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Crystals and Cells.

UNTIL very recent years, the addresses of presidents of Sections of the British Association were never made subjects of formal discussion. The address delivered on Monday, August 11, by Sir William Bragg to Section A (Mathematical and Physical Science) of the British Association meeting at Toronto departed from the former custom in being an introduction to a joint discussion with Section B (Chemistry), on crystal structure. Sir William Bragg explained how X-rays have made it possible to analyse the structure of crystals, thus opening up the chemistry of the solid. The X-rays tell us the number of molecules in the crystal unit and the mode of their arrangement, on which, of course, many properties of the substance depend. It may be noted that just as there are *atoms* of silicon and of oxygen, and a *molecule* of silicon dioxide, so there is a *crystal unit* of quartz consisting of three molecules of silicon dioxide arranged in a particular way. There are thirty-two classes of crystals, according to the kind of external symmetry which they display; but now that he can look into the interior of the crystal, Sir William Bragg finds that there are 230 different modes of internal arrangement. This is a new kind of crystal-gazing.

It has often been asked why a crystal should grow ("Lapides crescunt," said Linnæus) in a solution, especially when the substance in solution is different from that of the crystal, though crystallising in the same style of architecture. There is a welcome beam of light in Prof. Desch's paper on the crystal surface, for it shows that the aplomb of the atoms on the space lattice of the interior, where they are held in position by forces symmetrically disposed, is not shared by those on the surface layer, where there is surface tension and a welcoming, so to speak, of support by accretion from without. At high temperatures, it is noted, the surface tension may be sufficient to cause rounding of the sharp angles of a crystal.

The key-note of the Toronto meeting seems to be "control," for we find Prof. F. W. Gamble, in his presidential address, telling the zoologists that "zoological problems have become problems of control," not so much in the way of restraint as of "quickening." "The infinitely varied animal fabric appears to be the exquisitely balanced individual expression of processes that quicken and restrain." "If to succeed is to come up from below, the actual animal life that succeeds must be but a fraction of the submerged recessive life that experiment reveals. These recessives when artificially bred are no mere cripples, nor disconnected with the evolution of normals. They show us something of the depths of animal nature, and help us to realise that

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but for the grace of organic regulation we should be even as they. But the study of such analysis as a branch of zoology leads to an even more striking result. Not only does it reveal the existence of these sub-normals, but also it accounts for the defection of certain expected offspring. There are non-viable combinations of living substances. These entering the egg that should by expectation produce a male, render the egg incapable of development. That family will be one of daughters only. The existence and the control of lethal factors is one of the most significant discoveries of the underworld."

Prof. Gamble is a strong swimmer and he led his audience into deep waters in his discussion of Prof. Child's hypothesis of metabolic gradients. That is to say, there is in an animal like a Planarian worm a gradation in the intensity of chemical change or metabolism from the head backwards. The rate increases again at a point far down the body and then falls to the tail-end. The second, smaller peak marks the place where the worm divides transversely in its asexual multiplication; it marks the site of the future head of the coming daughter! Prof. Gamble regards the suggestiveness of the evidence in support of the gradient hypothesis as exceeding its conclusiveness for the time being. He goes on to discuss with insight the periodicity of vital functions, the problem of nervous control, the control of environment, and the lightening of the eyes that will come when people take zoology seriously.

In his address to Section M (Agriculture), Sir John Russell discussed "Present-day Problems in Crop Production." One of the big conclusions that has emerged of recent years is that the plant is an even more plastic organisation than we thought; it can be moulded to a notable extent, though within certain—very uncertain—limits. One way of doing this is the Mendelian method of picking out desirable unit characters from plants in which they occur and assembling them in a new plant. The other way is selection, in which a desirable plant is caused to produce seed from which stocks are multiplied. A second generalisation is that the soil is not a fixed, constant thing, but is pulsating with change. The micro-organisms fluctuate continually, and even the mineral part of the soil is not constant in composition. "Modern research work shows that many of the properties determining fertility in soils are due to the soil colloids, and some of the most important are attributable to calcium complexes. These are unstable and are affected by the soil water."

Sir John Russell spoke of the control of the plant, the control of environmental factors (for example, by high-tension electric discharge), the control of soil factors, and the control of soil organisms. But he sounded another note, too seldom heard in these utilitarian days; he spoke eloquently of the value of science for its own sake. "How many farmers know anything about the remarkable structure of the soil they till, of its fascinating history, of the teeming population of living organisms that dwell in its dark recesses, of the wonderful wheel of life. . . ." "No one knows much of these things; but if we knew more, and could tell it as it deserves to be told, we should have a story that would make the wildest romance of human imagination seem tame by comparison, and would dispel for ever the illusion that the country is a dull place to live in." This is well said. Trust the agriculturist, fundamental utilitarian as he is, to be loyal to the life that is more than meat.

A familiar experience at meetings of the British Association, especially if one wanders out of "one's own Section," is a coercive abandonment of facts and conclusions which one had treasured as absolutely certain. This holds for the Toronto meeting. Thus it used to be common teaching that the earliest Pre-Cambrian rocks represented the original crust of the earth, formed as it cooled from a molten to a solid condition. This was a comfortable view, for it gave one, so to speak, a geological jumping-off place. But Prof. A. P. Coleman has punctured our illusions in his paper on "Pre-Cambrian Climates." For it seems that there was before the Cambrian a long period of desert conditions and a making of red sandstones; before that was a time of cool moist climate and a making of grey carbonaceous slates; and before that there was a Huronian Ice Age. "Below this, after a profound break, is the Sudbury or Timiskaming series, mostly of water-deposited materials, including 4000 feet of well-banded greywacke and slate, evidently of seasonal origin. This gritty but well-established material and some boulder conglomerates make one suspect a cold and perhaps glacial climate." So the story runs; and the Pre-Cambrian basis, once regarded as primordial, is shown to have behind it a stupendous history.

It is well known that two forms of digestion—intra-cellular and extra-cellular—occur among animals. Intra-cellular digestion, where the food is taken into ingestive cells and then digested, occurs, as Mr. F. A. Potts points out, in sponges, stinging animals, flat worms, and molluscs, often accompanied, however, by the extra-cellular method where the secretion of a digestive juice dissolves the food in the cavity of the food-canal. The latter is the exclusive method in Annelids, Arthropods, Echinoderms, and some smaller phyla. "In the Gastropod Molluscs digestion in the flesh-eating forms is mainly extra-cellular; in the

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vegetarians it is largely intra-cellular." In some cases of specialised diet the intra-cellular method is prominent, as Mr. Potts illustrates by the case of the wood-boring Teredo. In some wood-eating Arthropods like termites, in which there is no intra-cellular digestion, the function has been taken over by symbiotic Infusorians.

In an interesting study of sex-development in fowls, Dr. F. A. E. Crew propounds the view that the genetic constitution of the individual determines what may be called the internal environment in the direction of "femaleness" or of "maleness." "In an internal environment of 'femaleness' the embryonic gonad becomes an ovary, in one of 'maleness' a testis. The bird has an ovary because she is a female, a testis because he is a male. The type of plumage is determined by the type of metabolism which obtains at the time of its development, and is not a response to any specific influence of an internal secretion elaborated by the differentiated gonad." The physiological theory of sex, championed by Geddes and Thomson long ago, is having its innings.

Dr. F. A. Dixey's paper on the minute scent-distributing structures in white butterflies is of noteworthy interest. There are secretory cells and distributing scales. The scent-distributing scale is usually a rather highly specialised structure, often in the form of a flattened lamina provided distally with a fringe of chitinous filaments, and proximally with a fine flexible footstalk. The latter expands into an accessory disc, very varied in size and character. The disc is inserted into a specialised socket, within or beneath which are found the cells that secrete the scent. Everything is so minute that it is difficult to be sure how the scent escapes. Dr. Dixey finds no convincing evidence of pores, and inclines to Weismann's view, that the scented material passes from the secretory cells into the disc, the footstalk, and the lamina.

The physiologists continue to discover new rôles for hormones. Thus Prof. W. B. Cannon and Dr. A. Querido find that adrenal secretion is increased in animals when there is liability to lowered temperature by heat loss. The increased secretion brings about an increased metabolism, a chemical calorigenesis, quite apart from the muscular movements of shivering. So the animal has two distinct lines of defence. In another paper by Prof. A. T. Cameron, Dr. T. Ingvaldsen, and Dr. J. Carmichael, evidence is brought forward to support the view that the internal secretion of the thyroid is a compound of thyroxin with some other radical which considerably increases its activity.

Prof. H. Wasteneys and Mr. H. Borsook have succeeded in effecting the enzymatic synthesis of protein in peptic digests of albumin. The maximum synthesis so far obtained has been 39 per cent. There is "incontrovertible evidence" that the material synthesised is of the order of complexity of native proteins. The enzyme responsible for the synthesis was found to be inseparable in every respect from the enzyme effecting the hydrolysis of proteins.

Every one is familiar with the feeling of having seen the same thing before, though one knows that it could not be so. This is the phenomenon of "déjà vu," which Grasset and Freud have explained as due to the activation of an unconscious memory of a real event, a fantasy, or a dream, which in some way resembles the coincident, conscious perception. The problem has been rediscussed by Dr. J. T. MacCurdy, who has found a somewhat analogous pathological phenomenon —the perplexity case—apparently with a similar obsessive suggestion of familiarity. As often happens, the pathological throws light on the normal.

Prof. G. H. Parker has been able to determine the amounts of carbon dioxide excreted by the lateral line nerve of the dog-fish, the sciatic nerve of the frog, and the ventral nerve cord of the lobster. The quiescent frog nerve produced on the average nine-thousandths of a milligram of carbon dioxide per gram of nerve per minute. In active nerve this was increased by about twelve per cent. Weight for weight, the resting frog nerve produces about the same amount of carbon dioxide as the resting human body does.

These, however, are scarcely more than random comments upon a few of the extraordinarily interesting series of addresses and papers presented at Toronto. A more adequate survey of the wide range of subjects brought before the various Sections must be reserved for later issues.

The Metallurgy of Iron and Steel.

(1) *Lehrbuch der Eisenhüttenkunde: verfasst für den Unterricht, den Betrieb und das Entwerfen von Eisenhüttenanlagen.* Von Prof. Dr. Bernhard Osann. Zweite neubearbeitete und erweiterte Auflage. Erster Band: Roheisenerzeugung. Pp. xi+923. (Leipzig: Wilhelm Engelmann, 1923.) 29*s*.

(2) *The Metallurgy of Steel.* By F. W. Harbord and J. W. Hall. (Griffin's Metallurgical Series.) Seventh edition, thoroughly revised. Vol. 1: Metallurgy; by F. W. Harbord. Pp. xii+545+41 plates. Vol. 2: Mechanical Treatment; by J. W. Hall. Pp. xv+553+42 plates. (London: C. Griffin and Co., Ltd., 1923.) 32*s*. net each vol.

WHILST primitive methods of making malleable iron or steel were mainly conducted in such a way that the product was obtained directly from the

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