abstracts in German, French, or English. These memoirs are profusely illustrated, and replete with statistics, tables, diagrams, and maps.

To the British forester the most interesting of these studies is the monograph on the cultivation of the larch in Sweden by Prof. Gunnar Schotte, which takes up pp. 529–840, followed by twenty-six pages of bibliography, enumerating the books and articles on the larch in various languages. The botanical part is excellent, but the great merit of the work lies in the admirable account of the sylviculture of the three species which are grown in Sweden. Of the European larch forty-two experimental plots have been exhaustively studied, and most of the conclusions arrived at are applicable to British conditions. Prof. Schotte only approves of pure woods of this species on exceptionally good soils. He recommends a mixture of European larch with pine or with beech on moderately good to medium soils, and is convinced that larch should never be planted on poor ground. For the prevention of canker due to Peziza, which is the scourge of this species in Sweden as well as in England, he advocates early, frequent, and heavy thinnings, with the object of removing the feeble and suppressed trees, which are liable to be attacked by the fungus. The Siberian larch, which is comprehensively treated, is successful in Sweden, but quite unsuitable for our climate. Sample plots of Japanese larch in Sweden are still young, but so far this tree is extremely vigorous and immune from disease. Prof. Schotte's article, which is accompanied by an abstract in English, is followed by a report (pp. 841–922) of an elaborate investigation by L. Mattsson on the form of the stem of the larch. The results, which are highly technical, are also given in an English abstract.

A similar investigation (pp. 9–110) by Nils Sylven of the variety of the common pine which is indigenous in northern Sweden is of considerable interest. This tree, distinguished by some botanists as a separate species, *Pinus lapponica*, differs mainly in its more slender pyramidal crown of foliage and in its thinner bark. The plate showing the variations in the form and colour of the seeds and cones of this variety and of the common pine is beautifully drawn. The germination of the seed of the northern pine is dealt with by E. Wibeck in a memoir (pp. 201–34). The insects which attack the cones of the pine and of the spruce as well, and the peculiar fungus, *Melampsora pinitorqua*, are dealt with in separate articles (pp. 1077–1204).

The composition of forest soils and the formation of humus have been investigated by H. Hesselman (pp. 297–528 and 923–1076). Mr. Hesselman distinguishes mild humus usually found in broad-leaved forests, and raw humus characteristic of most coniferous forests. In the latter no nitrification ordinarily takes place, and natural regeneration is rendered difficult by the feeble growth of the seedlings in the absence of nitrates. He also points out the measures which can be adopted to transform the raw humus, such as partial felling, which admits light on the ground and brings about a radical alteration in the bacterial flora. The change undergone by the humus is accompanied by an alteration in the ground vegetation. When the nitrogen is transformed into nitrate, plants like raspberry, *Epilobium angustifolium*, *Senecio sylvaticus*, etc., appear. In the absence of this transformation, *Aira flexuosa* is the predominant plant in the clearings of the forest. Hesselman's investigations are of considerable interest to ecologists.

The fifteenth volume of the memoirs, just received, contains a number of miscellaneous articles: on a new plough designed by Mr. Widen; on the seed crop of the principal trees of Sweden during 1917; on the attacks of the more important insects and of the fungus *Melampsora pinitorqua* during the same year; and on a new method of ascertaining the form and volume of single stems of spruce. The programme of the investigations to be carried out by the institute during the triennial period, 1918–20, is also given.

PLANTATION RUBBER RESEARCH.

MESSRS. EATON, GRANTHAM, AND DAY have published (Department of Agriculture, Federated Malay States: Kuala Lumpur) an account of important researches carried out in Kuala Lumpur, Malaya, during the last three and a half years in connection with the preparation and vulcanisation of plantation rubber. The Bulletin runs into 398 pages, and gives one of the most detailed accounts of rubber research in Malaya yet published. The authors point out that they, as Government officials, are working under difficulties in so far that, whereas they give full publicity to their methods and results, they are precluded from gaining knowledge of the methods adopted or apparatus used by other technologists in Malaya and London who are carrying on similar experimental work with rubber. It is clear that the policy of secrecy adopted by companies and associations which privately employ chemists and mycologists in the East is open to very grave objection. The policy of secrecy is not only against the true scientific spirit, but must also, in the long run, seriously reduce the value of research even to those who privately employ their own technologists. All scientific work should be open to criticism based upon knowledge of the method and apparatus employed. The present unsatisfactory arrangement may work well enough for privately employed technologists who have the advantage of studying detailed accounts of methods employed by Government officials: the reverse, however, is obviously not the case.

Considerable energy appears to have been thrown into the researches on variability of plantation rubber, a subject which raises hostility among owners of plantations who consider that their finished product cannot be improved upon. We have never agreed with those plantation producers who refuse to believe in the variability of plantation rubber, and the fact that they have introduced the word "uniformity" in a comparative sense does not blind us to the real position.

The authors, as a result of their work, believe that the ordinary forms of smoked sheet and crêpe, now so common in the markets of the world, will be superseded by a new type of rubber turned out in "slabs." If it is true that the rubber prepared in slabs is superior to the common forms now produced, a great advance will have been made.

The problem of vulcanisation has been investigated in an unusual direction. It is claimed that in connection with organic vulcanisation accelerators a discovery has been made which ranks only second with the original discovery of vulcanisation by Goodyear and Hancock. The authors have demonstrated that valuable vulcanisation accelerators are present in Hevea latex, and can be formed by special treatment of the coagulum. A number of vulcanisation accelerators were sent by the present writer to these investigators in 1915; they appear to have led to an interesting line of research which should have far-reaching results. The discovery of the vulcanisation accelerators in Para rubber was made prior to the authors' knowledge of the discovery and use of patent organic accelerating agents. The accelerator found in rubber is said to be produced by the decomposition of the proteins, and to consist probably of an amino-acid or amine. The substances found in plantation rubber are responsible

for variability in rate of vulcanisation. In addition, the authors point out that this variability in respect to rate of cure exists in technical mixings with which manufacturers load the rubber. These mixings are largely mineral constitutents in addition to sulphur. It is further contended that the use of strong accelerating agents, such as oxide of lead, tend to obscure the differences produced in raw rubber by the presence of a natural accelerator.

Recommendations are made to planters which, if adopted, should considerably reduce variability. They are :—

(1) Dilution of latex to a constant rubber content.

(2) The use of acetic acid or other weak organic acid (such as formic acid) as a coagulant.

(3) All coagulating-tanks should be standardised so that the final rubber sheets or crêpe are of the same thickness after rolling.

(4) Conditions of drying and smoking, especially during the early stages, should be kept as uniform as possible.

It is pointed out that if sheets of rubber are of varying thicknesses the rates of drying will be different, and, consequently, there will be more variation in the biological changes which take place during the early stages of drying rubber. H. W.

THE SENSITIVENESS OF PHOTOGRAPHIC PLATES TO X-RAYS.[1]

ALTHOUGH observations have been published on the effect of X-rays on photographic plates, the constants of various plates in use do not appear to have been determined. These experiments follow the standard methods of sensitometry of photographic plates to light in respect of exposure of the plate in strips, of development at a standard temperature and for a constant period (namely, hydroquinone at 20° C. for four minutes), and of the subtraction of the density of a fog strip. The density, *i.e.* the logarithm to the base *e* of the ratio of the intensity of the incident to that of the transmitted light, was determined by a polarisation photometer.

The "exposure" E is defined by the relation $E=V^2it/d^2$, where V, volts, is the pressure applied to the Coolidge tube; *it*, coulombs, the quantity of electricity passing through the tube during the exposure of *t* seconds; and *d*, cms., the distance of the focal spot from the photographic plate. This expression gives the energy of the incident rays. Three values for V were used—31,500, 73,000, and 83,000. The current varied between 0·03 and 0·06 milliampere, which is lower than the currents ordinarily used in radiography. Experiments are in progress using higher intensities of radiation.

When the density, D, for a given plate is plotted against the logarithm of the exposure as above defined, a curve similar to those of Hurter and Driffield is obtained. For densities from 0 to about 1 the curve is convex to the log E axis; above that it is straight to densities of 4, the maximum measured. The intercept on the log E axis of the straight line produced backwards is the logarithm of the inertia of the plate, which was found to be independent of the development. This result is the same as for exposure to the visible light. The slope of the straight portion of the curve gives the contrast. A high value for the contrast is one of the desirable properties of an X-ray plate. The "speed" of a plate may be tentatively defined as the reciprocal of the exposure required to produce a density of 5.

[1] Abstract of a paper by Miss N. C. B. Allen and Prof. T. H. Laby read before the Royal Society of Victoria on August 8, 1918.

The density produced in a given plate was found to be constant for a constant value of the exposure V^2it/d^2 over the range V 31,500 to 83,000, and for a limited variation of *i* and *t*, but not for a large variation of *i* and *t*. This means that, for the wave-lengths used, the density of a plate depends, not on the wave-length, but only on the energy of the X-rays.

Plate	Inertia	Contrast	Speed
Paragon ...	$0·74\times10^3$	2·4	0·00017
,, ...	1·18	2·3	0·000096
Diagnostic ...	0·71	2·2	0·00015
Sunic	1·00	2·35	0·00012
Seed	1·12	1·9	0·000066
Wratten	1·95	2·2	0·000052
Wellington ...	1·70	2·0	0·000050
Imp. X-ray ...	1·26	1·6	0·000036
Cramer	2·14	1·9	0·000035
Ilford	2·19	1·9	0·000033
Imp. S.R. ..	1·45	1·55	0·000028

RAINFALL VARIATIONS.

AT the meeting of the Royal Meteorological Society held on April 16, two papers on variations of rainfall were read. The papers are summarised below.

Mr. A. A. Barnes, in his paper on rainfall in England, the true long-average as deduced from symmetry, stated that it has been usual to assume that the average annual rainfall during any period of thirty-five years can be adopted for obtaining the "long-average" at any rain-gauge, but he considers that the fluctuations which occur between such averages for various thirty-five-year periods tend to show that the basis is somewhat uncertain. By an exhaustive analysis of the annual readings at thirty-eight rain-gauges in England during the sixty-two years 1856–1917, he shows that variations of as much as 5 per cent. on each side of the mean are quite possible when dealing with successive thirty-five-year periods. From these same records it is then shown that far greater consistency in the value of the average can be obtained by taking periods symmetrical about the end of the year 1886. Both by means of tables and diagrams Mr. Barnes shows that that date is a very critical one in regard to rainfall in England, and that, as a rule, the years before that date were relatively far wetter than years subsequent to it. Hence the balancing of the earlier wet years by the later dry years establishes the principle of symmetry about that date, and it is shown that by this method the maximum departure from normal which results from taking each of the fifteen long periods symmetrical to the end of the year 1886 does not exceed 1 per cent. in the case of any of the thirty-eight gauges which were examined.

Mr. C. E. P. Brooks's paper was on the secular variation of rainfall. In order to obtain a measure of the secular variation of rainfall during the past thirty to fifty years, correlation coefficients were worked out between the annual rainfall at each station and "time," the measure of the latter being the number of years before or after the middle year of the series. This was done for 162 stations distributed over the globe, and the results were charted on a map. This map shows that the greater part of the world is divided among a few definite regions of wide extent, in each of which the rainfall has been either increasing or decreasing. The most important area of increasing rainfall is temperate Eurasia (except the western sea-board); other areas are south-east South America and the south of Australia. Areas of decrease are the tropical regions as a whole, South Africa, and the west coast of Europe. It is noted that the number