

degrees of transformation of the spiral lock into the flattened wave can be traced in such fleeces as the Border Leicester, according as the staples are free throughout their length ('locky') or compact below for a greater or lesser part of their length.

The change from spiral to wave is also recognisable in the first coat of sheep having a short compact fleece, as in the Merino and Southdown. At birth, as already remarked, the coat consists of independent spirals, maybe with an outer coat of kemp. The spirals grow upwards as the tip of the corresponding lock or staple and retain their form, while the wool below is in waves or crimps (Fig. 3). The spiral tips, known to the farmer as 'mother hair,' enable the woolman to determine wool of the first from later shearings.

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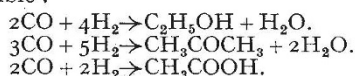
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The Reduction of Carbon Monoxide.

F. FISCHER (*Brennstoff Chem.*, 7, 97, 1926), in describing the formation at atmospheric pressure of solid, liquid and gaseous hydrocarbons by passing a mixture of carbon monoxide and hydrogen over a variety of catalysts, has advanced the theory that hydrocarbon formation depends on the transient formation of high carbon carbides which, by the action of hydrogen, give rise to products similar to petroleum. He states that no acids or other oxygenated substances are formed.

We have confirmed the formation of liquid hydrocarbons by passing an artificial water gas over a catalyst consisting of reduced manganese, cobalt and copper oxides (*Fuel*, 5, 263, 1926). Further experiments have shown the possibility of synthesising oxygenated compounds from this gas mixture, at ordinary pressure, although the literature available on the subject seems to indicate that pressure is essential for the production of such compounds. From thermodynamic considerations (Matignon), the reaction $\text{CO} + 2\text{H}_2 \rightarrow \text{CH}_3\text{OH}$ is scarcely possible at atmospheric pressure and $\text{CO} + \text{H}_2 \rightarrow \text{HCHO}$ cannot be carried out at all. The following reactions are perhaps possible:



In an experiment where a gas mixture (composition 53.9 per cent. carbon monoxide and 44.6 per cent. hydrogen) was passed at atmospheric pressure over a contact mass consisting of the reduced oxides of manganese, cobalt and copper, impregnated with 0.5 per cent. lithium carbonate at 302°C., we obtained evidence of the formation of products apparently similar to those obtained in the now well-known high-pressure reactions between these gases over certain catalysts.

In this experiment 1.2 c.m. of the gas mixture gave 1.4 gm. of a yellow oil not miscible with water, and water-soluble acids equivalent to 0.33 gm. of potassium hydroxide. The steam distillate from this solution of potassium salts of the acids, on distillation through a column, gave about 0.5 c.c. of a pleasant smelling liquid with a boiling range of 74-80°C. This liquid possessed a ketonic odour and gave the iodoform reaction in the cold, but did not readily reduce ammoniacal silver nitrate. Reducing substances were present in the aqueous part of the fractionated liquid. There was also formed 0.5 gm. of solid which blackened on exposure to light and air.

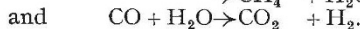
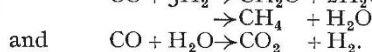
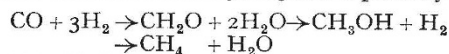
The theory of the intermediate formation of carbides

advanced by Fischer does not suffice to explain the formation of oxygenated compounds.

It is possible that the hydrocarbons he obtains are formed by the dehydration of alcohols followed possibly by hydrogenation, but again this does not explain the absence of acids and ketones from the products obtained by him at atmospheric pressure.

If the view is accepted that catalysis is an acceleration of reactions already taking place, then the formation of organic substances, other than methane and carbon dioxide, must depend on the preferential acceleration of the definite reactions which give rise to them. In the case considered here the question is complicated by the probability that not only does hydrogenation take place, but also oxidation, dehydration, and possibly polymerisation.

The reaction stages, if any, which lead to methane from carbon monoxide and hydrogen are possibly



Up to the present, however, the formation of formaldehyde and methyl alcohol has not apparently been established at ordinary pressure without the intervention of extraneous sources of energy such as ultra-violet light, X-rays, etc.

The formation of oxygenated compounds and hydrocarbons may also be regarded as being preceded by the hypothetical formation of methyl alcohol, which is converted, according to the catalyst and the experimental conditions, into methane or into other substances. Thus the reaction may proceed in consecutive stages or the catalyst may accelerate one or more of the thermodynamically possible reactions from carbon monoxide and hydrogen. No doubt, where a mixed product of aldehydes, ketones, acids and hydrocarbons is obtained, both of these courses may be followed.

Manganous oxide, cobalt and copper are not generally considered to have dehydrating powers as catalysts, but Medsforth (*J. Chem. Soc.*, 123, 1452, 1923) has explained the action of nickel in methane formation as being partly of a dehydrating nature, while the addition of oxide with dehydrating properties leaves the nickel more free to accelerate the hydrogenation stage of reaction. Nevertheless, we are of the opinion that the majority of the products obtained, in which acids, alcohols, ketones, aldehydes and hydrocarbons are all probably present, are formed simultaneously rather than consecutively. Carbon dioxide, water and methane would have to be considered in formulating chemical equations for the reactions involved.

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The Spark Spectrum of Lithium.

It has been shown by Schüler and the present author that the first spark spectrum of lithium (the Li II spectrum) is of the same type as the arc spectrum of helium and consists of two spectral systems. In a letter published in *NATURE* of October 17, 1925, a scheme of those terms of the lithium spark spectrum was given, which must be considered as analogous to the terms of the ordinary 'doublet' spectrum of helium (the orthohelium spectrum). In this note the results of further research on the lithium spark spectrum will be given. A number of new spark lines has been found which makes it possible to establish a series scheme of the terms of the lithium spark spectrum which are analogous to the terms of