the two would interact reversibly to their mutual destruction:

At high temperatures, such perhydrols would no longer be formed and the direct combustion of the carbonic oxide with the aid of hydrogen, acting as depolariser, would be effected without their interference and with special readiness.

One other case of apparently anomalous protection against oxidation may be referred to—that afforded by so-called rustless steel and the more recently introduced soft alloy staybrite. The former is a chromium steel, the latter an alloy of iron, nickel and chromium, as free as possible from impurities. That chromic acid will protect iron against oxidation is well known. It may be supposed that, in an alloy of iron with chromium, in which the chromium is properly distributed, both materials undergo surface oxidation to perhydrols, which act reversibly, so that at most a layer of molecular thickness is affected, a coating being formed which may well correspond with the (?) unimolecular layer of oxide upon the surface of the far more sensitive metal aluminium.

It is permissible to suggest that the influence of certain dyestuffs in checking the "fogging" of an undeveloped photographic plate may perhaps be traceable to the initial production of antagonistic perhydrols by simultaneous hydroxylation of the sensitive film and the coloured material.

Finally, some reference to the oxidases may not be out of place. These are commonly spoken of as enzymes but they are in no way comparable with

these, in so far as they act selectively. They are only selective in the broad sense, that they are effective agents in determining the oxidation of compounds of a particular general type. Thus so-called tyrosinase will determine the oxidation of phenolic compounds of a certain type—not of tyrosin alone. This is true of "oxidising" organisms, such as *Bacterium aceti* and *B. xylinum*. The behaviour of *B. aceti* is altogether peculiar—although active towards ethylic and normal propylic alcohols, it has no action upon either methylic or isopropylic alcohol. At present we know so little of the process at work that it is impossible to attempt any precise explanation of these peculiarities. It may be suggested, however, that they are traceable both to configurational and energy differences in the systems concerned; moreover, it is clear that something more than the simple, direct oxidation of the alcohol is to be contemplated and that cross-interactions may be at work. Maybe we shall have little success in interpreting such actions until we no longer think " on paper " but have clear conceptions of the solid configuration of molecules. The oxidases may well be discarded from the class of enzymes and regarded as simple catalysts--of a parity with platinum black.

Not a few mysterious processes may be open to interpretation in accordance with the principle developed in this essay. The peculiar behaviour of phosphorus is a case in point—especially the dependence of the appearance of luminosity upon the partial pressure of the oxygen and the phenomena of intermittent luminosity to which Lord Rayleigh has recently directed attention. Little can be said with advantage, however, until we know far more of the several stages of the oxidation process—which may well be as complex as that of the interaction of nitric acid and metals.

Genetical Investigations.

THE practical value of chromosome studies is perhaps nowhere better demonstrated than in the wheats, where the species belonging in different groups have different multiples of $_7$ as their chromosome number. In hybrids between species with different numbers of chromosomes, the peculiarities in the hybrid behaviour are largely explained by the history of the chromosomes, some of which pair in meiosis while others remain single.

Sax and Gaines 1 draw several conclusions from a study of hybrids between emmer wheats (28 chromosomes) and vulgare wheats (42 chromosomes), which have been grown through several generations. The various segregates tend ultimately to have the same chromosome numbers as the original parents. This is accomplished through sterility or loss of chromosomes in forms with intermediate numbers, as has been found also in the Enotheras and in other cases. Segregates with 28 chromosomes resemble the emmer wheats, while those with 42 have most of the vulgare characters. This indicates that the 7 extra pairs of chromosomes determine most of the vulgare characters. The chromosome behaviour would lead to the expectation that ordinary Mendelian segregation would occur in characters, such as presence or absence of awns, yellow or black awns, and red or white grain, which are common to both the emmer and vulgare groups of wheats; while aberrant segregation would occur in regard to characters which distinguish the two groups. This is largely borne out by the

¹ Sax, Karl, and Gaines, E. F., 1924, "A Genetic and Cytological Study of certain Hybrids of Wheat Species," *Journ. Agric. Research*, 28 : 1017-1032, pls. 2.

results of experiment. Some of the segregates show combinations of typical emmer and vulgare characters, which indicates that the 7 unpaired chromosomes (which are irregularly distributed in meiosis) independently determine particular characters of the vulgare group.

Another interesting result, obtained by Mr. and Mrs. Sax,² is derived from a cross between $\mathcal{E}gilops$ cylindrica, a grass found in Italy, the Balkans, and neighbouring countries, and Marquis wheat, one of the most productive varieties of *Triticum vulgare*. $\mathcal{E}gilops$, like the emmer wheats, is tetraploid, having 28 chromosomes. The F₁ hybrid with *T. vulgare* is pentaploid (35), but unlike the crosses between tetraploid and hexaploid wheats, there are only 6 or 7 bivalents in meiosis (instead of 14), the remaining 21 chromosomes remaining univalent or unpaired. Nevertheless, the tetrad divisions are run through with very few irregularities, some of the univalent chromosomes apparently dividing in the first meiotic division while others divide in the second. The F₁ hybrids are in general intermediate between the parents, and are almost but not completely sterile.

The authors point out that this species of Ægilops and another both contain all the characters which distinguish the vulgare from the emmer wheats; and they suggest that the hexaploid vulgare wheats may have arisen through a spontaneous cross between Ægilops and a tetraploid (emmer) wheat. Irregular distribution of the unpaired chromosomes, of which there would probably be 14, would occasionally

² Sax, K. and H. J., 1924, "Chromosome Behaviour in a Genus Cross," *Genetics*, 9: 454-464, pls. 2.

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produce a gamete with 21 chromosomes. The union of two such gametes, if the chromosomes were balanced in qualities as well as in numbers, might have produced the first of the hexaploid wheats. Thus is crossing combined with chromosome aberrations made the basis for a theory of the origin of our cultivated wheats.

Contributions continue to be made to the study of size inheritance. The prevalent interpretation is that size in organisms and in their parts is controlled by cumulative polymeric size factors the various increments of which give the appearance of a continuous series. Much evidence is appearing in favour of this view. Sax ³ has 'recently, from experiments' with beans, found evidence of linkage between certain seed-coat colour patterns and certain factors for size of seed. Cases have even been found in which a factor for large size was contributed by the small parent. Such a result might occur if the small parent contained a few factors for large in addition to a number which made for small size.

Closely related to size-inheritance are the problems of shape. The work with animals indicates that some size factors may affect the body as a whole while others independently determine the size of particular organs. These conceptions have already been applied by Davenport to man, and in a recent contribution ⁴ he considers the inheritance of body build. He recognises five classes of build, ranging from very slender to very fleshy. Two slender individuals usually have only slender children, while the progeny of fleshy individuals are much more variable. Such data lead again to the hypothesis of multiple factors, and it is believed that in some families so many as three genetic factors for increasing fleshiness are present. These factors are thought of as influencing size by the effect they have upon the activity of the thyroid, pituitary, and other endocrine glands.

Similar conceptions are being applied by Frets, Hildén, and others to the inheritance of head-shape. Thus it appears that several factors for broader head may change a dolichocephalic to a brachycephalic skull. Thus genetics is destined to have a fundamental effect upon the interpretations of anthropologists. R. RUGGLES GATES.

The Carbonisation of Coal.

THE Chemical Engineering Group of the Society of Chemical Industry met on July 16 at the forty-fourth annual meeting of the Society at Leeds. Three important papers on features of coal carbonisation were read before a crowded audience, and the discussion had to be adjourned to another session proposed to be held in Leeds in the autumn. Solid fuels were dealt with in two papers: "Smokeless Fuels—the Present and Future Possibilities," by C. H. Lander and Margaret Fishenden, and "Solid Smokeless Fuels," by E. C. Evans. In the former paper the British fuel situation was analysed, particularly with the view of estimating the possibility of establishing new carbonising industries. If all coal were to be pre-carbonised, the disposal of gas and tar would become considerable problems. If domestic fuel only were to be carbonised, this difficulty would be much less, but it was considered that a coke of much more suitable character than that currently produced in gas works would be required. The domestic fuel market is the most promising outlet for carbonised

^a Sax, K., 1924, "The Nature of Size Inheritance," Proc. Nat. Acad. Sci., 10: 224-227. ^a Davenport, C. B., 1925, "Body-build: its Development and Inheritance," Eugenics Record Office, Bull. No. 24, pp. 42, figs. 25.

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fuel of suitable character. It was concluded that the most suitable carbonisation process to meet this need cannot be defined with certainty. The solution of the problem may prove to be not in any single method of carbonisation but in several, each operating in circumstances most favourable to its requirements.

E. C. Evans gave a classification of smokeless fuels, directing attention to the properties of anthracite, for which there is a steady demand even to-day, in spite of its high price. This points a moral to those desirous of introducing carbonised domestic fuel. Gas coke he considered as far short of the ideal, particularly because of its high ash and moisture content. The reactivity of coke was treated at length, and the factors influencing it were analysed. Methods of low temperature carbonisation were discussed. In summing up, Evans thinks that low and high temperature systems are approaching one another, and that ultimately a compromise will establish itself. In the discussion it was significant that, in so representative an assembly of fuel technologists, no one could be found to assert confidently the commercial feasibility of existing methods of low temperature carbonisation which figures so prominently in the Press and on the platform.

F. S. Sinnatt and J. G. King brought forward a study of the tars and oils from coal. From an analysis of the economics of mineral oils and coal tars, they drew the conclusion that the prices obtainable for low temperature tars would, so far as present promise goes, be low and liable to great fluctuation. The calorific value of such tar is low, and the difficult miscibility with mineral fuel oil is a limitation. This is not necessarily fatal, for the Lessing process for separating the pitch-giving constituents, now under trial at the Fuel Research Station, shows considerable promise. Some account of these results was given. The limited knowledge of the chemistry of low temperature tar was emphasised, and it was suggested that organic chemists should take up the study of its properties. The production of liquid fuel from coal, either by hydrogenation of the coal or of the gasified product, was also discussed.

University and Educational Intelligence.

"INFORMATION regarding courses and careers open to students of science " proposing to enter the Faculty of Science of the University College, Cardiff, is given in a little pamphlet issued this year for the first time by the College authorities. It follows the lines of the similar pamphlet issued by the University of Birmingham last year and represents a commendable anxiety on the part of the College to acquaint parents, guardians, and heads of schools with the opportunities it offers, so that the last year or two at school of those intending to go on to college may be utilised to the best advantage.

FROM the Royal Technical College, Glasgow, and the Merchant Venturers' Technical College, Bristol, we have received prospectuses for 1925–26. The former, which is the only institution in Great Britain providing regular courses in the technology of sugar manufacture, announces that to meet the requirements of the beet sugar industry, the lectures in this subject will begin in January and will extend over the summer session. Both Colleges give lists of the engineering firms which offer facilities to students for acquiring practical experience in their works. The Merchant Venturers' College offer, as alternative courses for the degree of B.Sc. in engineering, a