that period, been developed to the dignity of voluminous quantitative sciences, whilst this section of the subject, which is of great antiquity, can be dealt with on a page or two of a text-book, and consists of incoherent qualitative facts.

A recent paper by Dr. P. E. Shaw (Proc. Roy. Soc., November, 1917) discloses interesting results, and indicates that this neglected field of research is being developed. Throughout the experiments described the conditions of the surfaces used were varied systematically—by rise of temperature before and during friction; by treatment when flexed; and by previously grinding or polishing, and so on. It is well known that there are condensed films on the surfaces of many solid materials. Little is understood as to the nature or depth of these adsorbed layers, but they have proved a veritable stumbling-block to the investigator of certain phenomena—*e.g.* surface-tension and photo-electricity. But these films have little influence on tribo-electric effects, for here there is always a rough impact of solid on solid, the films are penetrated, and the true solid surfaces bear on one another.

The tribo-electric series consists of thirty-six places in order from the extreme + at top to the extreme − at bottom. The outstanding feature of the present results is the readiness with which a solid changes its place in the series when its surface condition is changed by heat, abrasion, flexure, and the like. Thus ordinary soda-glass drops from place 5 to place 21 when made matt, and to place 26 when its temperature has been raised to 245° C. Mica, which normally occupies place 6, drops to place 18 when matt, and to place 26 when heated to 270°. On the other hand, ebonite rises from place 28 to place 27 when matt, and to place 21 when heated to 100°. The remarkable character of these changes is that they are not erratic, but follow a simple law, as follows: All materials in the series above place 14 fall when rendered matt or after heating; but all materials in the series below 14 have the contrary tendency, and rise when heated or made matt. Thus the tendency is for the two ends of the series to come together as a result of these changes of condition. The temperature at which the change by heat occurs is quite definite for each material, and has been found for some sixteen metals and non-metals. It ranges from 70° C. to 300° C.

Dr. Shaw considers that this diametrically opposite behaviour in the + and − groups of the series indicates the existence of two kinds of atom or atomic group, one kind for each group, the difference between the two kinds being fundamental. But whatever form the theory of these effects may take, these new facts can scarcely fail to be of great importance. The research provides an explanation of the well-known readiness with which materials change their tribo-electric character. It should now be possible to avoid, in great measure, the confusion and irregularity which have hitherto characterised the subject.

THE RELATION BETWEEN CHEMICAL CONSTITUTION AND PHYSIOLOGICAL ACTION.[1]

THE relation between chemical constitution and physiological action occupies a definite and important place in the study of drugs. Chemical investigation of a drug begins with the attempt to isolate the principle to which its activity is due. Then follow the determination of its constitution and the synthesis of a number of substances related to the parent compound, and comparison of their physiological action.

The wideness of the term "physiological action," covering as it does any action on the living organism, renders its discussion difficult. It is impossible, for instance, to compare the bactericidal action of phenol with the hypnotic effect of diethylbarbituric acid, or with the anæsthetic action of cocaine, for the same superficial signs of physiological action may be due to widely different causes. Examples of physiological action are not wanting. Compounds of similar constitution generally possess a characteristic group-smell, whilst each member may have a specific odour. Sense of taste also provides an occasional means of discrimination not only between side-chains of different length, but also in certain cases between stereo-isomerides.

Stereochemical influences often exercise profound effects, particularly on nerve-endings. Thus *l*-hyoscyamine has about a hundred times the mydriatic action of *d*-hyoscyamine, and *l*-adrenine many times the pressor effect of the dextro-compound. Asymmetry of a nitrogen atom may also condition a difference, as in the case of the α- and β-methochlorides of *l*-canadine. The cause of this variation still remains in doubt.

The influence of physical properties, such as solubility in different media, may be of importance, and it has been shown that for a particular series of aliphatic compounds their narcotic effect on tadpoles was proportional to the partition-coefficients of their solubilities in oil and water.

As an indication of the effect of chemical properties, it has been shown that whilst certain basic dyes stain the grey nerve substance, their sulphonic acids do not. This difference suggested that bases, liberated in the blood-stream by alkalis, are extracted by the nerve substance, whilst their sulphonic acids remain in solution as alkali salts.

In the case of alkaloids it is a general rule that the introduction of a free carboxyl group profoundly modifies the physiological action. Benzoyl ecgonine, of which cocaine is the methyl ester, has no local anæsthetic action; whilst quitenine, obtained from quinine by oxidation of the vinyl group, is non-toxic. Formation of quaternary salts has also a considerable effect. For instance, papaverine has a strychnine-like action which is missing in its methochloride, and reappears in its reduction product laudanosine.

In the many cases in which members of a group of compounds of similar constitution resemble one another in physiological action it is of interest to observe the effect of slight chemical alterations. The following four pieces of work were then outlined:—(1) *Tropeines* (acyl derivatives of the amino-alcohol tropine); (2) *aminoalkyl esters* (formed by the esterification of an *acid* with an *alcohol* containing an *amino*-group); (3) *adrenine and the amines* (adrenine is the active principle of the suprarenal gland); (4) *protozoacidal drugs*. The results of experiments that have been made on the relative toxicity to infusoria of a number of cinchona derivatives, with a view to their employment in the treatment in malaria, indicate that ethylhydrocupreine was the most active, but they do not admit of any certain conclusions as to the relation between their chemical constitution and protozoacidal action.

Experiments have also been made on the relative toxicity of the ipecacuanha alkaloids to amœbæ, and they indicate that the full amœbacidal action characteristic of emetine is exhibited only when the nucleus is intact.

[1] Summary of a lecture delivered before the Chemical Society on December 6 by Dr. F. L. Pyman.