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SOME NOTES ON THE INTERDEPENDENCE OF THE COTTON AND THE COTTON SEED INDUSTRIES

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felt he was voicing the feeling of all the members in expressing great pleasure and satisfaction in proposing the re-election of Sir Frank Warner as President for the coming year.

Mr. W. FROST seconded, and said it was most gratifying that the Institute should be able to retain the excellent services of Sir Frank.

The re-election was unanimously and heartily carried.

The PRESIDENT, in reply, expressed thanks for the honour conferred upon him. He was not sure if his re-election was a recognition of services rendered during the past year, or an opportunity, generously given him, to redeem his character during the next twelve months. (Laughter.) Whichever way it was, and whatever the reason, he was confident that, with the assistance they would all render him, the burden would be light. He would enter upon his second year of office with the hope, and even with the confidence, that when that second term expired the Institute would be still further advanced in membership, in funds, and in the development of its work. Their membership had been doubled during the past three years. The Foundation Fund, in his opinion, had done admirably, and they had received a sum of over £10,000 towards the ultimate goal of £50,000. He felt sure there were prosperous times ahead, and they would find that the money was required if the machinery of the Institute was to work full time, and if they were to carry out the projects they knew should be carried out for the good of the Institute, and the textile industry as a whole. He had felt much pleasure and satisfaction in seeing the development of the *Journal*. The Institute to his mind had become an educational institute of great value—not educational in the sense that they set out to teach other people, but educational to the members. The Institute taught more to those who came in than those who stayed out, for the man who joined the Institute, no matter how highly equipped he might be on matters connected with his own particular branch of industry, would obtain substantial benefit from becoming a member, and he would acquire a vast fund of information and knowledge which would be of immense value. In conclusion, he had to express his thanks to the Chairman and Vice-Chairman of the Council, and to all the members of the Council, for the immense amount of work they had put in during the year.

ELECTION OF VICE-PRESIDENTS.

The following gentlemen were elected or re-elected, subject to acceptance, as Vice-Presidents: Sir Herbert Dixon, Bart., Sir Mark Oldroyd, Mr. Charles John Wilson, Sir Henry Hibbert, Bart., and Mr. Geo. L. Craig.

ELECTION OF COUNCIL.

It was announced that the Council had elected Messrs. R. Farrington, Dr. R. H. Pickard, Luke Thornber, and Frank Wright to fill casual vacancies on the Council, and these gentlemen, together with the nine retiring members, were declared elected.

Messrs. Arthur E. Piggott & Co. were re-elected auditors.

A hearty vote of thanks to the President terminated the morning's proceedings.

In the afternoon the following paper was read. The audience included delegates from the European Commission in reference to the World Cotton Conference to be held at New Orleans in October next. The President accorded the delegates a hearty welcome, and Mr. Fuller E. Callaway, Chairman of the Commission, extended an invitation to members and representatives of the Institute to attend and take part in the Congress.

SOME NOTES ON THE INTERDEPENDENCE OF THE COTTON AND THE COTTON SEED INDUSTRIES

By ED. C. DE SEGUNDO, A.M.Inst.C.E., M.Inst.M.E., M.I.E.E.

THE object of this paper is to bring forward for discussion one or two points in connection with the future of the spinning industry which, it seems to me, are peculiarly relevant to-day when, as a consequence of the world-war, we appear to have arrived at the parting of the ways in regard to sources of future supplies of raw material for the cotton spinning industry. First, then, how much do we *really* know about the science of cotton cultivation in its relation to the spinning qualities of the fibre? As a result of long practical experience, it is known that a mixture of this, that, and the other variety of cotton will produce such and such a character of yarn. But let us suppose that Lancashire were suddenly bereft of all known varieties, and had to deal with a new assortment of types of cotton. In that case, am I not right in saying that, virtually, the whole industry would be thrown into chaos until you had again, by long continued trial, ascertained what blends of the new varieties would produce the results you required? Although such an eventuality is, let us hope, not imminent, it is agreed, I think, that it is scarcely a sound policy for Lancashire to continue to be dependent for some 75 per cent to 80 per cent of its raw material upon the United States, where climatic and economic conditions have caused, and must ever be liable to cause, serious fluctuations in the available supplies. Added to this, it must be remembered that the proportion of the cotton grown in the United States and taken by American spinning mills has, of recent years, increased by leaps and bounds, and has now (1917-18) reached 58 per cent. Labour difficulties can scarcely fail to become accentuated in the United States in years to come, owing to the effects of the upheaval through which the world has passed during the last four and a half years, and there seems little prospect either of the area under cotton, or of the yield per acre in the United States being increased, unless, perhaps, some genius should perfect a mechanical cotton picker.

Further, the *New York Journal of Commerce* for January 27th, 1919, sounds the following sinister note:

"Advices from a large number of reliable sources in South Carolina, Georgia and Florida, indicate that there is a strong prospect of the crop of Sea Island cotton being reduced to negligible proportions during the coming season as a result of the widespread movement that is under way among the planters to abandon

completely, or nearly completely, the growing of Sea Island."

Professor John A. Todd tells us that in order adequately to satisfy the world's demands for cotton, there will be required a progressive increase, which will be cumulative, of about 1,000,000 bales per annum, and in a review, some time ago, of the world's sources of cotton, he expressed the view that it is to India that we must look for any reasonably rapid relief in the cotton situation. Be it India, or elsewhere, it would surely be the part of wisdom to stimulate and encourage the cultivation of the varieties of cotton required by Lancashire within the confines of the Empire. It has been well known for many years that enormous areas exist in various parts of the Empire where economic and climatic conditions are suitable for the cultivation of cotton, but if, for example, I told you that I was prepared to put a million acres under cotton in, let us say, West Africa, and I asked you gentlemen here to-day to give me a specification of your requirements as regards the physical characteristics of the cotton you wished grown, what would you say to me? You could only give me samples of various types of cotton you have been using, and say that you wanted stuff like that. In other words, you could show me *what* you wanted, but could not tell me just exactly what there was about it that *caused* you to want it. You will say that length of staple, number of convolutions per inch, uniformity of convolutions, uniformity and smallness of diameter, and a certain tensile strength, are governing factors in "good, spinnable cotton," and that the higher the counts the greater should be the length of the fibre, the less the diameter and the higher the number of convolutions per inch. So far as can be judged, the natural staple of Indian cotton is short, say ½ in. to ⅝ in., as compared with two inches and over in West Indian, and the convolute formation is less developed than in the West Indian. It is well known, however, that some 200 years ago fine Indian muslins were much in request in European markets. The character of the soil of India cannot have altered materially during this period, and whatever may have been the type of appliances used in those days in India, it is certain that nothing approaching in complexity and refinement that of the spinning machinery of to-day could possibly have been employed. In view of this, can we be absolutely positive that the characteristics which spinners believe are essential for spinning fine yarns are the only ones that *are* essential? From the very nature of the way in which yarn is made, it is clear that the breaking stress of the individual fibre cannot have a wholly governing influence on the strength of the yarn, which must necessarily be largely dependent upon the friction of contiguous fibres upon each other, which *may*, in some unknown measure, be due to the existence of hitherto undetected and unsuspected factors, outside of convolutions or twist, and referable to the physical character of the walls or sheath of the fibre. In brief, can you gentlemen be absolutely sure that by no possibility could a yarn, for which Sea Island is now considered essential, be produced from a shorter or a different staple? Is this thing, in itself, intrinsically impossible? And if it be so considered, how did the Indians manage by hand spinning? Must we conclude that it is impossible to achieve by machinery so fine a quality as that which is achievable by manual skill? Or are we to think that the climate best suited to the cultivation of cotton is also that best suited for spinning it? An examination into the reasons of these seeming paradoxes would surely take us some distance on the road to the discovery of the nature of the connecting links that should be established between grower and spinner. The air is now thick with Commissions and Committees urging upon us the extreme value of scientific research in all branches of commerce and industry. Would it not be well vigorously to continue and greatly to extend the very valuable research work that has already been done by several able scientific men, with a view to discover the relations subsisting between the character of the soil, the variety of the seed, the length of staple, the physical and chemical characteristics of the hair, the influence of climatic conditions, and other factors which, in the laboratory of nature, enter into the production of cotton? At the moment, an unbridged gulf exists between the cultivator of cotton and the man who has to turn the cotton to industrial account. So far as the spinner is concerned, he divides cotton, roughly, into two classes—good and bad. Good cotton is cotton that spins well, and bad cotton is cotton that doesn't, but the spinner does not know all the reasons why some cotton spins well and other cotton does not; at least, it does not seem quite clear whether the reason is entirely due to the physical characteristics of the cotton itself, or whether it may not be due, perhaps, to methods of manipulation, character of machinery employed, or mode of operation of such machines. There is a certain fixed routine of processes through which all cotton goes from the time it arrives in the bale to the time it appears as yarn. Much can be done by blending and by variations of the mode of operation of certain machines within certain limits. We also know that certain preliminary processes through which cotton goes in the spinning mill are designed to bring about, as nearly as possible, the ideal of having fibres of equal length, equal diameter, and equal strength, lying in juxtaposition so that alternate fibres overlap each other uniformly, to the end that the diameter and strength of the yarn produced be uniform throughout its length. The machines used are supposed to provide an approximation to this condition, and yet examination into results has shown in some cases that higher counts contain fibres of greater so-called average diameter than lower counts, which, of course, is a paradox. This fact indicates that the machinery used does not always produce the result for which it is designed, but it is again not clear whether this is referable to the machine or to the character of the fibres, and, if the latter, what physical or chemical properties these particular fibres possess that defeat the object of the machine.

In this connection I cannot refrain from making a few comments upon the character of the treatment to which cotton is subjected in the bale breaker,

opener, and scutcher. It seems incredible that the staple can escape injury in these processes, and it would not be surprising to learn that the injury is much greater than is at present realised. So far as I am aware, no attempts have been made as yet to determine, with any degree of scientific accuracy, the extent to which the staple may be damaged or reduced in length in these preliminary processes, but the very ingenious sorting machine recently devised by Dr. Lawrence Balls seems to me to afford a means of getting some information upon this question which should not be neglected.

If the proportion of fibres of maximum and minimum length in a certain mass of cotton *before* being baled were ascertained by means of Dr. Balls' sorter, and again measured *after* passing through the bale breaker, the opener, and the scutcher respectively, data would be obtained which I think could not fail to yield useful indications, and which might throw very valuable light upon this important question. Research work in this direction should amply repay time and money spent upon it.

These views are not based upon what I understand is a tradition in the spinning trade, but are dictated by my own somewhat special experience in detaching and segregating the short residual fibres from cotton seed and from the decorticated hulls of cotton seed.

Under present conditions, the cultivation of cotton and its treatment up to the time the spinner receives it, is carried on in about as unscientific and haphazard a manner as could well be imagined. For instance, no particular attention is paid—I am speaking generally—to the selection of seed for planting, nor to the "husbandry" of cotton cultivation. The consequence is that the character and quality of the staple tend more or less rapidly to the level determined, it would seem, by the uncontrolled—and, perhaps, uncontrollable—natural governing factors in any particular locality. If, for instance, you plant American Upland in India, you will get Upland staple for a season or two, and then it deviates from type, and, curiously enough, seldom in the direction of improvement. But is this unavoidable? Is it an instance of Darwin's principle of "reversion to type?" Is it not possible that American Upland could be cultivated in India, given the necessary knowledge, care, and attention, and made to yield staple to type season after season? No doubt, the question you gentlemen will at once ask is:—Granted the possibility, how much would it cost?

Everyone possessing even a superficial knowledge of the character and instincts of the Indian cultivator will realise the difficulty of the task and the complexity of the problems involved in introducing any innovation in India, and will readily admit that to attempt any such thing by private enterprise would be to court failure, but it would be otherwise were the practically unlimited resources, both political and financial, of the Government, brought into play. I would make this suggestion:—Let a commencement be made by largely extending the system of inspection and control of the ginneries to the end that the mixing of cotton be minimised and the proper selection and distribution of planting seed be effectively carried out. If necessary—and it has already been tried with success—the cultivator should be guaranteed by the Government against loss if he satisfactorily carries out the instructions of the Government.

Now, you may be wondering when the interdependence of the cotton and the cotton-seed industries is going to be dealt with. In the time at my disposal it will not be possible for me to lay before you more than the skeleton of my argument. The cotton seed from which your cotton is grown was, until 1860, or thereabouts, looked upon as an absolutely waste product, and treated accordingly. In the United States, enormous heaps of rotting cotton-seed were familiar sights at that time in the neighbourhood of the ginneries. Even to-day, when the phenomenal development of the cotton-seed oil industry in the United States has given an average cotton-seed crop in that country a value to the planter of between twenty and thirty millions sterling (pre-war values) the importance of the scientific treatment of cotton-seed as a factor in cotton cultivation does not appear to be by any means fully realised. I maintain that the scientific treatment and handling of the ginned seed cotton is an essential condition to all progress in cotton cultivation. About 95 per cent of the residue of the ginning of the fruit of the cotton plant, known as seed cotton, is of the woolly variety, that is to say, retains, after ginning, residual fibres to the amount of from 2 per cent in the case of certain lightly-fibred Indian seed to 12 per cent of the weight of the seed in the case of American Upland, Uganda, and the majority of the woolly varieties. Dr. Lawrence Balls has dealt at some length with the origin of the "fuzz," as he terms it, which forms the greater part of these residual fibres, in his valuable work on the "Development and Properties of Raw Cotton," but it is not clear—at least not to me—whether the fuzz is brought about by arrested growth of what otherwise would have become spinnable fibres, or whether it is distinct in character from the lint. Besides the "fuzz," the residual fibre comprises some staple which has escaped the action of the gin, and some other fibres which are too short to be included in "staple." These may conveniently be removed by any of the well-known saw-linting mechanisms.

The ginning operation is, generally speaking, carried on by parties who know even less about spinning than I do. They are usually not interested, financially or otherwise, either in the cultivation of cotton or in its industrial applications. Their interest lies solely in making as much money as possible out of the ginning of the seed-cotton. This operation is, so far as I have been able to judge, a purely mechanical one. Saw-gins are used in the United States; roller gins in India. Nobody seems to know exactly why, and nobody seems to care. The grower, naturally, likes to see a large ginning out-turn. The spinner has other views and keeps his eye on the staple, and the grading of cotton by buyers and their agents has long since become a fine art, and a judicious adjustment of price offered to length of staple keeps a wholesome check upon "close-ginning."

I have had some quite special experience in the detaching of hairs from cotton seeds, and I am of opinion that the present system of putting every type of seed-cotton through the same type of gin, be it saw or roller, is on a par with putting every kind of plastic material into a brickmaking machine and expecting to turn out the best quality of bricks of their respective kinds. I think there is room for a good deal of research work in connection with the relation of the design and mode of operation of ginning appliances to the several varieties of seed-cotton. It is an axiom that "cotton thirds itself." This may be true in many cases under subsisting conditions, but is it necessary and inevitably true? Why should it be popularly considered that the one-third ratio should always hold? As a matter of fact, the one-third ratio does not hold universally. At least one variety of Indian cotton yields a ginning out-turn of about 40 per cent, while West African varieties often yield only 28 per cent. If the ginner's objective were a high standard of quality, considered from the spinner's point of view, instead of, as it is now, the highest out-turn consistent with saleability, can we be sure that cotton would "third itself" so generally? Further, how much of the "third" does the spinner subsequently find to consist of bits of the boll, leaf, mother earth, debris of all kinds, and how much water does he buy at the price of cotton?

But from the point of view of the proper cultivation of cotton, the most serious brake on the wheel of progress lies in the system of ginning all varieties and heredities together. Under the system now prevailing it is practically impossible to segregate the seed ginned out from the various types of seed-cotton brought in by the planter. The effect of this is not so marked in the United States as in India, for reasons to which attention has already been drawn in a very instructive paper by Professor John A. Todd, read before the Royal Society of Arts in December, 1916, entitled "The World's Cotton Supply and India's share in it"—a paper which will amply repay careful study.

I do not think I need labour the point. We cannot but be agreed upon the importance of re-planting with properly selected seed, and the ideal would be to establish seed farms for the production of planting seed to be distributed to the several growers every season.

The next best thing is to prevent the mixture of varieties of seed at the ginnery. Neither of these expedients can be introduced in a day, but what could be done, and done at once, is either partially or wholly to denude the seed of its fuzz to the end that, by simple mechanical means, sound, plump, germinable seed could be segregated, and none but such seed used for planting, although, naturally, this course must be combined with proper control of the constitutional properties of the seed. When the seed is covered with fuzz, it is not easy to discern whether it be sound or not. I do not suppose for a moment that the average planter ever gives a thought to the *character* of the seed he sows. In the words of a well-known American authority, "99 per cent of the planters haven't the skill to deal with the question, and 99 per cent of the remainder don't care."

In the opinion of the same expert, the planting of sound, plump, germinable seed only, irrespective of heredity, should certainly bring about an increase of at least 10 per cent in the American crop. Were this achieved in the United States alone, we should have rather more than one million extra bales next year. I should not like to father upon our American expert the view that the employment of sound, germinable seed would result in a *continuous* increase of 10 per cent year after year. If this could be done, Professor Todd's progressive and cumulative million bales per annum would readily be provided.

You will probably again ask: Granted the possibility, what will it cost? Would the expense of denuding the seed of its fuzz and segregating the germinable seeds be greater than the benefit derived?

I am happy to be in a position to answer this question. Even if the resultant increase in the crop were less than 10 per cent—even if there were no increase at all—the defibration of the seed would pay handsomely even in the United States where the cotton-seed oil industry is developed up to the limit of seed production. In a cotton-growing country where no scientific cotton seed milling industry has been established—in India, for instance, which will very probably continue to be a seed exporting country for many years to come, in spite of the economic drawbacks involved thereby—the profit would be very much greater. This is due to the fact that of recent years means have been devised for detaching the "fuzz" without injury either to the seed or to the short cotton fibres, and for delivering the latter in a clean, merchantable form, free from what has been termed the "fatal defect" of the presence of pieces of the shell and other foreign matter, thus rendering these residual fibres available for a number of industrial purposes. I am informed that, hitherto, this "fatal defect" has been found in the product of all machines constructed with a view to the utilisation of these short fibres—which I have termed "residual fibres"—whether obtained direct from the whole seed or from the decorticated hulls of cotton seed.

For certainly more than twenty years, the potential value of these residual fibres in many industrial applications has been well recognised in scientific circles.

A small proportion, consisting of the longer fibres, has for many years been recovered by saw-linting mechanisms, which form part of the equipment of the greater number of the cotton oil mills in the United States. This product is known in commerce as linters, and has found a market chiefly in Germany for the manufacture of coarse yarns, &c. The successful removal of the remaining fibres, namely, the "fuzz," proper, from the shell in which they are rooted, proved to be an exceedingly difficult problem.

About the year 1909, a machine was devised which separated out the "fuzz" remaining on the decorticated hulls of cotton seed, a by-product in the milling of seed on the American system of which about 1,500,000 tons are produced in the United States annually. The product delivered by this machine was free from the "fatal defect" just referred to, and up to the outbreak of the war about 2,000 tons had been shipped over to this country and sold to papermakers on continuing

contract by a British company which had established a plant of these machines in the United States in 1912. During the war, this factory sold upwards of 8,000 tons of this "hull-fibre," as it is called, to the Dupont de Nemours Powder Company of America for the manufacture of explosives.

During the last two or three years, the machine which is exhibited here was brought to the commercial stage. Its function is to denude woolly cotton seed of the residual fibres not efficiently recoverable by saw-linting machines, without injury either to the short fibres or to the seed.

[The principle of action of the machine will be explained here.]

American Upland seed—which may be taken to be similar to Uganda, Cambodia, West African, White Sudanese, and cognate varieties—retains, when not ginned too closely, about 10 per cent to 12 per cent of residual fibres calculated upon the total weight of the ginned seed. In American milling practice—the decorticating system—these fibres should be removed in three steps :—

(i.) About 2 per cent (or say 45 lbs. per ton of seed) in the saw-linting machines (producing linters).

(ii.) About 3 per cent (or say 67 lbs. per ton of seed) in the seed-defibrating machine (producing seed-lint.)

(iii.) About 5 per cent (or say 112 pounds per ton of seed) in the hull-defibrating machine (producing hull-fibre.)

To-day, these products would command very high prices.

Upon the basis of pre-war trading conditions, these three grades aggregated in value about 45s. per ton of seed, and the costs of the extra operations involved amounted to about 11s. 6d. per ton of seed, thus leaving a nett extra return per ton of seed of about 33s.

On the British milling system—the cotton seed being crushed in its entirety—the recovery of the residual fibres will not be so complete, as some seed crushers claim that there is some advantage in leaving a small quantity of the very short fuzz on the seed.

Let us assume that 2 per cent is thus left on the seed, and that 2 per cent is taken off in the form of linters and 6 per cent in the form of seed-lint. The nett additional return should then work out to 32s. per ton of seed. This, it must be remembered, is the nett gain exclusive of the increased value of the defibrated cotton seed—as compared with woolly cotton seed—*in the oil milling operation*. It is clear, however, that the seed should be defibrated in the country of origin whenever practicable, and preferably at the ginnery. Let us now examine into the benefits attaching to so doing. We will consider the case of, say, Uganda seed defibrated at the ginnery in Uganda.

FIRST : There will be the profit on the linters and seed-lint.

SECOND : Uganda seed when stripped of its residual fibre will occupy less space. Measurements indicate that a cubic foot will contain from 25 per cent to 30 per cent more weight of defibrated than of undefibrated seed. This means a saving of from 5s. to 6s. in the £ on ocean freight alone.

THIRD : Woolly seed is very liable to heat in the confined space on board ship during a long sea voyage, and has often been the cause of an outbreak of fire. Even a moderate degree of heating sets up the liberation of free fatty acids in the kernel, causing deterioration of the seed, high losses in refining the oil, and increased cost—not to speak of expenses in arbitration and allowances to the buyer. These risks are reduced to a minimum if the seed is defibrated before shipment; hence, the insurance rate should be lower on defibrated seed.

FOURTH : In the discussion which followed my recent paper at the Royal Society of Arts, Mr. W. H. Pinnock, of the well-known firm of Pinnock Brothers, in Mark Lane, London, stated that it might safely be assumed that defibrated Uganda would fetch in British markets 20s. more per ton than undefibrated.

The total of all these benefits should amount to about £2 10s. per ton of seed above the price obtainable for undefibrated Uganda in British markets in pre-war days. No doubt, prices will rule higher for some years after the war than before, and the benefit should be, in some degree, greater.

One ton and a half of Uganda seed cotton would yield about half a ton of cotton worth say (pre-war) £25, so that an extra £2 10s. on the value of the ton of seed is equivalent to about 10 per cent of the value of the cotton concomitantly produced.

This subject could be pursued almost indefinitely, but I fear I must already have sorely tried your patience.

Last February, I dealt with the general subject of the industrial value of these residual fibres in a paper entitled "The removal of the residual fibres from cotton seed and their value for non-textile purposes," which was read and discussed at a meeting of the Royal Society of Arts, and to which I must refer you for further details than those I am able, in the time at my disposal to-day, to give you.

In the course of the discussion which ensued, Professor Todd drew attention to the economic aspect of the industrial employment of the residual cotton seed fibres. He said : "There were many countries in the world in which cotton could satisfactorily be grown, but the question was whether it could be made to pay in competition with other crops. One of the factors in that question was the by-products that could be realised, and he thought the by-products obtained from cotton seed by means of the author's machine might just turn the scale in many cases in favour of cotton." The importance of these by-products could hardly be exaggerated.

We are concerned here to-day more particularly with the question of the supply of raw cotton for what is one of the largest of the staple industries of the Kingdom, namely, the production of cotton goods. In a lecture delivered at the School of Economics in London on February 16th, 1917, Professor Todd pointed out that the value of the Lancashire product is probably well over 50 per cent of the world's total; that the supply of the raw material for this country is

probably the greatest problem which the cotton trade has to face to-day ; and that the average annual value of exports of cotton goods from the United Kingdom was about £110,000,000, or about one quarter of the total value of our exports. These figures sufficiently indicate the grave consequences which would follow any interference with the quantity of the raw material required, or any serious variation in the quality. The constitution of the League of Nations has no doubt been exceedingly well thought out, but it is difficult to see how by legislative enactment alone we can hope to eradicate from human nature those fundamental characteristics which the history of philosophy teaches us are inherent in mankind, and which may be summed up in the old saw "Charity begins at home." The figures I have quoted to-day—and they have not been quoted to-day for the first time by any means—regarding the rapidly increasing proportion of American cotton which is being taken by American spinning mills, coupled with the real agitation in the United States for a reduction of the area under cotton, and the increasing difficulty experienced in the United States of obtaining labour for picking the crop at a wage that makes the growing of cotton remunerative to the planter, point clearly and unmistakably to the pro duction within the Empire of the necessary supplies of cotton of the quality and character suitable for our spinning industry. I am quite aware that this is by no means an original idea, but the very fact that although it has been realised by far-seeing men for so many years, so little has been done by the authorities to bring about its materialisation, makes it necessary to insist and to continue insisting, in season and out of season, that *we must have "Empire cotton."*

Now, we do not want to have "Empire cotton" at the expense of "Empire cereals," or at the expense of the taxpayer, and, therefore, one of the fundamental principles underlying the realisation of Empire cotton is that Empire cotton should pay as industry in competition with the product in the international market. Professor Todd has, indeed, sounded the right note in insisting on the importance of the industrial utilisation of these hitherto neglected residual fibres, for the reason that the added revenue thus obtained might operate to make cotton growing pay in many cases where under subsisting conditions it would not. I feel some natural diffidence in dwelling upon this point, because the machines whereby these residual fibres are turned to so good account happen to be my design, but for the purpose of the argument, it is immaterial whose machines they are. What we are concerned with is the stimulation of cotton cultivation within our Empire in the greatest measure possible, and there can be no doubt that any process which tends to make cotton growing more profitable must be a potent factor in the realisation of this object.

But what is also needed is a clearer perception by the spinner of the relation between the physical characteristics of the cotton fibre and its spinning qualities ; more knowledge on the part of the grower of the science of cotton cultivation and of the spinner's requirements ; complete co-ordination of effort between spinner and grower, and as a logical corollary, that every step, from the selection of the planting seed to the finished yarn, should form a link in one and the same chain.

[Demonstration of the machine in operation defibrating lightly-fibred Indian cotton seed was given here.]

I may draw your attention to the fact that the defibration of such lightly-fibred seed as this constitutes a very severe test of the capabilities of the machine. It is evident on inspection that this seed has retained an almost negligible quantity of residual fibre, and I have ascertained, by continuing the defibration of the seed down to the coffee berry brown stage, that this particular sample does not contain more than 1 per cent of its total weight of useful residual fibre. In the operation you have just witnessed, about one-half of this quantity has been removed.

Seed-lint removed from linted Uganda seed has been exhaustively examined by Mr. C. F. Cross, F.R.S. (of the firm of Cross & Bevan, analytical chemists), who has analysed a number of samples and has reported a yield of cellulose as high as 87 per cent, or approximating to the yield of cellulose obtained from raw long cotton. Mr. Cross has also independently examined into the properties of "seed-lint" for the production of cellulose acetate, and has written to me that in this regard it fulfilled the most exacting requirements. The great firm of manufacturers of artificial silk, Messrs. Courtauld Limited, of Coventry, recently tried seed-lint on a manufacturing scale for the production of artificial silk, and wrote saying that it was in every way suitable for the purpose. Seed-lint has also been examined at the instance of the Director of Propellant Supplies (Ministry of Munitions of War) who has written that it was found suitable for the preparation of nitrocellulose powders.

The practical cessation of imports of woolly cotton seed during the war has rendered any commercial development in this country impracticable heretofore, but Mr. J. W. Pearson, Chairman of the British Oil and Cake Mills Limited, the largest seed crushing company in the kingdom, and, I venture to say, one of the most progressive, has now placed one of the company's up-to-date mills at my disposal f r the installation of a plant of these machines in co-operation with the oil-milling process, and this plant is now in course of construction. With the resumption of imports of woolly cotton seed, the production of the short cotton fibre direct from the seed, or "seed-lint" as it is called, will be proceeded with on a commercial scale.

Discussion.

The discussion which followed the reading of the foregoing paper is held over, and will appear in the next issue of this *Journal.*