of the staffs of Government laboratories and factories and to control and assist in the production of war material of all kinds. For certain requirements essential to the production of armaments and munitions, for a number of drugs, for laboratory glass and porcelain ware, filter-paper and other necessities, we had hitherto been almost entirely dependent on Germany and Austria, and this state of affairs would have led to serious difficulties if our chemists had not speedily and successfully dealt with such matters. Students in college laboratories assisted, under the supervision of their professors, in the preparation of drugs and the examination of materials, or left before finishing their courses to take up positions in works. Women science graduates, mostly teachers in time of peace, obtained appointments in analytical laboratories as substitutes for chemists who had joined the forces or been transferred to war work. The demand for trained analysts and works chemists still persists, and has been accentuated by the undoubted fact that manufacturers generally are learning to appreciate more and more the value of science in industry.

In addition to the activities referred to above, mention must be made of the help rendered to the Government by leading consulting chemists, professors of chemistry, and technologists, in an advisory capacity, with regard to inventions and to offensive and defensive measures, wherein many of our best are pitted against the much-vaunted chemists of the enemy. German chemists had obviously devoted attention to the employment of scientific frightfulness in warfare which other nations, if such means had occupied the minds of their men of science at all, would have refused to believe that any civilised people would adopt. British chemists, therefore, were perforce called upon to investigate problems wholly repugnant to their inclinations and degrading to their science in order to fight the enemy with his own weapons. Much of what they have done must remain, and probably will always remain, a sealed book; but the results are shown in the well-deserved praise accorded them in the despatches of Lord French and Sir Douglas Haig.

When the Germans started using asphyxiating gases, the War Office called for volunteers with training in chemistry and formed with little diffi-

culty a new fighting force, selecting the officers from chemists already holding commissions and transferring non-commissioned officers and men with scientific qualifications from other units. Their work did not call for much scientific attainment, yet the force was for the most part made up of graduates and qualified professional chemists, a body of men far too valuable to the country to risk in hazardous enterprise. However, they proved good soldiers and "carried out their unfamiliar duties during a heavy bombardment with conspicuous gallantry and coolness," as reported by Lord French.

Later, the force was augmented, and many of the original corporals were promoted or, as the demand for chemists became more pressing at home, were withdrawn for work in Government and controlled establishments. Chemists were also promptly engaged on research for devising methods of defence against poisonous gases, and for inspection work in that connection.

Apart from measures of offence and defence, however, the work of chemists in the Royal Engineers and in the sanitary companies of the Royal Army Medical Corps engaged on active service for the purification and examination of water and for other sanitary matters, has doubtless contributed to the maintenance of health in the armies on the Continent, in the East, and in Africa, while we must not overlook the fact that not a few of these chemists are also first-class bacteriologists, and their work as such has been indispensable. Mention must also be made of the chemical advisers to the various armies, inspectors of ordnance, instructors in gas defence, chemists with the Army Service Corps concerned with chemical supplies and those attached to the Air Services.

Many of these men have been promoted to high rank, so that we find among them quite a number of colonels, lieutenant-colonels, and majors. One professional chemist who enlisted as a private in the early months of the war has risen to the rank of lieutenant-colonel through his scientific and inventive ability. Comparatively few qualified men who have seen active service have not been afforded the opportunity of taking commissions, and a remarkable number have won honours in the field.

We yet hope to see, however, due recognition accorded others, less in the foreground, who have given loyal service and have materially contributed to the results achieved. We refer especially to chemists working at home, including those in the Civil Service and in Government and controlled factories, the majority of whom we do not doubt would willingly have volunteered for active service had they been permitted to do so. Not a few have worked throughout the war quite gratuitously, while some are in receipt of salaries out of all proportion small in comparison with the responsibility of the duties entrusted to them. There are many chemists attached to different departments of the Civil Service, but few are in receipt of remuneration which would compare favourably with that of men of similar qualifica-

tions and attainments engaged in private work or in industry.

The terms and conditions of service offered to qualified temporary assistants in the Inspection Department at Woolwich were, we understand, improved towards the close of 1914, partly as the result of the publicity given to the matter, but also owing to the dearth of candidates for the appointments. Even though the remuneration of 2*l.* 0*s.* 6*d.* a week was increased to 15*l.* a year, and a miserable allowance (about 1*s.* 4*d.* an hour) made for overtime, in the prevailing circumstances the position is distinctly unsatisfactory. If the work is not of a responsible character, the authorities need scarcely be so insistent on high qualifications. We cannot but conclude that such matters have been too much in the control of the clerical establishments, who are ignorant of the significance of chemistry and its vital importance to the interests of the country; yet, perhaps, they are not entirely to blame for the existence of a system prevailing in several places under which, if insufficient financial provision is made for chemical assistants, such men find themselves classified as "foremen" or "draughtsmen," or that some sort of shuffle has been made to bring them within the funds allotted to the expenses of their department.

It is greatly to be deplored that competent professional men have not been graded and treated as such, paid proper salaries, without talk of overtime, and afforded more encouragement generally in the service they render to the State. Now that the Inspection Department is under the Ministry of Munitions we look for a more enlightened appreciation of scientific work. The terms attaching to the appointments of shift chemists in works controlled by the Ministry when they were first decided on were fairly satisfactory for younger men and made allowance for increments up to a moderate limit; but these again call for revision under the altered conditions of living to enable educated professional men to maintain their status and to lessen the sacrifice many of them have made.

In other Government laboratories and chemical establishments many assistants are continuing their work under pre-war rates of pay, and although there is a graded scale of war bonuses we trust their case also will receive due consideration. Throughout the war chemists have made good wherever they have been in request, and we repeat the time has come for a more substantial acknowledgment of their services.

We have already indicated that in industries the demand for chemists is now in excess of the supply, due not only to the fact that so many are with the forces, but also to the growing appreciation of the value of their work and the development of scientific methods of manufacture. The shortage of qualified men has compelled employers to offer better terms, and, as a consequence, a considerable number of teachers have been attracted to works appointments, and in the production of munitions many are engaged as "shift chemists" in charge of plant in factories where scientific control is essential to the safety of the employes. The colleges, at present, have fewer

students than in normal times, but there is much difficulty in securing sufficient lecturers and demonstrators, and, with the professors and heads of departments engaged on war work, the junior staffs are in most cases overburdened. It is doubtful whether many who were teachers before the war will return to their former work, the remuneration and outlook being usually unsatisfactory for any but those of outstanding ability. Yet the majority of our science graduates have hitherto turned to teaching for lack of opportunity of securing appointments in industry, few being in a position to start practice individually.

The private practitioners in chemistry who are really successful are not numerous, and these rely in most cases mainly on consulting and analytical work in some branch in which they have acquired a reputation. The fees for commercial work leave no great margin for the principals when all expenses of maintenance have been taken into account, and they are seldom able to afford high salaries, even to their chief assistants. Much of the routine analytical work is entrusted, as in the factories, to men with no special qualifications. Thousands of men who have received an elementary training in secondary and technical schools are available and can be utilised for a limited range of analyses and comparatively simple operations. The more competent are thereby crowded out.

Reviewing the position as a whole, we come to the conclusion that qualified professional chemists will find in future an increasing demand for their services in industry, either as research chemists, works chemists in control of plant, or works managers, the routine testing work being relegated to the less qualified assistants, only the best of these being eligible for promotion on the works on showing promise of real ability. In progressive concerns arrangements will be made for such assistants to receive systematic training in neighbouring universities and colleges. Works chemists will be wise to take every opportunity of improving their training and experience on the engineering side, whereby they may become capable of designing and erecting plant as required. In the course of time many such men will establish themselves in independent practice, along with public analysts, official agricultural analysts, metallurgists and other specialists, and general consultants.

Appointments in governmental and municipal departments, for which in the higher grades only qualified chemists should be accepted, will probably become more numerous, and should, in the interests of the community, be made attractive to men of the right stamp. Under this head we embrace appointments in arsenals, factories, and dockyards, with those of inspectors under the Alkali, etc., Works Regulation Act, and similar statutory offices, as well as those under county and municipal authorities, health departments, river boards, sewage works, etc., gas examiners, water examiners, and so forth. Chemists engaged in official laboratories should have prospects at least equivalent to those in industry and

private practice, a principle which applies in a limited number of the higher appointments of the Civil Service. Nor should we omit the staffs of the National Physical Laboratory, the Imperial Institute, and similar institutions where research is the primary function.

Finally, but by no means the least important, there are the professors and teachers of chemistry, who represent a very large body, engaged in our universities and technical colleges, public and secondary schools, whose positions generally should afford far better prospects than they have in the past. With all these openings there should be no lack of recruits for the profession of chemistry, either in the Mother-country or in the Overseas Dominions, where also competent chemists are afforded opportunities corresponding to those here indicated.

#### THE WEATHERING OF COAL.

THE Canadian Department of Mines has lately issued a volume of 194 pages, constituting an extra volume supplementing Report No. 83, and forming a portion of the "Investigation of the Coals of Canada with reference to their Economic Qualities," which has been prepared by Dr. J. B. Porter, of McGill University. This is devoted to a discussion of the literature of the subject and of the results obtained by the author and his assistants in their researches upon this difficult and important problem. It has very long been known that whilst all coals are liable to undergo deterioration on storage, some give rise to marked heating, whilst others are even liable to spontaneous combustion. The latter, as being attended with most obvious disastrous consequences, was the first of these effects to attract attention, and a Royal Commission on Coal Cargoes was appointed to study the matter exactly forty years ago. It is only within the last few years that much progress has been made towards its solution, and that mainly through the labours of a few first-class chemists under the scientific guidance of Dr. J. S. Haldane, in a laboratory the expenses of which have been defrayed by the Doncaster Coalowners' Association; this association took up the question from a slightly different point of view, namely, with the object of discovering the causes of, and finding a remedy for, the "gob-fires" to which some coal-seams are particularly liable. Dr. Porter's attention has been directed mainly to the question of the safe storage of coal and the prevention of deterioration in its quality.

It was soon obvious that all these problems are closely related, and depend, indeed, essentially upon the oxidation of coal, and this, again, upon the absorption of oxygen by the coal. Dr. Porter has presented his conclusions in the form of a brief summary, in which he shows that oxidation depends upon the presence of moisture in moderate amount, absolutely dry coal and thoroughly wet coal (*e.g.* submerged in water) being both less liable to oxidation than coal in the presence of a small quantity of moisture; it depends also upon