carcinomata and sarcomata, the Peyton Rous chicken sarcoma, tar carcinoma in rabbits, and all kinds of human cancers, which qualitatively and almost quantitatively show the same result. We have here, therefore, a general characteristic of carcinoma and sarcoma cells which is entirely independent of any particular kind of irritation or of the nature of the normal tissue in which the tumours originate.

If, now, it be asked in what manner tumour metabolism arises out of normal cellular metabolism, it is necessary to inquire first of all under what conditions normal cells split glucose into lactic acid. Normal body cells produce lactic acid when their respiration is inhibited, either by cutting off the supply of oxygen or by poisoning. The production of lactic acid from glucose is, therefore, no peculiar property newly acquired when tumours first form, but is a property common to all body cells. But whilst in normal cells lactic fermentation is only set up by absence of oxygen, tumour cells always produce lactic acid, even when they are fully supplied with oxygen.

The results of these investigations may therefore be summed up in the statement that the tumour, so far as its metabolism is concerned, always behaves as a normal growing cell in a state of asphyxia. If normal growing cells be deprived of oxygen, then we have the reaction of a carcinoma cell. Since by deprivation of oxygen respiration is inhibited, fermentation cannot be masked or prevented, and the asphyxiated cells continue to produce lactic acid in excess, even when the oxygen supply is restored. Most of the cells so treated die because they are unable to live at the expense of energy of fermentation. Only a small number of them remain alive, and in their nature, magnitude and action they are indistinguishable from carcinoma cells.

Dr. Warburg then considered the question whether the asphyxia of normal growing cells sufficed to bring about the cancerous state, or whether other unknown factors also played a part. Reference was made in this connexion to the recent experiments of Carrel, Dresel and Wind, in which the attempt was made to discover whether carcinoma cells can not only exist without breathing, through energy of fermentation, but can also grow. The general conclusion was that tumour cells, like yeast, cannot live their full period without oxygen, but that both kinds of cells are able to grow for a time without oxygen, by the energy of fermentation, and that the asphyxiation of normal growing cells is sufficient to produce the cancerous state

Hæmoglobin.

HÆMOGLOBIN, the oxygen-carrier in the blood of vertebrates, upon which life depends, is a substance of great interest and importance, the investigation of which has received considerable attention from research workers. Prof. J. Barcroft, whose lecture on hæmoglobin, delivered before the Chemical Society on February 11, 1926, has been published in the Society's journal for May 1926, gives an account of recent investigations on the subject.

The old idea that hæmoglobin is a compound of two bodies, called *hæmatin* (containing iron) and a protein, *globin*, is not altogether untrue. The well-defined crystalline substance *hæmin* is obtained by the action of glacial acetic acid on dried blood. When hæmin is oxidised in the presence of alkali, hæmatin is obtained. Alkaline reduction of hæmin yields *hæm*, a substance having an ill-defined spectrum. Nicotine, pyridine, globin, etc., when added to hæm, produce a class of substances with well-defined and similar spectra, called *hæmochromogens*. Of these it appears that the globin compound alone can form a hæmoglobin by regulation of the hydrogen-ion concentration. Cytochrome, another substance well known to the biochemist, has been proved by examination of the absorption spectrum to consist of three hæmochromogens.

The determination of the equilibrium constant K for hæmoglobin and oxygen and for hæmoglobin and carbon monoxide by the ordinary methods of gas analyses is exceedingly difficult on account of the low pressures of the gases involved, and methods have been worked out which involve spectroscopic measurements. The velocity constants, k and k', for these reactions have been obtained by an ingenious form of apparatus which overcomes the difficulties due to the high order of velocity by very rapid mixing of the components. For the reaction $HbO_2 \longrightarrow Hb + O_2$, k' is relatively small, whereas the constant for the formation of the oxide is very large and is also comparatively independent of the temperature and hydrogen-ion concentration. It follows that the equilibrium constant, $K = k'/k$, must be a measure of the effect of the reduction phase. Parallel observations with carbon monoxide show that the slow-reduction phase in the case of oxygen is peculiar.

There is a shift towards the blue in the position of the important α-band in the absorption spectrum when the hæmoglobin is treated with carbon monoxide. This shift, measured in Ångström units, is called the 'span,' and a nearly linear relation is obtained between log K and the span of hæmoglobins from various sources, where $K[HbO_2] \times [CO] = [HbCO][O_2]$. This is supposed to indicate that "there are a limited number of hæmoglobins, say two, which in different animals are mixed together in different proportions." The difficulties encountered in the measurement of osmotic pressures are also considered and in conclusion attempts are made to reconcile the equation, $Hb_4 + 4O_2 \rightleftharpoons Hb_4O_8$, which these measurements indicate, with the shape of the equilibrium curves previously obtained.

Contact Catalysis.[1]

THE Committee on Contact Catalysis under the chairmanship of W. D. Bancroft has performed an excellent piece of work in collecting together and commenting upon the interesting peculiarities of surfaces in affecting the rates of chemical change of reactants at, or in close proximity to, those surfaces. Whilst certain purists may object to the term 'contact' in connexion with reactions the velocities of which are accelerated by the presence of substances which, although taking part in the chemical change, are not present either in the eactants or products in stoichiometric quantities; yet the word possesses advantages in differentiating homogeneous reactions from reactions heterogeneously accelerated.

In the United States, Dr. H. S. Taylor himself has been largely instrumental in stimulating interest in problems in this field, which during the last decade has attracted an increasing number of research students in all countries, and from which a remarkable crop of new technical industries, not without economic value, has already been harvested.

In 1917 Langmuir showed that chemical reaction

[1] Fourth Report of the Committee on Contact Catalysis. By Hugh S. Taylor. *Jour. Phys. Chem.*, xxx, 145, 171, Feb. 1926.