enheimer and his coworkers prepared methylethylaniline oxide, methylethyl-β-naphthylamine oxide and other similar compounds,

$$(CH_3)(C_2H_5)(C_6H_5)N=O$$
$$(CH_3)(C_2H_5)(C_{10}H_7)N=O.$$

The racemates were resolved by means of d-bromocamphorsulfonic acid or d-tartaric acid. After fractional crystallization and separation, each salt was converted into the active picrate, which was changed to the corresponding active chloride and finally into the active amine oxide itself.

Previous attempts to resolve compounds with two like radicals, Na_2bcd, have been fruitless. Even compounds more closely allied to these amine oxides in form, such as N-methylpicolinium salts, N-methylquinolinium salts, could not be resolved by H. O. Jones.[24] Meisenheimer takes it for granted that an explanation of the stereoisomerism is provided when he has called attention to the fact that, in the amine oxides, the doubly bound oxygen engages the valence which usually holds the acid radical, while in the case of the compounds studied by H. O. Jones, only non-ionizable valences have been satisfied by doubly bound carbon.

It seems that a more consistent explanation may be offered in terms of the electronic viewpoint, if the amine oxides and their hydrates are assigned the following formulas:

$$\begin{matrix} R & + & - \\ R' & + & - \\ R'' & + & - \end{matrix} \!\!\begin{matrix} \\ N \\ \\ + \end{matrix}\!\! \begin{matrix} - & + OH \\ & \\ - & OH \end{matrix}, \qquad \text{I.}$$

$$\begin{matrix} R & + & - \\ R' & + & - \\ R'' & + & - \end{matrix} \!\!\begin{matrix} \\ N \\ \\ + \end{matrix}\!\! \begin{matrix} - & + O. \\ & \\ - & \end{matrix} \qquad \text{II.}$$

It must be assumed that the linking in formula II. is similar to the grouping in formula I., in so far as its effect upon the asymmetry of the molecule is concerned, since amine oxides dissolved in benzene often show large rotations. The nitrogen atom, in either even, *does not hold two like groups,* since the properties of positive and negative hydroxyl are as divergent as those of positive and negative chlorine. In this respect, the conditions are not the same as those in ammonium compounds of the form, Na_2bcd, but are comparable to the condition existing in ammonium compounds of the general type, *Nabcde.*

In conclusion, permit me to express the belief that chemists will soon come to realize more fully that the recent investigations into the structure of the atom have a practical bearing upon their particular problems. The study of electromers, and the investigations of the conditions under which they may be prepared, certainly furnishes an inviting field of research, which, in my opinion, is worth tilling, and can not fail to be productive of results of far-reaching importance to chemists. Furthermore, with our present limited knowledge of the subject, no one can predict in what manner the discoveries, sure to be made, may react to modify and clarify our theories concerning the structure of matter, and, in particular, our vague notions of "chemical affinity."

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[24] H. O. Jones, *J. Chem. Soc.*, 83, 1400 (1903).

RECENT PHYSIOLOGY AND THE WAR[1]

This theme, kindly suggested by Professor Sir James Dewar, is sufficiently large to preclude more than a succinct treatment of some outstanding points in the time permissible in a single lecture. But these points are of considerable interest and have a more than fleeting importance.

The first is that of fatigue, its measurement and incidence in factory employees. The indices taken have been speed of output and quantity of output by groups of workpeople working under the conditions of a munitions factory. An inference of

[1] Address before the Royal Institution of Great Britain, February 2, 1917.

practical value drawn from the observations is that when the number of working hours per week was reduced from sixty-two to fifty-six the output actually increased. The reduction of the length of the working day by one hour per diem gave a rise of the total output of the week from an amount stated numerically as 6,150 to an amount expressed as 6,759. The output per hour increased 22 per cent. The kind of work in this case was "heavy," namely, deep screw-cutting by hand.

In another case, that of 200 women turning aluminium fuse-bodies, the reduction of the working hours per week from 68.2 to 60 notably increased the total output, and of course still more the rate of output. From these and other examples the lesson seems to be that there is for manual labor a certain length of working week, or working month, best suited for satisfactory production in permanence. The length varies with the class of the manual work. If a good efficiency is to be maintained in the factory this "most favorable" length of working month has to be followed. Before that it has to be found out and measured.

The next point raised was the influence of alcohol on the workers' output. The question has at present been attacked only in the laboratory so far as physiology is concerned. Physiological experiment shows that even a large single dose of alcohol—*e. g.*, 40 c.c.—has little or no effect upon the muscles *per se*, but that it does impair the working of the nervous system which actuates the muscles.

A suitable test in respect of the simplicity of the nervous centers involved in it is the knee-jerk. This is a familiar reaction to every physician; it is a reflex act, the spinal center for which has been thoroughly investigated. The effect of a single dose of alcohol of 30 c.c. quantity diluted with 120 c.c. of water is to diminish and render sluggish the knee-jerk; the speed of the response is sometimes decreased by 9.6 per cent., the amplitude of the response lessened by 48.9 per cent. The greatest impairment of the reaction was noted about one hour after the dose.

Another test of the effect of alcohol on the musculo-nervous actions was furnished by a very simple voluntary act. The person subjected to the experiment was required to move one finger to and fro, that is, to bend and straighten the finger alternately, as rapidly as possible. The rate of movement was examined before and after taking a dose of 30 c.c. alcohol diluted as above. This dose impaired the rate at which the oscillatory movement of the finger could be performed. The rate was diminished an hour after the dose by 8.9 per cent.

Such a movement is not well calculated to test that form of skill which consists in precision. Reasons were adduced for thinking that a precision of movement is that aspect of a muscular act which will be most detrimentally interfered with by alcohol. The testing of alcohol effect by the ergograph seems to show that a moderate dose, say 30 c.c. of alcohol, in a person accustomed to moderate use of alcohol, does not appreciably impair the power of the movement nor its resistance to fatigue. But the movements chosen as suitable for ergographic record are such as give little opportunity for the exhibition of precision or of skill of any kind.

The next point dealt with was the attempt to devise some fluid which can be injected to counteract the effect of severe loss of blood in the wounded. The properties desirable for the required fluid were shown to be: harmlessness in respect of avoidance of causing clotting in the circulation; restoration of the volume of the fluid in the circulation; maintenance of the due degree of viscosity of the circulating fluid, since on that factor depends the arterial and

capillary pressure; and, finally, preservation of the balance between the osmotic pressure of the fluid inside the blood-vessels and outside in the tissues. It was shown that considerable success had been reached in this problem by the experiments of Professor Bayliss and others.

A final point dealt with was the treatment of tetanus by administration of "anti-tetanus serum." This serum is obtained from the blood of horses which have been subjected to gradually-increasing doses of tetanus-toxin, the poison produced by the tetanus-bacillus. The high efficiency of this anti-toxic serum when used as a prophylactic was first demonstrated on man on a large scale by its employment in the first autumn of this war. Curves illustrating the statistics were shown. The severe outbreak of tetanus which ensued in the troops at the outset of the campaign was checked and practically stopped almost instantaneously by the orders that every wounded man, as soon as possible after being wounded, that is to say, at the first field casualty-station, should receive a small injection of anti-tetanus serum from the immunized horse. But the efficacy of the serum when once signs of tetanus have appeared in the patient is far less satisfactory. The remainder of the lecture was devoted to discussion of why this should be, and in what ways the difficulty may be, at least in part, overcome.

Charles S. Sherrington

PRE-MEDICAL TRAINING IN CHEMISTRY[1]

As a country we are rubbing the sleep out of our eyes and wishing we had split the kindling and brought up the coal the night before. The alarm clock has been ringing for some time, but we have preferred our dreams of ease to the realities of necessities.

The medical profession is awake and trying to start the water boiling, but finds it can not lay the fire. The wood and coal are at hand, but the knowledge of their proper use is lacking. Now, more than ever, do progressive physicians realize the dependency of successful practise on a well-founded knowledge of the chemistry of the human body, and more than ever do they irritably contemplate their lack of preparation.

This lack of preparation in a science so obviously fundamental to rational understanding of the human mechanism as to require no elaboration, at present exists; that a continuation of this condition should be allowed is a parody upon our intelligence.

The futility of expecting the physician to utilize all possible sources of relief to suffering without a knowledge of the application of basic chemical principles to the body reactions is apparent.

It is equally as absurd to expect the medical student to appreciate or assimilate the possibility of chemistry being a practical science for his uses, if he does not have sufficient foundation in this subject before he enters the medical school. The medical school is fundamentally a school of applied science. It is where the individual is taught science as applied to the human body. Any attempt to teach a student biological chemistry without his having received an adequate foundation in the fundamental principles of chemistry in general, and to expect him to know much of anything when we are through with him, is as idiotic as to try to teach calculus to men who have yet to know algebra. The foundation must be laid in the pre-medical work.

It is only in recent years that the teaching of elementary chemistry has been dropped from the medical curriculum. Unfortunately however even to-day it is only the few schools interested in turning out doctors instead of groups of men competent to pass State-board examinations, that have adapted themselves to the logical demand of the times as justified by the ever-increasing applicability of chemical

[1] Read before the Division of Biological Chemistry, American Chemical Society, Boston, September, 1917.