LXXI.—*Hydrocellulose*.

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THE recent contribution of A. L. Stern (this vol., pp. 336—340) bearing the title "The so-called hydrocellulose" is based on experimental matter of obvious value, which may be taken as being beyond criticism, but the author's interpretations appear to us to be somewhat at variance with accepted facts and liable to misconstruction.

This appears in the title itself, which must be read in the light of the context supplied by one of the concluding paragraphs, where the author says :

"It is evident . . . that when cellulose is exposed to the action of hot dilute acids there is no formation of hydrocellulose The cellulose residue does not differ in elementary composition from the original, but has been converted into a fine powder A microscopic examination shows that the disintegration is due to the fact that certain portions of the fibres are more easily attacked than others, and when these portions are converted into soluble products the whole fibre falls to pieces."

We do not propose to discuss these statements in detail, but with all possible brevity to emphasise some antecedent facts, which, although of critical importance in this connection, have apparently been overlooked.

(1) The author's criticisms of the work of A. Girard are scarcely justified, because the three methods for the production of the typical hydrocelluloses carefully described by the French chemist (*Memoire sur l'Hydrocellulose et ses derivees*, Paris, 1881) are in no case followed.

(2) The question as between an empirical formula $C_{12}H_{20}O_{10}$ or $C_{12}H_{22}O_{11}$ for the products described by Girard as the typical hydrocelluloses is therefore not raised by the fact that the author has obtained, under other conditions, residues which have the empirical composition $C_{12}H_{20}O_{10}$ of the original cellulose.

(3) On the other hand, we submit that these residues are constitutionally different from the original celluloses. They are attacked by dilute alkaline solutions, are largely soluble in 15—20 per cent. caustic soda solutions, are oxidised by Fehling's solution, and generally show differences in the reactivity of the typical carbonyl and hydroxyl groups. Their behaviour towards nitric acid, acetic anhydride, and esterifying reagents generally differs from that of the original cellulose, and the properties of the corresponding derivatives are also different.

Girard studied this part of the subject in detail, in regard to the typical hydrocelluloses, and his results have been frequently confirmed.

(4) The main point which Stern appears to overlook is that structure in the celluloses is bound up with chemical composition and constitution. The structural properties of cellulose and hydrocellulose persist in their esters, and also through a cycle of reactions such as is involved in the conversion into xanthate and the regeneration of the cellulose (or hydrocellulose) from this condition of combination.

This very important point has closely engaged the attention of investigators, and considerable positive evidence has already been accumulated showing that the structural properties of cellulose are a function of the actual molecular aggregate taken in the chemical sense.

Incidentally we would emphasise this point, that it is at present easily open to chemists to settle any question as to chemical changes in cellulose, independently of structure, by operating on the homogeneous, structureless forms of this compound now available.

Without extending our criticism to lesser details, we conclude that the sub-group connoted by the term "hydrocellulose" remains unaffected by Stern's investigations save as regards his useful contribution of new matter.

Finally, in order to illustrate the actual state of our knowledge of the sub-group in question, we may point out:

That the normal cellulose (anhydride) is chemically labile, as it is a structurally plastic aggregate, occupying a middle position between the two extremes, determined by treatment (*a*) with alkali hydroxides, (*b*) with halogen hydracids, both in presence of water.

These extremes are both chemical and structural; under (*a*), the carbonyl groups show no reactivity and may be assumed to occupy a ketonic or cyclo-ketonic position in the aggregate: under (*b*), they become distinctly aldehydic, and in fact the aggregate is partly resolved with the production of free aldoses.

Structurally, the maximum of integration is attained under (*a*), whilst the maximum of disintegration is reached under (*b*).

This very wide range of variation falls mainly within the limits of hydroxyl reactions; the direct effects produced are those of hydration and hydrolysis, with the complementary phenomena of reversion.

In the case of the alkali hydroxides, the reactions, including the phenomena of "mercerisation" are chiefly those of hydration, some hydrolysis probably accompanying the effects, but without resolution of the cellulose to soluble forms, at least in the case of the normal cotton cellulose.

With acids, it appears that the hydrolysis which occurs and which, in fact, proceeds to the extreme limits—since the cellulose is partly resolved into the simple aldose—is accompanied by effects of reversion. The substances described by Stern have the character of reverted products.

In either case, it is obvious that the empirical composition of a final

residue throws but little light on the changes it may have undergone. In many such reactions, the alterations in composition are fractional, but it is none the less evident that profound constitutional changes occur.

A terminology for the brief expression of these classified effects must for the present remain on a conventional basis.

It would be convenient to retain the terms which have hitherto been current, namely, hydracellulose and hydrocellulose. The former might be limited to the products of the action of alkalis on cellulose, which are certainly hydrates; hydrocellulose, on the other hand, might be applied to the products of acid reactions, which are certainly hydrolysed, although in many cases showing the empirical composition of the original anhydride.

The latter have many properties in common with the "hemicelluloses," a term which is useful in designating a group of natural, mostly cellular, celluloses, which are distinct from the fibrous celluloses in chemical constitution as well as in structure and function in plant life ("*Cellulose*," Cross and Bevan, p. 87). This term might be very well extended to include the hydrocelluloses, if the suppression of the latter designation be considered advisable.

Whatever terminology may be finally adopted, it is important that in the meantime the empirical facts should be kept clearly expressed, and our purpose in this contribution is to prevent the confusion of issues which is likely to result from the theoretical views set forth in the paper now under discussion.