pounded are recommended for use for skins infested with insects, for it prevents insect pests and mildew "ever appearing afterwards." Great care is always necessary in the use of poisons; but as there is no greater danger in using arsenical soap containing bichloride of mercury than an alcoholic solution of the salt, we are at loss to understand his strong denunciation of the evidently more efficient medium. The present writer has found no preservative equal to it, and has used it for thousands of skins, bird and mammal, in various regions of the globe, and cannot recollect to have lost one by moth, mite, or dermestes—except when the soap was insufficiently applied. Many of them also, after lying for years as dry skins, have been relaxed, and have proved all that could be desired. The alcoholic solution of corrosive sublimate applied to a tender skin renders it very brittle, a result entirely obviated when the salt is incorporated in the soap. Several formulæ, of which Mr. Browne claims the authorship, are given for the preservation of cartilage; but we miss any reference, either in the book itself or in the bibliography at the end, to Prof. Jeffery Parker's methods. He was one of the first, if not the first, to preserve cartilaginous fishes as "dry" specimens in museums, by very similar, if not essentially the same, processes as Mr. Browne.

Not the least valuable section of the book is the ninth chapter, describing "casting and modelling from natural foliage, flowers, fruits, algæ, fungi, &c., and their reproduction in practically indestructible materials,"—the Mintorn Art Fabric. This is quite a recent branch of the taxidermist's art—if it really belong to it—which is as important, and demands equal care an ability as the mounting of the specimen which it is to enhance. The reproduction in this material of the species of the British flora in our museums would prove a very great incentive to the study of botany, which even the best prepared herbarium can scarcely be said to do. How naturally such plants can be modelled may be seen from the second plate (Fig. 2), which we are kindly permitted to reproduce. The volume, which is dedicated to the *doyen* of museum reformers, Sir William Flower, is so beautifully printed, illustrated and bound, that we feel we cannot close our commendation of the author's part without a word of appreciation of the publishers' share in its production.

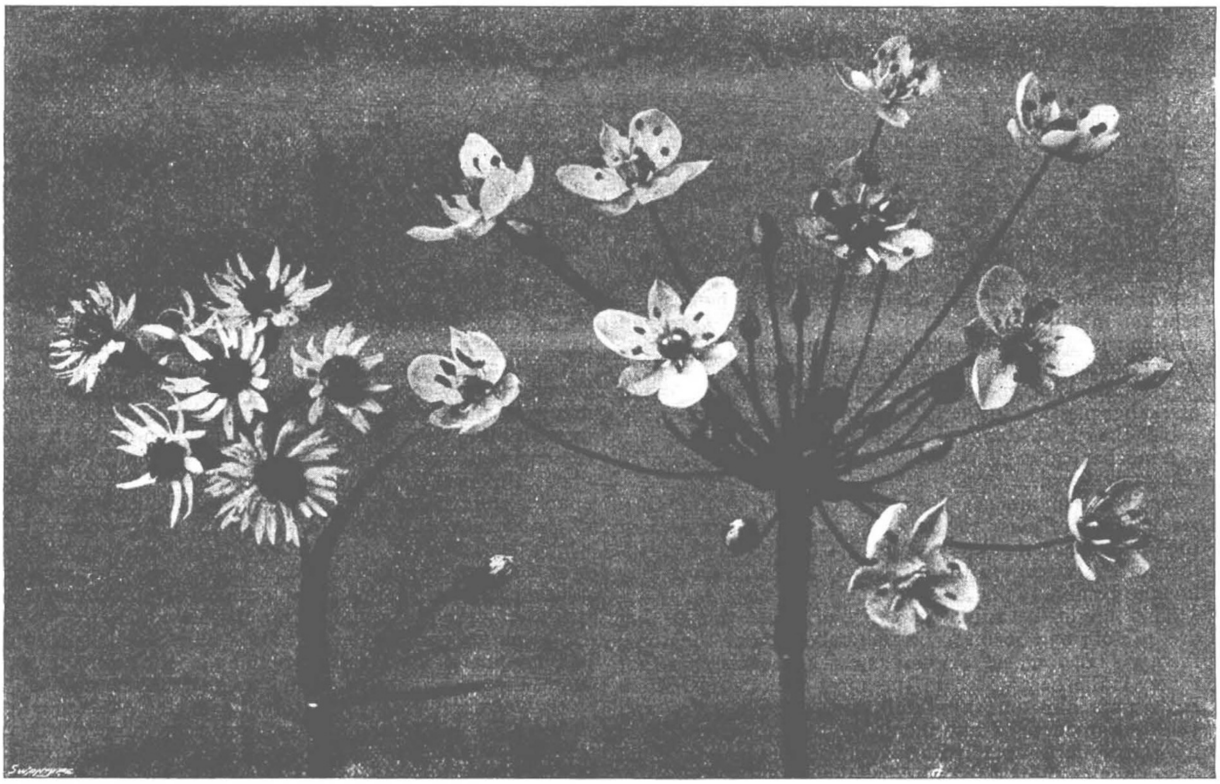

Fig. 2.—Models, in Fabric, of Sea-Aster and Flowering Rush.

PROGRESS IN STEREOCHEMISTRY.

To the stronger minds among men of science, exercised in abstract conception, and independent of such aids to the imagination as are embodied in drawings of atomic arrangements, models of molecules and even formulæ of atomic groupings, there is no doubt something almost repulsive in the representation of the molecule as a machine, a combination of mechanical powers. It is nearly forty years since the screw was suggested (by Pasteur) as a symbol of the atomic arrangement in tartaric acid, and now we find the lever introduced in such phrases as "the moment of a chain of atoms varying with its length." The wheel-and-axle has not yet been pressed into the service to explain atomic vagaries; and of the philosopher who shall venture to take this further step, the abstract thinkers of to-day will surely say, as Kolbe said of the chemist who was destined to succeed him in his professorial chair at Leipzig: "Hereby he declares that he has left the ranks of men of science, and has gone over to the camp of those philosophers of ill-omen, who are separated from the spiritualists by only a very thin *medium!*"

Yet as surely as Kolbe was succeeded by the stereochemist whose doctrines he denounced, so surely will the vague atomic groupings of to-day be succeeded by definite systems, in which each atom will have its orbit mapped out with ever-increasing minuteness; for as long as the atomic theory endures, so long will it become more and more of a mechanical theory; and indeed it would be absolutely inconsistent, when we are perpetually striving to arrange the atoms of a molecule into groups, to give up all attempt to determine the relative positions and motions of the groups and of the atoms within them. It is as true to-day as it was when Kekulé published the statement in his "Aims and Achievements of Scientific Chemistry," that as the great present aim of physics is the elaboration of a system of molecular mechanics, so the great present aim of chemistry is the elaboration of a system of atomic mechanics, in which every reaction will be accounted for by the mass and motion of the reacting atoms. This may be deplorable; but those who think it most so, most keenly realise that it is true.

For instance, quite recently, in his plea for "Emancipation from Scientific Materialism,"[1] Prof. Ostwald wrote:—

"We read and hear with countless repetition the statement that the only intelligent explanation of the physical world is to be found in a 'Mechanics of the Atoms'; matter and motion appear as the final principles to which natural phenomena in all their variety must be referred."

With regard to physics, a similar acknowledgment is contained in the words of Duhem, uttered in 1894:—

"When the science of motion ceases to be the first in logical order of the physical sciences, and becomes only a special case of a much more general science, which embraces in its formulæ all the changes of bodies, the temptation will be less to try to reduce to the study of motion the study of all physical phenomena; it will be better understood that change of position in space is a problem no simpler than change of temperature or of any other physical property. Then we shall more easily avoid the most dangerous reef of theoretical physics —a mechanical explanation of the universe." (*Jour. de Mathématiques*, x. 207.)

Such statements as these are valuable, in that they remind us that even the most necessary of our present theories is a temporary makeshift—a crutch which indicates the weakness that it helps, and which we may hope to be able to discard.

This might be said, however, of most things that are useful; and it must be remembered that the same theory is not the best for every one. For each man that theory is the best which is the most stimulating, which best spurs him on to useful work, which urges and guides him forward into the unknown. Another theory may have more facts in its favour, but if these facts do not specially interest the worker in question, it will be of less value to him than a theory, otherwise inferior, which enables him vividly to realise, and aptly to utilise, those facts which do interest him.

Moreover, even if we admit that the atomic theory may be near the end of its existence, and that it may, and should, shortly be superseded by a more widely useful theory, it must yet be maintained that the way to hasten this consummation is to push the theory with all rapidity, and in every direction, to its extreme consequences, in the full assurance that, so far as it is incomplete, this will be the quickest way to demonstrate its deficiencies.

Now, among the consequences of the atomic theory, the consideration of the space relations of the atoms occupies the first place; it is not an extreme, but an immediate and a necessary consequence. For this reason alone, if stereochemistry did not exist, it would be necessary to invent it. But to find a *raison d'être*, stereochemistry needs no such arguments. It has justified its existence by its achievements.

[1] *Science Progress*, February 1896.

The stereochemical explanation of the existence and properties of the two different substances formed when a carbon atom unites with four dissimilar groups of atoms, has long been generally admitted. As to the exact three-dimensional formulæ by which we should represent these two substances, both of which correspond to the ordinary formula $CR^1R^2R^3R^4$, differences of opinion exist; but it is certain that the formulæ must resemble those given in the figures (1 and 2), in so far as these represent three-dimensional arrangements, each unsymmetrical, but such that the two together form a symmetrical whole; in other words, each being the mirrored image of the other. And space-formulæ, in these re-

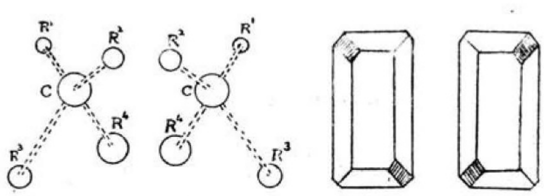

FIG. 1. FIG. 2. FIG. 3. FIG. 4.

spects similar, must be admitted for the two compounds formed by the union of a nitrogen atom with five different groups.

It is true that, beyond this, the services of stereochemistry are questioned by some chemists. Yet it cannot be denied that the tetrahedral grouping of the atoms combined with carbon forms a connecting link between whole groups of facts, in the most varied branches of organic chemistry, which, without it, would have been left in comparative isolation. But without entering into the necessarily complicated discussion of these developments, it may be shown, by the consideration of a single instance, that the simple original conception of the three-dimensional asymmetric grouping of dissimilar atoms about the carbon-atom to which they are attached, enables stereochemistry not merely to follow in the steps of structural chemistry, and to explain many anomalies which the latter leaves unaccounted for, but to push its investigations in advance, and to declare the space-relations prevailing in the molecules of substances as yet never analysed, and even never isolated.

The action on polarised light of a substance in solution is a test for the asymmetric grouping of the atoms in its molecules. Just as when we find a substance crystallising in two forms, such as Figs. 3 and 4, having the relation of the right and left hands, we know that these crystals will have the power of rotating the plane of polarised light to the right and to the left respectively; so when we find that a dissolved substance exerts a one-sided action on the light, we know that it possesses a one-sided molecule capable of existing in the right- and left-handed forms (Figs. 1 and 2); which, it will be observed, bear the same relation to each other as the crystal forms 3 and 4.

Further, it is known that although the two members of a pair of substances like those shown in Fig. 1 and Fig. 2, through the identity of their atoms and the equality of the distances dividing them, show no difference in their behaviour towards any ordinary substance, yet they differ entirely in their behaviour towards molecules which are themselves asymmetric. To go back to Pasteur's simile, they resemble equal screws with their threads turned in opposite directions. Both will fit the same hole equally well if it is an ordinary hole; but if it is a hollow screw, then everything will depend upon whether the thread of the hollow screw is right- or left-handed.

Conversely, if towards any substance the right- and left-handed molecules, $CR^1R^2R^3R^4$, act differently, we may conclude that this substance contains molecules which are themselves asymmetric. So that when we find, for example, a certain species of microscopic organism fermenting and destroying a "right-handed" sugar, but not attacking a "left-handed" sugar otherwise identical with the first, we may conclude that those molecules of the ferment which are concerned in the attack are themselves, all or some of them, of a decidedly right- or left-handed character. The line joining their atoms would itself be a spiral, the thread of a screw. And in fact we find living organisms to be largely composed of asymmetric molecules, albuminoids, which themselves exert a one-sided action on light.

It is evident, then, that there is a relation between a ferment and the substance it ferments, as between a solid screw and a hollow screw with threads which enable one to turn in the other.

And the recent researches of Fischer and Thierfelder show the relation between every turn of the two threads to be most intimate. In these experiments, twelve different species of yeast were obtained pure and free from other organisms, and fourteen different sugars were tested with each species of yeast. After eight days it was found that some of the sugars were completely fermented, some only partially, some not at all. And it was observed that the same ferment would attack sugars of widely varying composition, a sugar containing only three carbon atoms, *e.g.*, as readily as one with nine carbon atoms in its molecule. But directly it became a question of the geometrical structure of the sugar molecule the ferments showed the nicest particularity. In the case of sugars containing six carbon atoms and of exactly the same chemical composition, some would ferment readily, and others not at all.

For example, there were tested :

Dextro-glucose.	-mannose.	-galactose.	-talose.
O=C—H	O=C—H	O=C—H	O=C—H
HCOH	HOCH	HCOH	HOCH
HOCH	HOCH	HOCH	HOCH
HCOH	HCOH	HOCH	HOCH
HCOH	HCOH	HCOH	HCOH
HCOH	HCOH	HCOH	HCOH
H	H	H	H
I.	II.	III.	IV.

In each of these four molecules the atoms are the same in kind and in number. The only difference is that whereas in I. there is on one side of the molecule—say on the left, as in the formula given—only one OH group, in II. there are two OH groups on the left, in III. also two, but not the same two, and in IV. there are three. Now it is found that, with the same yeast-species, III. ferments with more difficulty than either I. or II., and the slight further change in the space-relations suffices to deprive IV. altogether of the power of fermenting. This is but one example of the way in which the yeast-cells pick and choose their food. Here, as Fischer observes, we have not simply to do with two similar substances of opposite activity—represented by screws having threads opposed throughout—but we find that of a great number of geometrical forms only a few satisfy the requirements of the yeast-cells; and these few forms are represented by screws in which the threads differ only as regards the direction of one or two of their turns. This may be illustrated by the figures below; for although it is impossible to give an exact representation of the geometrical forms of the molecules of the sugars in question, it is certain that the relations between their forms must correspond to the relations between the figures given, which are formed by a line starting from the COH group (*a*), joining C, OH, and H, always in the order named, and ending at the group CH_2OH (*B*). If the zigzag thus obtained be considered as the thread of a screw, it will be seen that in I. (Fig. 5) the thread is reversed at C^2 and again at C^3. In II. (Fig. 6), which also ferments readily, there is reversal at C^3 only, in

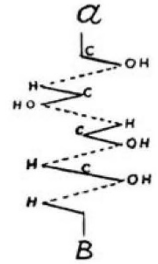

FIG. 5.

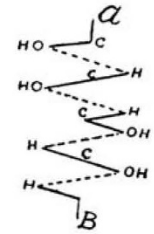

FIG. 6.

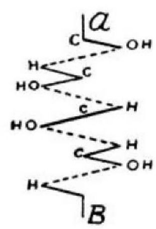

FIG. 7.

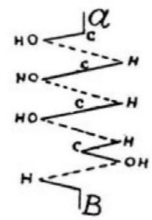

FIG. 8.

III. (Fig. 7), which ferments with difficulty, at C^2 and C^4, and in IV. (Fig. 8), which ferments not at all, a C^4 only.

These relations are shown yet more clearly in the following figures, in which the side of the OH group is represented by a broad curve, while the sharp angle is retained for the H side.

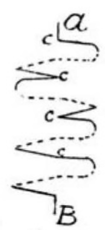

FIG. 9

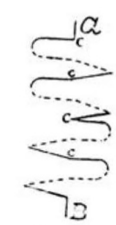

FIG. 10.

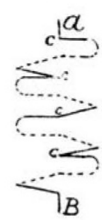

FIG. 11

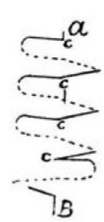

FIG. 12.

In the fermentation of all the sugars, the chief agent is, according to Fischer, proteid matter, a substance which is itself asymmetric, and which, being formed from the carbohydrates of plants, probably possesses a geometrical structure similar to that of the natural six-carbon sugars. Hence it can attack and ferment substances geometrically not far removed from these, *i.e.* from grape sugar. The question arises, Why do not all yeasts ferment the same sugars? If the origin of the fermenting molecules is in all cases the same, has a change of environment power to alter them, provided many generations of yeast-cells are exposed to the same conditions? In order to answer this question, Fischer and Thierfelder attempted to breed a yeast which should ferment a sugar its ancestors were incapable of attacking. Starting with a yeast which could attack only dextro-glucose, they mixed this sugar with its own weight of a left-handed sugar (l-mannose), and gradually increased the proportion of the latter during three months—a time sufficient for many generations of yeast-cells to succeed one another. When the proportion of glucose was reduced to one-half per cent. the fermentation still went on, but, on reducing it to nothing, fermentation ceased altogether.

So far, then, this attempt has been a failure. In another direction, however, the research was developed with more success. The experiments described had been complicated by the presence of an unknown factor—the life of the fermenting organisms. Analogous experiments were therefore made with lifeless ferments, or enzymes, such as invertin, and emulsion, by allowing them to attack molecules differing only in the space-relations of their atoms. It was found that their power of discrimination was no less exact than that of the living cell. The difference between a glucose- and a galactose-grouping (I. and III. p. 323), which is merely a matter of H and OH changing places, is for them a difference absolutely vital. In the one case they attack the molecule, in the other they will have nothing to do with it. The explanation is similar to that given in the case of the sugars. Invertin and emulsin much resemble proteids, and no doubt possess asymmetric molecules. Their limited action on the glucosides is therefore to be accounted for by the supposition that the approximation of the molecules necessary for chemical action is possible only for molecules of similar geometrical build. To use Fischer's simile, ferment and fermented substance must fit like lock and key. For stereochemistry this image is the more valuable now that the observations have been removed from the biological to the purely chemical field of the lifeless ferments. And indeed for physiological chemistry, also, this last step is no less important, since very many of the processes which go on in the organism are effected by lifeless ferments, and must be largely influenced by the geometry of the molecule.

Nevertheless, those who already deplore the use of materialistic aids to the scientific imagination will find, in this image of the lock and key, but another count in their indictment of stereochemistry.

ARNOLD EILOART.

NOTES.

A REUTER telegram reports that the English tourist steamer *Garonne* arrived at Vadsö on August 2, and landed some of the members of the British expedition to observe the forthcoming eclipse of the sun. They proceeded at once to the south of the Varanger Fjord, where Her Majesty's cruiser *Volage* had already landed the astronomical instruments required for the observations. The steamship *Norse King* also arrived at Vadsö on Sunday with a large party of astronomers to observe the eclipse.

THE prospects of astronomers who have gone to Norway to observe the forthcoming total eclipse of the sun, are decidedly good. A telegram has just reached us stating that Mr. Norman Lockyer, assisted by officers and men of H.M.S. *Volage*, has established a camp on Kio Island, and completed the arrangements for observing the eclipse. As many as forty observers will be employed at this station in recording various characteristics of eclipse phenomena. There is every probability that fine weather will prevail on the day of the eclipse at the station selected.

CANADA is not only to be the meeting-ground of the British Association next year, but also of the British Medical Association. At the annual meeting of the latter Association, held in Carlisle last week, it was decided to accept the invitation to meet at Montreal next year, at the end of August or beginning of September. The British Association meets at Toronto on August 18, so that it will be possible for the medical members of it to attend both meetings if they wish to do so.

DR. A. BALDACCI has undertaken, during the present year, a botanical investigation of Northern Epirus, especially the district of Konitza.

THE annual meeting of the Italian Botanical Society will be held this year at Pisa, from September 10 to 17. The proceedings will commence with an evening reception, and several botanical excursions are arranged during the week.

WE regret to announce the death of Sir William Grove, at the age of eighty-five. His investigations in physical science, and especially the voltaic battery which bears his name, earned for him a wide reputation. He was elected a Fellow of the Royal Society so far back as 1840.

A METEOR of great size is reported to have fallen on July 24, at the mines of Santos Reyes in the State of Chihuahua, Mexico. A loud explosion was heard, and a mass of luminous matter was seen to fall, striking the side of a mountain, and bringing down with it in its course a large amount of rock. The meteor finally buried itself in the ground to a great depth.

AN important astronomical expedition left Chicago a few days ago for Flagstaff, Arizona, and ultimately for Mexico. Mr. Percival Lowell heads the expedition, and will make observations of Mars, assisted by Mr. A. E. Douglas. Dr. T. J. See, assisted by W. A. Coggeshall and D. A. Drew, will study double stars, and make a survey of the southern heavens. Mr. Alvan G. Clark accompanies the expedition, to put up the 24-inch telescope which has been taken.

REUTER'S correspondent at Tromsö reports that the Conway expedition has successfully accomplished the first crossing of Spitzbergen from west to east and back. Starting from their headquarters at Advent Bay, on the south side of Ice Fjord, the party ascended the Sassendal, at the head of Sassen Bay, and, branching off into a long lateral valley, climbed to the high land, which was found to be one vast glacier reaching nearly to Agardh Bay, on the Stor Fjord, or Wybe Jans Water, on the east side of the island.

THE retirement of Prof. Victor Horsley from the chair of Pathology in University College, London, has been made the occasion of presenting him with a testimonial in the form of a piece of plate and an album, as a mark of appreciation of the way in which he has advanced experimental pathology in this country. The album contains photographs of about fifty of the subscribers to the testimonial, together with a record of the work done by them, either in conjunction with Prof. Horsley or in the Brown Institution, and in the Pathological Department of University College, during the time he directed these laboratories.

AS already announced in these columns, the Committee organised by the Kazan Physico-Mathematical Society to obtain funds to found a memorial of the renowned Russian geometrician, N. J. Lobatchefsky, received the total sum of 9072 roubles (£1433) in support of that object. A circular received from Prof. Vassilief informs us that the fund has been utilised in the following manner. A capital sum of six thousand roubles has