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SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial and Indian Governments concerned.

CEARÁ RUBBER.

A CONSIDERABLE number of samples of Ceará rubber have been forwarded to the Imperial Institute from British Colonies and Protectorates, and the following selection of reports gives the results of the examination of specimens from Ceylon, Uganda, the East Africa Protectorate, Nyasaland, the Sudan, and Southern Nigeria.

CEARÁ RUBBER FROM CEYLON.

The specimen weighed 10 oz. and consisted of three square sheets of light-brown opaque rubber, clean and well prepared, but a little mouldy on the surface. The physical properties of the rubber were very satisfactory.

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Composition of dry washed rubber:—

	Per cents.
Caoutchouc	84·1
Resin	7·8
Proteid	6·5
Ash	1·6

The value of consignments of rubber similar to this sample is uncertain, but they would probably realise from 4*s.* to 4*s.* 6*d.* per lb. in London, with find hard Para quoted at 6*s.* 11*d.* per lb.

This rubber is only of fair quality on account of its deficient strength. The large loss on washing is due primarily to the moist condition of the rubber. The percentages of resin, proteid and ash are all rather high, especially the proteid.

If the latex flows sufficiently freely from the trees to be collected in bulk it would be advisable to prepare the rubber in the form of biscuits, by diluting the latex and allowing it to stand. This method would probably reduce the amount of proteid present in the rubber.

The appearance of this sample of rubber was greatly improved by conversion into crêpe.

TURPENTINE OIL FROM INDIA.

SAMPLES of turpentine oil were forwarded to the Imperial Institute by the Assistant Conservator of Forests at Naini Tal, United Provinces, in August 1910. The oil was stated to have been prepared at the Government turpentine oil distillery at Naini Tal, from the oleo-resin of the "chir" pine (*Pinus longifolia*), and it was desired to ascertain its value as compared with the turpentine oils of commerce.

Description of Samples.

The samples were two in number, marked "A" and "B." Each weighed 16 lb., and consisted of colourless turpentine oil.

Results of Examination.

The specific gravity and the rotatory power of the oils were as follows:—

	A.	B.
Specific gravity at 15°/15° C.	0·871	0·368
Optical rotation in 100-mm. tube	−0° 45′	−2° 10′

The samples were subjected to fractional distillation with the following results :—

	A.		B.	
	Percentage of total sample by volume	Optical rotation in 100-mm. tube	Percentage of total sample by volume	Optical rotation in 100-mm. tube
Fraction boiling at :—				
165° C. or below .	1	− 9° 45′	1	—
165° C. to 170° C. .	54	− 5° 15′	55	− 7° 15′
170° C. to 175° C. .	25	+ 2° 0′	28	+ 0° 20′
175° C. to 195° C. .	12	+ 6° 35′	9	+ 7° 5′
Residue . . .	7	+ 10° 45′	6	+ 17° 25′

The above figures show that the present samples, yielding practically no distillate below 165° C., are quite different from American turpentine oil, which should yield not less than 70 per cent. by volume between 155° and 160° C. They are of the same nature as a sample of turpentine oil from *Pinus longifolia* from the Jaunsar Division, United Provinces, previously examined at the Imperial Institute. One-third of the latter was lævo-pinene, boiling at 157° C., and having a rotatory power in a 100-mm. tube of − 36° 30′, and two-thirds consisted of a mixture of sylvestrene and other high-boiling terpenes, with a boiling-point of 173° C. and a rotatory power in a 100-mm. tube of + 13°.

This oil most nearly resembles Russian turpentine oil among those on the English market, but the Russian product is very variable in composition, and in this respect the Indian oil would have an advantage. The following figures have been recorded for two samples of commercial Russian oil :—

		I.	II.
Specific gravity at 15·5°/15·5° C.		0·866	0·884
Optical rotation in 100-mm. tube		+ 14° 29′	+ 16° 20′
Fraction boiling at :—			
145° to 160° C.	per cent.	4	2
160° to 165° C.	„	12	16
165° to 170° C.	„	43	36
170° to 175° C.	„	20	18
175° to 180° C.	„	11	7
180° to 185° C.	„	3	4
185° to 190° C.	„	2	2

No. 1 was also found to contain some petroleum.

	Per cent.
Moisture	0·9
Caoutchouc	91·3
Resin	3·1
Proteid	3·4
Ash	1·3

The specimen was valued at probably about 8*s.* per lb. in London, with fine hard Para at 10*s.* per lb., and good to fine plantation Para biscuits at 8*s.* 10½*d.* to 9*s.* per lb.

This rubber is of good quality and satisfactory in composition, except that the amount of ash is unusually high.

CEARÁ RUBBER FROM UGANDA.

1. Ceará rubber coagulated by means of lime-juice, and a very weak solution of formaldehyde added as a preservative.

The sample weighed 1½ lb., and consisted of thin biscuits of pale yellow rubber, very uniform in colour and excellently prepared. The physical characters of the rubber were very satisfactory.

The chemical examination gave the following results :—

	Rubber as received. Per cent.	Composition of dry rubber. Per cent.
Moisture	4·8	—
Caoutchouc	72·8	76·5
Resin	7·6	8·0
Proteid	11·9	12·5
Ash	2·9	3·0

The rubber was valued at from 8*s.* 2*d.* to 8*s.* 4*d.* per lb. in London, with fine hard Para at 10*s.* 1*d.* per lb., and good to fine plantation Para biscuits at 8*s.* 10¼*d.* to 9*s.* per lb.

This Ceará rubber is of very good quality, and its preparation leaves little to be desired. The results of the analysis show, however, that the percentages of resin, proteid and ash are all high, the amounts of the two latter constituents being much greater than is usual in biscuit Ceará rubber.

It is difficult to account for the large percentage of proteid (12·5) present in the rubber, unless it is to be attributed to the method of preparation employed, and it was suggested that it

would be desirable to prepare for comparative analysis a few biscuits of the rubber by simply diluting the latex with water and allowing it to stand without any other addition.

2. Ceará rubber prepared with water only.

This specimen of rubber was prepared in response to the suggestion made in the preceding report. It weighed 1¼ lb. and consisted of three pieces of corrugated sheet rubber about ¼ inch thick, which were rather moist internally when received. The rubber was light yellow externally but quite white within, and it was free from vegetable impurities; its physical properties were very satisfactory.

A chemical examination gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	3·5	—
Caoutchouc	86·1	89·3
Resin	5·7	5·9
Proteid	3·6	3·7
Ash	1·1	1·1

The rubber was valued at 4*s.* 3*d.* per lb. in London, with fine hard Para quoted at 5*s.* 2*d.* per lb.

This specimen of Ceará rubber is much superior in composition to the previous sample. The percentages of resin, proteid and ash are all much lower, and the amount of caoutchouc consequently greater. It appears, therefore, that the method of coagulating the latex by simply adding water and allowing it to stand will give a much purer rubber than the process adopted in the previous case.

CEARÁ RUBBER FROM THE EAST AFRICA PROTECTORATE.

1. From the Kibos District.

The specimen weighed 2½ ozs., and consisted of a small ball of pale brown rubber which was very moist internally when freshly cut. The rubber was slightly sticky, but exhibited fair elasticity and tenacity.

An analysis gave the following results :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	12·4	—
Caoutchouc	58·9	67·2
Resin	10·5	12·0
Proteid	12·1	13·8
Insoluble matter	6·1	7·0
Ash	2·4	2·8

The sample was too small for trustworthy valuation, but rubber of similar quality would probably realise about 3*s.* per lb. in London, with fine hard Para quoted at 4*s.* 3½*d.* per lb.

The percentages of resin, proteid and insoluble matter present in this rubber are all rather excessive. These defects may, however, be due in part to the fact that the latex coagulated spontaneously in the incisions and the rubber had consequently to be collected as "scrap." Practically the whole of the resin and proteid present in the latex would therefore be included in the rubber.

2. From Kisumu.

This sample was stated to have been obtained from Ceará trees about 18 months old at the Mill Hill Park Mission Station near Kisumu. It consisted of a small ball of light brown rubber, rather sticky externally and moist within. The rubber exhibited poor elasticity and tenacity.

An analysis showed the rubber to have the following composition :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	10·0	—
Caoutchouc	59·8	66·4
Resin	8·7	9·7
Proteid	13·9	15·5
Insoluble matter	7·6	8·4
Ash	4·02	4·46

The sample was too small for trustworthy valuation, but rubber of similar character would possibly realise about 3*s.* per lb. in London, with fine hard Para at 5*s.* per lb.

The rubber is of inferior quality on account of the large amounts of resin, proteid and insoluble matter present, which adversely affect its physical properties. It must, however, be borne in mind that the rubber was derived from very young trees, and that the quality may improve as the trees become older.

CEARÁ RUBBER FROM NYASALAND.

This sample was stated to have been prepared from two-year-old trees by pricking. It consisted of very small balls of light brown rubber, the average weight of a single ball being 1·08 gram. Some of the balls were moist internally, and a little vegetable impurity was present. The rubber exhibited fair elasticity and tenacity.

The results of the examination were as follows:—

	Per cent.
Loss on washing (moisture and impurities)	4·9
Composition of dry washed rubber:—	
Caoutchouc	78·6
Resin	10·8
Proteid	8·4
Ash	2·2

The rubber was submitted to brokers, who valued it at about 5*s.* per lb. in London, with fine hard Para at 10*s.* 6*d.* per lb.

The rubber contained a high percentage of resin, but as it was derived from trees only two years old, this feature is not surprising. The amount of proteid is also excessive.

The value of this sample of Ceará rubber was placed at about half that of fine hard Para, whereas Ceará biscuits from Nyasaland have realised prices equal to that of fine hard Para (see this *Bulletin*, 1910, 8. 128). If, however, the rubber were less resinous than this specimen, there is no doubt that the balls would fetch a better price than the present quotation, and it was suggested that a number of mature trees should be tapped by the pricking process, and the rubber forwarded for examination and valuation.

The rubber obtained from the two-year-old trees would, however, be saleable, and if the pricking at this early age does not damage the trees, there is no reason why the method should not be adopted.

The relative values of the pricking and herring-bone system of tapping Ceará trees, as regards the yield and value of the rubber obtained and the effect upon the trees, will have to be determined by experiments in Nyasaland. The chief objection to the pricking method is that the rubber is obtained in balls or as "scrap," but the use of a washing machine would obviate this drawback.

CEARÁ RUBBER FROM THE SUDAN.

The sample was labelled "Rubber from Ceará plantations in Mongalla," and consisted of five small biscuits of pale yellow rubber, which were clean, well prepared, and free from impurities. The rubber exhibited good elasticity and tenacity.

The rubber had the following composition :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	2·2	—
Caoutchouc	80·1	81·9
Resin	5·8	5·9
Proteid	9·8	10·0
Ash	2·1	2·2

The specimen was valued at 4*s.* 10*d.* per lb. in London, with fine hard Para at 5*s.* 10*d.* per lb., and good to fine plantation Para biscuits at 5*s.* 1*d.* to 5*s.* 4*d.* per lb.

This rubber, derived from two-year-old trees, is of very good quality, and its preparation is quite equal to that of any Ceará rubber on the market. In composition it is not quite so good as some specimens of plantation Ceará from Ceylon, but it is superior to samples from East Africa which have been examined at the Imperial Institute.

The results of this investigation are very promising, and indicate that the Ceará trees at Mongalla may be expected to furnish rubber of very good quality.

CEARÁ RUBBER FROM SOUTHERN NIGERIA.

1. From Lagos.

The specimen consisted of about 3 ozs. of rubber in irregular lumps, which had been formed by the aggregation of very small

balls. The rubber was light brown and free from visible impurity. Its physical characters were not very satisfactory, as the greater part of the sample appeared to be slightly perished, especially on the outside of the lumps, and the rubber was very deficient in elasticity and tenacity.

The rubber was found to have the following composition :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	6·4	—
Caoutchouc	62·8	67·2
Resin	3·4	3·6
Proteid	22·4	23·9
Insoluble matter	5·0	5·3
Ash	2·6	2·7

The striking feature of the analytical results is the large amount of proteid contained in the rubber. The presence of this excessive quantity has probably arisen through the immediate coagulation of the latex as it issued from the tree, whereby the whole of the proteid matter in the latex was included in the rubber.

The rubber was submitted for valuation to brokers, who described it as rather stringy and perished scrap, and valued it at about 2*s.* 9*d.*, with fine hard Para quoted at 5*s.* 7*d.* per lb.

The investigation showed that this sample of Ceará rubber was unsatisfactory, both as regards physical properties and chemical composition, and that it would consequently fetch only a low price in the market.

2. From Olokemeji.

The sample was described as "Ceará rubber prepared by the Lewa method and afterwards smoked." It weighed 10 lb., and consisted of cakes of rubber formed of aggregated balls, which were rather moist internally, and contained a little vegetable impurity. The rubber was dark brown externally but white within, and it had a strong smoky odour ; it was rather deficient in strength.

The results of the examination were as follows :—

	Per cent.
Loss on washing (moisture and impurities)	21·7