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Cotton Research and Industry.

IN a recent issue (Mar. 10, p. 362) we directed attention to the scientific work being carried on in the cotton fields by the Empire Cotton Growing Corporation, and the possibility of this work being checked, if not discontinued, because of the difficult position in which the Lancashire industry finds itself. The publication of the reports of the experiment stations founded by the Corporation for the year 1926-27, comes therefore at an opportune moment ; as they throw a considerable light on the character of the research instituted—probably in the long run the most important of its many activities. A sound scientific basis appears to have been laid for the success of its effort to increase the quantity and improve the quality of the cotton being produced within the British Empire. These reports are collected in a handy volume of about 250 pages, interspersed with tables, diagrams, plates and maps, and placed before the public at the low figure of half a crown.

The founding of an experiment station concerned with any particular crop is by no means so simple a matter as it might appear, and usually follows years of local study. Even when the need for it has been demonstrated and the problem to be solved has been clearly defined, a thorough survey of the country has to be made in order to determine the most suitable site, special attention being paid to such economic factors as communications, transport facilities, supplies, as well as climate and soil. It is often found advisable to take up a small area of land for a couple of years to make sure that no adverse factors have escaped notice. This preliminary survey work of the Corporation, made at a time when no staff was available for the running of the stations, deserves a passing reference. Experienced officers were deputed to travel over practically all of the cotton-growing tracts in the Colonies ; and in this work the Corporation was specially fortunate in securing the co-operation of a number of senior members of the Indian agricultural service, who were permitted to retire on proportional pensions under the Reforms Scheme. A series of valuable reports has been sent in and published, and some idea was thus formed as to where research was most likely to be profitable.

As to the staffing of the stations, a wide net was spread over the scientific and agricultural schools in Great Britain, and selected students were encouraged by scholarships to undergo post-graduate training to fit them for cotton research.

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The response was on the whole good, and many of these students are already at work. The stations reported on this year are naturally in all stages of development, varying from a few acres tentatively acquired, to large ones with full equipment and buildings, and the reports are in consequence of very different interest and value. It is evident, however, that the Corporation has within a remarkably short period succeeded, in spite of great difficulties in obtaining suitably trained officers, in building up an agricultural department of an entirely novel character, namely, one devoted to the study of one crop scattered over the whole range of British Colonies in the warmer tracts. There are in the present volume reports from Queensland, the Transvaal, Natal, Swaziland, Southern Rhodesia, the Anglo-Egyptian Sudan, Uganda, Nyasaland, Nigeria, and Fiji, prepared by plant breeders, entomologists, and agriculturists in charge of separate areas.

It must be remembered that the research work recorded in the pages of the reports is only a portion of that being conducted by the officers of the Corporation. The Cotton Research Station in Trinidad is not included; and it is somewhat difficult to draw the line between the Corporation's work and that of the existing agricultural departments of the various Colonies, because there seems to have been a gradual drafting of men sent out by the former into the expanding Colonial service, whenever it has been found possible to allocate funds for the purpose. The unity of aims and the perfectly amicable relations existing between the officers under these two controlling bodies is a marked characteristic of the work of the Corporation.

Before proceeding, however, to more detailed reference to the character of the scientific work embodied in these reports, it is natural to inquire why the local agricultural departments cannot deal with the work undertaken by the Corporation; and also why this particular crop—cotton—needs financial assistance from Great Britain, as against such staples as rubber, tea, and sugar, for which research is provided for locally. The answer to the first question is fairly simple. The agricultural department in any colony has charge of the whole of the crops grown within its limits; and it can rarely afford to depute an officer entirely to the study of one crop, however important.

The second question is not capable of quite so simple an answer, because it depends on the distribution of capital. The capital connected with the cotton industry is located in Lancashire,

while that in tea, sugar, and rubber lies chiefly in the places where these crops are grown. The cause for this is to be found in the character of the raw material yielded by the plant in either case. The cotton plant produces, naturally, in the fields, a raw material in its finished state; and all that is required is for this to be collected, kept dry and clean, and sold to the local buyer for pressing and forwarding to the mills at home. But in tea and sugar, and at present in rubber, the produce of the plant is in such a condition that it has to undergo complicated treatment before it can be sent across the ocean. Taking sugar as an example, the canes are full of sweet juice which has to be expressed, and which is then liable to rapid deterioration in the air; and the more stable sugar has to be extracted from it on the spot as expeditiously as possible. Furthermore, the canes grown on an acre of land will vary in weight from, say, 20 to 50 tons or more, and the transport of this mass of material to the crushing mill is an important item of expenditure. For both of these reasons the sugar factory must be placed as near to the cane fields as possible; and the capital for the erection of an efficient, up-to-date sugar factory will run to some £200,000. A similar location of factory on the plantation is also necessary for tea and rubber; and in all three cases a large tract of land must be acquired and put permanently under one crop—which, in effect, adds considerably to the capital to be sunk on the spot. Moreover, whether the selling price be high or low, cultivation must proceed and the factory be kept going: in sugar, at any rate, closing down the factory in lean years would spell ruin.

The growing of cotton is under entirely different conditions. There is no local capital involved, and anyone who owns a bit of land can either grow it or not at will; when prices are high the area increases, and when low other crops are grown instead. Rotation of crops, practically impossible in the other staples mentioned, is a prime necessity, and is everywhere practised in native cultivation; therefore a change of crop is easily effected. To attempt to collect a levy on the growers for the prosecution of research would immediately curtail the area sown, and thus defeat the object in view. It is obvious then that, with cotton, the capital required to finance research must come from the mills; and the Cotton Corporation, as representing them, takes the part of the fairy godmother to the cotton growers. It acts on the principle that improving the quality is the surest way to increase the quantity, in that

it enhances the price received by the cultivator ; and thus the two aims of the Corporation are inseparably connected. The most encouraging features in the project are that the class of cotton raised in British Colonies is, as a rule, distinctly better than that grown in the United States, which it is designed to replace ; and also that land and labour cost less, and therefore it can be more cheaply produced.

One glance through the reports will convince anyone that each tract has its own set of problems, and in most cases may have its own limiting factors ; and the idea of one central experiment station devoted to cotton growing can at once be abandoned. In the Union of South Africa the annual rainfall is the basal factor, and has been found to be distinctly unreliable ; and, in addition, a minute insect attacks the leaves to such an extent that it is essential to breed types resistant to this pest. In Nigeria the limiting factor seems rather to be competition with other crops, coupled with transport difficulties, and a cotton fetching a high price is needed. Nyasaland is chiefly concerned at present with working out the most suitable rotations for three sets of conditions : European plantations, and native cultivation for high and low areas. Fiji is devoted to the finer counts, and can grow Sea Island cotton, but, owing to the practical disappearance of the market for this during recent years, is concentrating on obtaining a long-stapled type which is more marketable. Queensland, however well she may grow cotton, will sooner or later have to face competition between that raised by white labour and native grown from elsewhere. The Anglo-Egyptian Sudan, with its varying conditions of moisture—obtained solely by irrigation, by rainfall, and by the two together—practically covers the whole field of cotton breeding and cultivation. Speaking generally, these tracts appear to be able to grow perfectly good cotton, but all require the services of (1) plant-breeders to evolve the most suitable type of cotton to be grown, (2) entomologists to preserve it from the local insect pests, and (3) agriculturists to grow healthy crops at the least possible cost.

Probably the most promising direction for a permanent increase in cotton growing in the British Empire is at the moment in India, but that country has its own problems and its own well-developed scheme of cotton research. There are vast possibilities in the Sudan, and great hopes are entertained in the Union of South Africa.

It will be sufficient here briefly to refer to the

work being carried out in these two places. The outstanding factor in South African research is the Jassid infestation, which has practically wiped out the standard varieties hitherto relied upon. It has been observed that hairiness in the leaves is a distinct hindrance to the development of this insect ; and the plant-breeder at Barberton has succeeded in evolving hairy forms strongly resistant to the Jassid, and at the same time with the good qualities of those forms it is necessary to replace. This result is being hailed with satisfaction by the planters everywhere, and the strains obtained will apparently also be required in Southern Rhodesia. This piece of research is particularly creditable, in that it has been conducted under most disheartening conditions ; a record drought has visited South Africa during the last three years, again and again spoiling the experimental plots.

The report from the Sudan covers more than forty pages ; but considering the large tract of country dealt with and its greatly varying conditions, this is not at all excessive. Special attention is now being paid to the southern, more tropical section, where a good deal of native cultivation has been inspected during the year. Although there is plenty of work still to be done in the northern, irrigated areas, it is perhaps to this southern rain-fed tract that we may look for the greatest permanent increase in cotton growing. A good deal of exploratory work is thus included in the report, and this portion is extremely interesting. Observations are recorded on the gradually changing vegetative covering of the country, with the increasing rainfall on going south ; and studies are mentioned of root range and the character of the different layers of soil in various places—always a matter of interest in the Sudan—as indicating likely areas for expansion. Variety plots have been laid down and a certain amount of selection has been begun among the native-grown crops.

It is obvious that a great deal of important scientific work is being done on the Corporation's experiment stations, all tending towards the ideal of making the Lancashire mills less dependent on the vagaries of the United States cotton supply ; and it would be little short of a disaster if the work were checked at the present stage.

When a new disease broke out in the Java canefields and swept through the island from end to end, the planters, although smarting from a loss of £200,000 in one year, came together and agreed to tax themselves in support of a scientific department to fight the disease. The amount of

the levy was at first small, but it paid so well that it has been gradually increased, until the annual amount spent on scientific work is at present £100,000. Again, when the trade slump in 1921 threatened the Hawaiian sugar industry, the attitude of the heavily hit planters was expressed by the director of the experiment station in the following motto: "More investigation, more experimentation, more research, leading to higher yields per acre and lower costs per ton of sugar"; and there was no suggestion of the planters cavilling at this increase in their levy.

One result of the action in these two instances appears to-day in the fact that Java and Hawaii are producing more than five tons of sugar per acre, against round about two tons in all the other chief cane-growing countries¹—a matter of some significance now that the sugar industry is in low water. The tea and rubber planters have within the last few years started their own research stations; at any rate one sugar concern, the Colonial Sugar Refining Company, runs its own agricultural, entomological, and mycological research; and a perception of the losses incurred by disease has in one case caused this company to multiply its mycological staff, so that every field on every estate can be thoroughly surveyed, and appropriate cultivation and scientific remedies applied. It is to be hoped that such will be the feeling inspiring the action of the Lancashire cotton trade, in the present deplorable condition of the larger section of this industry.

Botanical Records in the Rocks.

Handbuch der Paläobotanik. Von Prof. Dr. Max Hirmer. Mit Beiträgen von Dr. Julius Pia und Dr. Wilhelm Troll. Band 1: *Thallophyta, Bryophyta, Pteridophyta*. Pp. xvi + 708. (München und Berlin: R. Oldenbourg, 1927.) 48 gold marks.

IN a 'handbook' of palæobotany, botanists, geologists, and others interested in the story of plant-life in the past expect to find a summary of the labours of students who have made it their business to collect and interpret the botanical records of the rocks. Prof. Hirmer's volume in the main satisfies this requirement. Among the many questions which experts are expected to answer we may include the following: What light is thrown upon the evolution of plants by the samples of vegetation preserved in sedimentary strata? Does a comparison of the successive floras which have flourished on the earth's surface afford

evidence of a continuous progressive development from simple to more complex types? Or is there reason to believe that a comparison of extinct and recent plants demonstrates a marked tendency towards recurrent cycles—a rapid rise to power and the successful colonisation of wide spaces on the part of certain groups, followed by their decline and by the apparently sudden appearance of new dynasties destined for a time to play the leading rôle in the world's vegetation?

In the second volume the author will no doubt deal with some or all of these general questions. The volume before us is mainly descriptive and carries us to the end of the Pteridophyta. Dr. Julius Pia contributes an introductory section on the preservation of plants as fossils, and to him have also been entrusted the Algæ and Fungi. No text-book of palæobotany is considered to be complete without a chapter on the various methods of fossilisation: there is, however, one aspect of the subject which is generally overlooked or inadequately treated. The present is in many respects the key to the past: geologists are accustomed to speak of the imperfection of the record, and it needs but little imagination to realise that the emphasis placed by Darwin on this imperfection was not exaggerated. On the other hand, we should be in a better position to form a just estimate of the proportion borne by fossils to the mass of contemporary vegetation if we had a fuller knowledge of what is now happening in different areas inhabited by trees or by herbaceous plants. We should like to know more about the conditions under which rivers are now accumulating in the sediments of deltas representative samples of the vegetation on their banks and on the higher ground watered by the parent streams; the relation of woody to herbaceous plants; the capacities of different kinds of vegetable debris to resist wear and tear; and so on. One suspects that many of the older floras are represented in the rocks almost exclusively by plants that were confined to certain habitats. By a closer study of the processes of rock-building at the present day, it might be possible to estimate with greater precision the chances of preservation of material derived from different geographical regions. Hints on the preparation of unpromising specimens for microscopical examination would have been a useful addition to the chapter on fossilisation.

The account of calcareous Algæ is on the whole very satisfactory; it directs attention to the wealth of form of such Algæ as the Dasycladaceæ in Mesozoic and Tertiary seas as compared with

¹ Maxwell, "Economic Aspects of Cane-Sugar Production," p. 57.