

NEW BOOKS

Soil Conditions and Plant Growth. By Edward J. Russell. *Fourth edition.* 22 × 14 cm; pp. ix + 406. New York and London: Longmans, Green and Co., 1921. Price: \$5.00. The previous edition was reviewed less than four years ago (20, 525.)—The subject has since grown so much that there are now to be a series of monographs called "The Rothamsted Monographs on Agricultural Science," of which this is the first.

The importance of team work is recognized explicitly by the author, p. 28. "At the Rothamsted Experimental Station, instead of a number of isolated individuals, there is a body of workers investigating the subject, each from his own special point of view, but each fully cognizant of the work of others, and periodically submitting his results to discussion by them. Separate workers investigate, respectively, the bacteria, protozoa, fungi, algae, helminths, and insects of the soil; in addition physical and organic chemists are studying the soil conditions, while others are concerned in the study of the growing plant. A body of workers by harmonious co-operation is able to make advances that would be impossible for any single individual, however brilliant."

There is a very good presentation, pp. 57-77, of the effect of some of the plant foods. With barley grown in sand cultures, the effect of nitrogen supply on the grain is very marked. When nitrogenous food is wholly withheld, the grain formed is only two-thirds of the normal weight per individual. "The first addition of nitrate causes a marked rise in the weight per grain and the proportion of grain to total produce, but successive additions cause no further rise. Indeed other experiments prove that excess of nitrogenous food causes the proportion of grain to fall off somewhat. The leaf and the general character of growth are affected to a much greater extent. Nitrogen starvation causes yellowing of the leaf, especially in cold spring weather, absence of growth, and a poor starved appearance generally: a moderate supply of nitrogen leads to more rapid growth, very useful in cold weather or in case of attacks of insect pests. Abundance of nitrogen, on the other hand, leads to the development of large dark green leaves which are often crinkled, and usually soft, sappy, and liable to insect and fungoid pests (apparently because of the thinning of the walls and some change in composition of sap) and to retarded ripening: the effects resemble those produced by abundant water supply. A series of plants receiving varying amounts of nitrate are thus at somewhat different stages of their development at any given time, even though they were all sown on the same day, those supplied with large quantities of nitrate being less advanced than the rest. If they could all be kept under constant conditions till they had ripened this difference might finally disappear, but in crop production it is not possible much to delay the harvest owing to the fear of damage by autumn frosts, so that the retardation is of great practical importance. Seed crops like barley that are cut dead ripe are not supplied with much nitrate, but oats, which are cut before being quite ripe, can receive large quantities. All cereal crops, however, produce too much straw if the nitrate supply is excessive, and the straw does not commonly stand up well, but is beaten down or 'logged' by wind and rain. Swede and

potato crops also produce more leaf, but not proportionally more root or tuber, as the nitrogen supply increases; no doubt the increased root would follow, but the whole process is sooner or later stopped by the advancing season—the increased root does, in fact, follow in the case of the late-growing mangold. Tomatoes, again, produce too much leaf and too little fruit if they receive excess of nitrate. At the Cheshunt Experiment Station the omission of nitrogen compounds from the fertilizer mixture has caused the yield of fruit to increase 11 percent. On the other hand crops grown solely for the sake of their leaves are wholly improved by increased nitrate supply: growers of cabbages have learned that they can not only improve the size of their crops by judicious applications of nitrates, but they can also impart the tenderness and bright green colour desired by purchasers. Unfortunately the softness of the tissues prevents the cabbage standing the rough handling of the market. These qualitative differences are of great importance in agriculture and horticulture."

The effect of a phosphate on the crop is two-fold. In the early stages of growth it promotes root formation in a remarkable way. "Dressing of phosphates are particularly effective wherever greater root development is required than the soil conditions normally bring about. They are invaluable on clay soils, where roots do not naturally form well, but, on the other hand, they are less needed on sands, because great root growth takes place on these soils in any case. They are used for all root crops like swedes, turnips, and mangolds; in their absence swedes and turnip roots will not swell but remain permanently dwarfed like radishes: the introduction of superphosphate as a fertilizer revolutionized agriculture on some of the heavier soils by allowing better growth of these crops. Phosphates are needed also for shallow-rooted crops with a short period of growth, like barley. Further, they are beneficial wherever drought is likely to set in, because they induce the young roots to grow rapidly into the moister layers of soil below the surface; probably, as Hall has suggested, this explains the marked effect of superphosphate on wheat in the dry regions of Australia.

"Later on in the life of the plant phosphates hasten the ripening processes, thus producing the same effect as a deficiency of water, but to a less extent; for this reason they are applied to the wheat crop in some of the northern districts of England, and the oat crop in the west, to bring on the harvest a few days earlier and obviate risk of loss by bad weather. The northern limit of growth of several crops may in like manner be extended. This ripening effect is well shown on the barley plots at Rothamsted; crops receiving phosphates are golden yellow in colour while the others are still green."

"The effect of potassium compounds is more localized than that of phosphates, so that potash starvation can be more readily detected. The colour of the leaf becomes abnormal; the potash-starved grass plots at Rothamsted have a poor, dull colour, as have also the mangold plots; the leaves also tend to die early at the tips. The stem is weaker, so that the plant does not stand up well. The most striking effect, however, is the loss of efficiency in making starch; either photosynthesis or translocation—it is not yet clear which—is so dependent on potassium salts that the whole process comes abruptly to an end without them. Mangold, sugar beets, potatoes, and other sugar- and starch-forming crops reduce their production of sugar with decreasing potassium supply even before the leaf area has been diminished."

Next to the sugar-producing plants, the leguminosae seem to stand most in need of potassium salts. The potash-starved grass plots at Rothamsted contain notably less clover than those fully manured, the actual depression fluctuating according to the season. Some of the weeds, especially the sorrel, require a good supply of potash. There is some controversy as to whether potassium plays any important part in protein synthesis in plants. In the absence of potassium salts, mitotic cell division does not go to completion; Reed observed that the cell and nucleus both elongate, but actual division does not occur.

"It is not at present possible to say whether all these phenomena are different manifestations of one and the same specific action of potassium in the plant, or whether there are several different causes at work. Zwaardemaker puts forward the interesting suggestion that the potassium ion (which is somewhat radioactive) may be replaced by any other radioactive element, light or heavy, or by free radioactive radiation, provided the doses are equi-radioactive.

"Sodium does not appear to be essential even to salt-marsh plants, although *salicornia* grew better in presence of salt than in its absence. It can partially, but not completely, replace potassium as a plant nutrient; it thus delays the setting in of potash starvation, but will not keep it off altogether. Hellriegel found that sodium salts always gave increases in crop even when potassium salts were present in quantity."

Forbes recognizes three classes of peat in Ireland, p. 135:

1. Mountain peat, corresponding with the wet peat lowland moss of the British Committee, which originates wherever the conditions are too sterile or the subsoil too impervious or water-logged to allow deep-rooted vegetation to flourish, and where, therefore, shallow rooted plants come in and, on dying, form a layer of organic matter on which sphagnum, cotton grass, etc., begin to develop. This occurs above the 800 feet level in most parts of Ireland, but in the west it often covers the entire surface down to the sea-level.

2. Marsh peat, corresponding with the British fen, which arises from reeds, sedges, rushes, etc., and which, so long as the water contains lime and nutrient salts, is as favourable a medium for plant growth as ordinary soil, though it affords no root-hold for trees, so that they are liable to be overturned in strong gales. This kind of peat forms the basis of all the low-land bogs in Ireland and of many of the small bogs in mountain districts.

3. This marsh peat finally becomes so consolidated with time and pressure that it loses connection with the water table, and a surface swamp forms on which a sphagnum bog of the "mountain type" arises. This, therefore, becomes similar in character to the first group: it differs, however, in its uniformity of growth, being higher in the centre than at the margins where soil water can get in and where, therefore, decomposition is more rapid.

A sandy soil may, without any change in type, be a dry and barren heath, if underlain near the surface with rock or gravel; a highly fertile fruit or market-garden soil if sufficiently deep; or a stagnant marsh giving rise to peat, if so situated that water accumulates and cannot drain away, p. 302.

The simplest case of a calcareous soil is presented by soils where the calcium carbonate exceeds about ten percent and dominates every other constituent, becoming the controlling factor in determining the soil properties, p. 304. "The conditions here seem to be extraordinarily well suited to plant

and animal life. Bacteria are numerous and active, rapidly oxidising organic matter. Hosts of animals, wireworms, earthworms, and others live in the grass land, and even get into the arable land, honeycombing the soil with their passages, puffing it up or 'lightening' it considerably, and encouraging the multiplication of moles. Rabbits abound in dry places. Vegetation is restricted on thin exposed soils, but becomes astonishingly varied where there is sufficient depth of soil and shelter to maintain an adequate water supply. Ash is the characteristic tree in the north and west, and beech in the south of England, and there is a great profusion of shrubs—buck thorn, spindle, guelder rose, dogwood, hawthorn, hazel, maple; and especially of flowering plants—scabious (*S. Columbaria*), the bedstraws, vetches, ragwort, yellow wort (*Chlora perfoliata*), salad burnet (*Poterium sanguisorba*), lady's fingers (*Anthyllis*), *Linum catharticum*, *Bromus erectus*. Still more remarkable, perhaps, is the fact that a few plants—the so-called calcifuges—do not occur. Where the amount of calcium carbonate is too high plants tend to become chlorotic; Chauzit showed that vines suffered badly when 35 percent, or more was present, but not when the amounts fell to 3 percent. Mazé attributes part of the action to the rendering insoluble of zinc, manganese, etc., necessary for complete growth.

"Investigations in Porto Rico, where a considerable portion of the arable land is sufficiently calcareous to produce nutritional disturbances in crops, show that bush beans (*Phaseolus manus*) and radishes are unaffected by even 35 percent of CaCO_3 ; sunflowers, soy beans, and sugar canes are somewhat depressed; while sweet cassava (*Manihot palmata*), rice and pineapples were considerably depressed by this amount. The amount of nitrogen, potash, and phosphoric acid in the various crops was apparently unaffected by the carbonate, but the iron was notably depressed."

Wilder D. Bancroft

Animal Proteins. By Hugh Garner Bennett. 21 × 14 cm; pp. xiii + 287. New York: D. Van Nostrand Company, 1921. Price: \$3.75.—The title is a bit ambitious because the author really discusses leather and glue. The subject is presented under six heads: hides for heavy leather; skins for light leather; chrome leathers; miscellaneous tannages; gelatine and glue; miscellaneous proteins and by-products.

The author classifies proteins, on the basis of their behavior towards water, into albumins, keratins, and gelatins, p. 3. "Cold water dissolves the albumins, does not affect the keratins, and only swells the gelatins. The behaviour in hot water confirms and elaborates the classification. When heated in water, the albumins coagulate at temperatures of 70–75° C, the gelatins (if swollen) dissolve readily, whilst the keratins only dissolve at temperatures above 100° C. Albumins and keratins may be distinguished also from gelatins by adding acetic acid and potassium ferrocyanide to their aqueous solutions. Albumins and keratins give a precipitate, gelatins do not. Another distinguishing reaction is to boil with alcohol, wash with ether, and heat with hydrochloric acid (S.G. 1.2). Albumins give a violet colour, keratins and gelatins do not."

While one will agree with the author that tanning is a problem of colloid chemistry, it does seem as though the theory of vegetable tanning could be stated more clearly. The reviewer fears that neither the tanner nor the colloid chemist will get very much from the author's description, p. 41. "Vegetable

tannage is a phenomenon of colloid chemistry. The old arguments as to whether tanning was a chemical or a physical process have been rendered obsolete by the advent of a new set of explanations, which, though shedding light on many obscure points, have enormously increased the complexity of the problem. In vegetable tannage an emulsoid gel (pelt) is immersed in a complex emulsoid sol (tan liquor), which immersion results, not in simple action or change, but in a series of changes.

"One of these changes is *adsorption*. Pelt is a gel which possesses a great development of surface. It not only exhibits like gelatine the phenomenon of imbibition and dehydration to a very marked extent, but also possesses a very fine fibrous structure due to its organic origin; thus pelt possesses an enormous specific surface, further intensified by the preparation processes previously discussed, which split up the hide fibres into smaller bundles and into much finer constituent fibrils. Tannins, on the other hand, are hydrophilic colloids which in water form emulsified sols, and which may thus be expected to exhibit the phenomenon of adsorption. A tan liquor usually contains several tannins in addition to other closely similar substances, also in colloidal solution, and is therefore a sol of considerable complexity. The immersion of pelt into a tan liquor results in an adsorption, which consists essentially in an inequality of concentration in the sol, the greater concentration being at the interface. This inequality between the surface concentration and the volume concentration of the sol, is due primarily to considerations of surface tension and surface energy, and exists before the immersion of the pelt. The surface layer having excess over the volume concentration, any considerable extension of surface in a fixed volume of sol must produce a very considerable decrease in the volume concentration. This is what occurs when pelt is immersed in a tan liquor, the immersion being the considerable extension of surface. It should be especially remembered that the inequality of concentration is in the sol, on the liquid side of the interface. In adsorption, the substance adsorbed, i. e., the excess at the surface, is too frequently regarded as bound to the solid immersed. This is because the excess is in the layer which wets the solid and remains wetting it when the solid is removed. Thus the immersion of pelt produces primarily only a change in the distribution of the tannins in the liquor. It follows from this that the adsorption is an equilibrium and that if the sol be diluted, the equilibrium will become the same as it would have been by immersing the pelt directly into the dilute solution. Thus, if pelt be first immersed in one tan liquor and then into a weaker one it will yield tan to the latter solution."

"In addition to adsorption, there is another phenomenon of colloid chemistry in operation, viz., the *mutual precipitation* of the solid in the liquid by the gels in the hide. In most sols the disperse phase is electrically charged. The sol therefore possesses electric conductivity, and migration occurs in the electric field to the cathode or anode according to the nature of the charge. Oppositely charged sols precipitate one another, the precipitate containing both colloids. The maximum precipitation occurs when the + charge of one sol exactly equals and neutralizes the - charge of the other. There is thus an electrical equivalence; an amount of sol which is equivalent to a given amount of the other. This is not a chemical equivalence, however, and the precipitate is not a chemical compound in spite of its fairly constant composition. The composition of the

precipitate, indeed, is not quite constant, for the optimum precipitation may not correspond exactly with the electrical equivalence, being influenced by the number of particles required, their size (dispersity), the rate of mixture, and the relative concentrations of the sols. This mutual precipitation is exhibited by emulsoids as well as suspenoids, but the charge (+ or -) on an emulsoid is in many instances largely an accidental matter, being determined by the medium in which it happens to be, its normal condition being electrical neutrality. Gelatin and pelt are such emulsoids, and a positively charged gelatin sol has been observed to precipitate a negatively charged gelatin sol. It is thought, however, that gelatin is primarily a positive sol. Pelt (whether delimited or not) is rapidly acidified by the quickly penetrating and strongly adsorbed organic acids of the old tan liquors and becomes positively charged before the tannins are adsorbed. The positive charge increases with the acidity of the liquor. Other emulsoids are not electrically neutral, but are electrically charged and exhibit considerable conductivity. Into this class fall the tannins, and in tanning it is thought that there is a mutual precipitation of the negative tanning sol with the positive hide gel, the precipitation of the negative sol being favoured by the acid condition of the liquor. The effect of increasing acidity soon falls off, however, as a saturation limit is soon reached. This mutual precipitation of colloids in tanning is in reality but an extension of the adsorption theory, which explains the predominant effect of H^+ , and OH^- on the electric charge by stating that these ions are more readily adsorbed than other ions, and that as OH^- is more readily adsorbed than H^+ most sols are negative to water.

"In addition to the adsorption phenomena described, there are in vegetable tannage *secondary changes* which are slow and 'irreversible.' These changes are obscure and are difficult to investigate. Oxidation, dehydration and polymerization have all been suggested but there is little direct evidence. Certain it is, however, that time renders the tannage more permanent. It perhaps should be pointed out that in the very strongest tan liquors the viscosity of the tannin sol is so great that adhesion would be a better term than adsorption. There is no abrupt division between the two phenomena."

The same remarks hold for the theory of chrome tannage, p. 129. "As to the theory of chrome tanning there is still considerable difference of opinion and much room for experiment. Some leather chemists regard the tannage as differing essentially from the vegetable tannages. Mr. J. A. Wilson has even suggested that the proteid molecule is in time partly hydrolyzed with the formation of a chromic salt with the acid groups. The author, however, strongly favours the view that in chrome tanning changes take place which are closely analogous to those which occur in vegetable tannage, the differences being mainly of degree. Thus the hide gel is immersed into a lyophile sol—the chrome liquor—and there follows lyotrope influence, adsorption, gelation of the tanning sol, as well as diffusion into the gel, and finally also, probably, precipitation of the tanning sol at this interface.

"In chrome tannage the lyotrope influence is much more prominent than in vegetable tannage, but the effect is in the same sense, viz., to reduce the imbibition of the hide gel. Thus the potassium sulphate in a chrome alum liquor has its own specific action of this kind and contributes to the leather formation.

Unhydrolyzed chromium sulphate and the sodium sulphate formed in 'making basic' act also in the same sense.

"The tanning sol is probably chromium hydrate, formed by the hydrolysis of chromium sulphate: it is a lyophile or emulsoid sol and is in consequence very strongly adsorbed by the hide gel. This adsorption, involving a concentration of lyophile sol, is the first stage in gelation, which occupies a relatively more prominent place in chrome than in vegetable tannage. Some diffusion into the gel occurs, and both the gelatin and diffusion of the sol are affected by lyotrope influence, but to a greater extent than in the vegetable tannage. Thus far the analogy is almost complete.

"There remains the question of the precipitation of the tanning colloid at the interface. This is a point which has not yet been thoroughly investigated, and which offers considerable difficulty to a clear understanding, but the matter may be probably summarized thus: the adsorbed chromium hydrate is precipitated at the interface of gel and sol to some extent, chiefly through the neutralization of its charge by the oppositely charged ions of the electrolytes present, but possibly also—in the last stages of manufacture by the mutual precipitation of oppositely charged gel and sol."

On p. 203, the author states that "On this view, we must regard a gelatine gel as a continuous network of water under great compression, and in this network are zones of still greater compression, which surround the particles of the disperse phase—the gelatine itself, and zones of less compression which in a weak gel, at any rate, have a compression equal to or much the same as the normal state of compression in water."

"However these things may be, the fact of water compression determines the rigidity of the gel, and the changes in this compression of the continuous phase determine the surface tension resultant which hinders swelling, and which is one of the two main factors fixing both the rate at which gelatine swells in water, and the final volume attained by the gel."

"Before leaving this point, it is desirable to note the effect on the swelling of gelatine of the extremes of this lyotrope influence. Substances like iodides, thiocyanates and urea prevent a gelatine sol from setting to a gel at all, and a piece of gelatine in such solutions swells rapidly until it solates. On the other hand, sulphates, tartrates, etc., make a stiffer gel on account of the enhanced compression. Gelatine in such solutions may swell, but at a much slower rate than in water and with a decreased maximum extent. A gelatine gel may in such solutions not only fail to swell at all, but actually contract and in some cases, indeed, be practically dehydrated. If a gel be in a very concentrated solution of such a substance, it may be that the lyotrope compression in the external solution is greater than the compression in the dispersion medium of the gel; in which case the surface tension effect is reversed, and the external solution tends to increase in volume and the gel to contract. Hence we find that the saturated solutions of such substances as ammonium sulphate and potassium carbonate will dehydrate a gel almost completely, and will also, by a similar action on pelt, make a kind of white leather. It is important to remember this contractile effect of strong solutions of salts, because it is very easy to confuse this effect with a similar result produced in another manner, viz., by a reduction of the force tending to swell."

It will be obvious from these quotations that the author has made a brave attempt to present the subject of leather and glue from the view-point of colloid chemistry. Unfortunately, he is like most of us in thinking that a new word is in itself an explanation. Also, he takes himself very seriously and his colloid chemistry is a bit rigid. He probably would not admit that chromic oxide can adsorb ferric oxide, because they are both positively charged colloids. On p. 210 he says that "a very important feature of the colloid state is that the particles of the disperse phase appear to possess an electric charge, and, if this charge be removed, a colloid sol no longer remains such, but precipitates, flocculates, coagulates, etc." This is perfectly true for a colloidal solution stabilized by adsorption of an ion; but it is not true when the colloid is peptized by a liquid. It is difficult, for instance, to see how the author's view-point could be applied to colloidal solutions of cellulose nitrate in amyl acetate or acetone.

The book is eminently praiseworthy as being the first attempt to present the subject from a common-sense point of view. That the effort is not more of a success is not entirely the author's fault. We are very much up in the air on the subject of jellies in general and of gelatine in particular. It is to be hoped that the author will rewrite this book when our knowledge of the subject has increased. Even if circumstances prevent this, he will always deserve credit as the pioneer in this line.

Wilder D. Bancroft

Soaps and Proteins. By *Martin H. Fischer*. 23 × 15 cm; pp. ix + 272. New York: John Wiley and Sons, 1921. Price: \$4.00.—The author states quite frankly in the preface that *Science* and *The Chemical Engineer* were the only scientific journals willing to publish any portions of the fragments of which the book is composed. We are not told whether these two are now wiser.

The subject is treated under three main heads: the colloid chemistry of soaps; the colloid chemistry of soap manufacture; the analogies in the colloid chemistry of soaps, protein derivatives, and tissues. On p. 19 we read that "sodium caprate yields a solid gel if 500 cc of water are present to the mol of soap. As we mount in the acid series, the water-holding capacity grows tremendously. One mol of sodium laurate will hold four liters of water; the same amount of sodium myristate, twelve liters; of sodium palmitate, 20 liters; of sodium margarate, twenty-four liters; of sodium stearate, twenty-seven liters; and of sodium arachidate, the enormous value of thirty-seven liters." This quotation shows the author's dramatic skill, the enormous value corresponding to a little under a one percent solution.

On p. 49 is the impressive and italicized statement that, when sodium linolate, sodium oleate, and sodium stearate are dissolved in different alcohols, the soap dissolves first in the lower members of the alcohol series and last in the uppermost, while, upon lowering the temperature, the gels formed first in the upper alcohols and last in the lowest members of the series. Most people would have said that the solubility (or peptization) decreases with increasing carbon content of the alcohol. On p. 69 the author says: "We are not unaware that the concept 'solution' needs itself to be defined. While the field of 'solution' constitutes slippery ground, we accept, for pragmatic reasons, as characteristic of the 'true' solution, the teachings of Wolfgang Ostwald and P. P. von Weimarn, who define such solutions as dispersions of A in B with the degree of subdivision

measurable in molecular or smaller values. To express the matter in the terms of A. P. Mathews, we may say that A is dissolved in B or *vice versa* when the solvent has overcome the cohesive forces of the dissolved substances. As Mathews has shown, the forces of cohesion operate within molecular dimensions."

There is a characteristic paragraph on p. 75. "Some years ago we showed in the case of gelatin, that the 'swelling' of this substance and its 'liquefaction' are not identical processes, and that the latter is not a mere continuation of the former. When ordinary gelatin is thrown into water, it swells up somewhat; but the amount of this swelling is enormously increased if a little acid is added to the water. If liquefaction were a mere continuation of this swelling, then the addition of a little acid to a gelatin near its gelatin point ought to make it set. As a matter of fact, not only does this not happen, but the addition of such acid to a previously solid gelatin makes it liquefy. As maintained at that time, an increased 'swelling' was declared to be an increased capacity for taking up the solvent; an increased tendency to liquefy, the expression of an increase in the degree of dispersion of the colloid material."

At first the reviewer thought that this must be a typographical error; but the author repeats elsewhere the extraordinary statement that if liquefaction is a continuation of swelling, addition of acid to a gelatine solution should make it set. The setting-up and knocking-down of straw men is hardly a legitimate scientific occupation. The curious thing about it all is that apparently some people are still impressed by the author, though the number is decreasing steadily.

The book is padded thoroughly with tables, graphs, and half-tones. Some of the half-tones are very good; but most of them show practically nothing.

Wilder D. Bancroft

Flüssige Kristalle und ihr scheinbares Leben. By O. Lehmann. 23 × 16 cm; pp. 72. Leipzig: Leopold Voss, 1921. Price: paper, 30 marks.—By means of about one hundred and sixty cuts the author brings out the variety of forms which liquid crystals can adopt under different conditions of stress. Many of these are so like the forms of living matter that Haeckel at one time was inclined to believe that these were actually living crystals. The author points out that in the living organisms we find a number of these materials which form liquid crystals, such as oleates, compounds of cholesterol, lecithin, phrenosin, cholin, etc.

On p. 12 there is brought out the very interesting fact that it is possible to make crystals of ammonium nitrate which are plastic like lead or yellow phosphorus and which can be bent into a ring shape. When one of these rings is examined under crossed nicols, it appears that the bending has caused no change in the structure and is not due to the breaking down of the crystals. On p. 14 we learn that the thrust given by crystals of *p*-azophenetol in changing from one modification to the other may be sufficient to shatter the glass tube in which they are, even though the new modification occupies a lesser actual volume than the one from which it is formed.

The author has taken moving picture photographs of all his results and it is possible in Germany to obtain a film showing the changes. It must be a very interesting one and should be of distinct interest to the universities.

Wilder D. Bancroft