

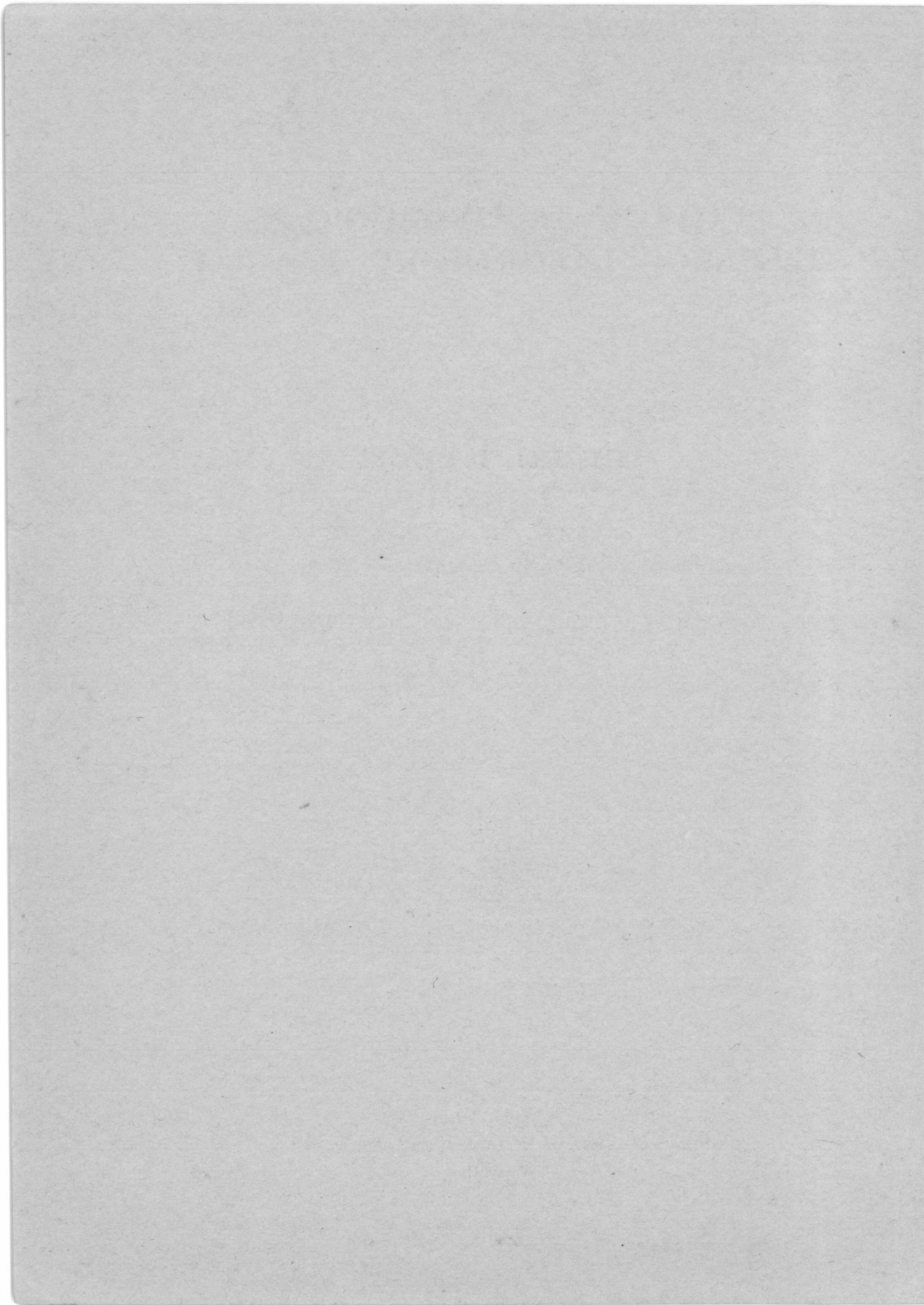
**COTTON TECHNOLOGICAL  
RESEARCH LABORATORY, BOMBAY**

**Annual Report  
1968**

(January 1, 1968 to December 31, 1968)



INDIAN COUNCIL OF AGRICULTURAL RESEARCH  
NEW DELHI



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Technological Research Laboratory



*Printed January 1970*

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Published by Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C., Director,  
Cotton Technological Research Laboratory, Bombay-19, and  
Printed by Rev. Theodore A. Pereira at the Examiner Press, Bombay-1.

## I. Introduction

This is the Forty-Fifth Annual Report of this Laboratory and pertains to the calendar year 1968.

This Laboratory was founded by the Indian Central Cotton Committee in 1924, immediately after it was constituted, in view of the essential need for an authoritative and scientific estimation of the inherent quality of the new varieties of cotton evolved. The Laboratory came under the administrative control of the Indian Council of Agricultural Research with effect from the 1st April, 1966, consequent on the abolition of the Indian Central Cotton Committee.

The chief functions of this Laboratory are :

- (i) to help the Agricultural Departments in evaluating the *quality of new strains* evolved,
- (ii) to help the trade and the industry by furnishing true valuation of different *Trade Varieties* cultivated,
- (iii) to carry out *basic research* in physical and chemical properties of cotton in relation to quality and spinning performance of cotton,
- (iv) to carry out investigations on the *ginning problems* of Indian cottons,
- (v) to investigate the *greater and better utilisation* of cotton, cotton wastes, linters, cotton seed, etc.,
- (vi) to issue authoritative reports on the samples received for tests from the *trade and other sources*, and
- (vii) to disseminate *technical information*.

This Laboratory consists of several sections concerned with the testing and research on different aspects of cotton fibres, yarns and fabrics. The main sections are Ginning, Fibre Testing, Spinning, Yarn Testing, Physics, Chemistry, Microscopy, X-ray and Statistics. This Laboratory maintains a good up-to-date library of books connected with cotton technology. The library contains 2,263 books, 102 of which were added during the year. The number of bound volumes was 2,114. The library also receives regularly about 120 journals dealing with textile and allied subjects, 60 of which were subscribed for and the others received on exchange or complimentary basis.

During the year under review, the following equipments were acquired for the use of the Laboratory:

- (i) 'Baush & Lomb' Spectronic 600 E Spectrophotometer and accessories,
- (ii) Polish-make Automatic Analytical Balance Model WA-31,
- (iii) Vacuum Rotary Evaporator—Buchi's Rota Vapor "R/A",
- (iv) Model H/7 two-stage Rotary Vacuum Pump,
- (v) Thermolab general purpose Shaking Bath,
- (vi) Lab. High Pressure Kier, and
- (vii) Thermostatic Water Bath—Thermolab.

Due to non-release of foreign exchange, a number of other instruments and equipments, urgently required, could not be procured from abroad.

Among the distinguished persons who visited this Laboratory, during the year under review, mention may be made of the following :

- Dr. Dale A. Porter — Director, U. S. Department of Agriculture, Agriculture Research Service, Eastern Regional Research Office, American Embassy, New Delhi.
- Mr. Caroll L. Hoffpauir — Assistant Director, Southern Utilization Research and Development Division, U. S. Department of Agriculture, New Orleans, U.S.A.
- Mr. Robert A. Zortman — Commodity Trader, New Orleans (Louisiana), U.S.A.
- Dr. Ross Le Roy Packard — Agricultural Officer, American Consulate General, Bombay.
- Prof. Srinagabhushana — Indian Statistical Institute, Bangalore 25.
- Shri C. Sundaram — Manager, Rajendra Mills, Salem.
- Dr. G. S. Misra — Director, Indian Lac Research Institute, Namkum, Ranchi.
- Dr. G. M. Bornet — Associate Director of Technical Research, International Institute for Cotton, Manchester 20, England.
- Dr. J. S. Pruthi — Director, Central AGMARK Laboratory, Nagpur.

In addition to the above, Dr. A. B. Joshi (Deputy Director General, Crop Sciences), Dr. J. S. Kanwar (Deputy Director General, S.I.A.E.), Shri K. P. A. Menon (Secretary), Shri M. Ahmed (Additional Secretary) and other senior officials of the Indian Council of Agricultural Research visited the Laboratory on various occasions in connection with official work.

During the year under review, two meetings of the Staff Research Council were held. The first meeting was held on the 23rd May, 1968, for considering the Research Programme of the Laboratory for the year 1968. The second meeting was held on the 16th November, 1968, when all the Senior

Research Assistants working at the different outstations were also present, and various administrative and technical difficulties experienced by them were discussed and suitable remedies suggested.

An All-India Co-ordinated Research Project on Cotton was sanctioned by the Indian Council of Agricultural Research with effect from the 1st April, 1967, and this Laboratory is one of the centres of work. Samples of the improved strains evolved under the scheme are tested for their technological properties at this Laboratory and eight outstations situated in the important cotton growing States, where specially trained staff have been posted.

A number of projects are being undertaken in collaboration with other organisations whenever opportunities arise. During the year, the following projects were functioning in collaboration with other departments as indicated below :

- (i) Secondary cell wall development of *G. herbaceum* and Indo-American cottons (in collaboration with Shri C. T. Patel, Cotton Specialist, Surat).
- (ii) Study of structural properties of chemically modified cotton by optical methods (in collaboration with Prof. E. H. Daruwalla, Department of Chemical Technology, Bombay University).
- (iii) Inheritance of x-ray angle and bundle strength (in collaboration with Dr. V. Santhanam, Head of the Regional Research Centre, Indian Agricultural Research Institute, Coimbatore).

The Project entitled "Investigation of the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information on the chemistry of cotton celluloses", which effectively commenced from the 16th August, 1965, is progressing satisfactorily.

The Director continued to be an *ex-officio* member on the following bodies:

- (i) Advisory Board of the Indian Council of Agricultural Research.
- (ii) Scientific Panel of the Indian Council of Agricultural Research.
- (iii) Board of Management of the Victoria Jubilee Technical Institute, Bombay.
- (iv) (a) Senate, (b) Academic Council, (c) Faculty of Science, (d) Board of Studies in Physics, and (e) Board of University Teaching for subjects in the faculties of Arts and Science of the Bombay University.

During 1968, the Director was appointed as a member of the following bodies :

- (i) Indian Council of Agricultural Research Society.
- (ii) General Advisory Committee for Research and Liaison and also its sub-committee (Physics and Physical Testing) of the Bombay Textile Research Association.

The Director and other scientific officers of this Laboratory continued to represent the Indian Council of Agricultural Research on the various committees and sub-committees of the Indian Standards Institution dealing with Cotton Textiles. Dr. V. Sundaram has been appointed as Vice-Chairman (Physical Methods of Tests Sectional Committee) TDC : 1.

The University of Bombay continued to recognise this Laboratory as a Post-Graduate Institution for guiding students for the M.Sc. and Ph.D. degrees in Textile Physics during the year. Dr. V. Sundaram, Director, and Dr. Jai Prakash, Senior Scientific Officer, continued to be teachers for guiding students for Ph.D. and M.Sc. degrees, respectively, of the University of Bombay in Textile Physics (by research). At present, seven members of the Research Staff are being guided for M.Sc. and one for Ph.D. degree in Textile Physics (by research) of the Bombay University.

The expansion and modernisation programme of the Laboratory has been held up since last year pending release of the required foreign exchange for importing certain parts for setting up the Temperature and Humidity Control Plant in the Testing Section. On receipt of the orders of the Government of India in September, 1967, the work of erection of the plant was immediately commenced by a local firm and is practically complete. However, the plant can be put into operation only after the fitting of some controls and other parts which are to be imported. The Chief Controller of Imports and Exports had issued license for importing only three of the six parts required. He has been requested to issue the required license for the remaining parts also to enable completion of the work.

In addition to 24 staff quarters already built and allotted to the members of the staff, 16 Type-I quarters are proposed to be constructed for allotment to Class IV employees of the Laboratory.

Consequent upon the manifold increase in the research activities of the Laboratory, the floor space presently available in its existing buildings is found quite inadequate for the use of the various research sections. Moreover, the Laboratory has no lecture hall or an auditorium. It is, therefore, proposed to add one more storey to the recently constructed building. The proposal has been approved by the Indian Council of Agricultural Research, New Delhi, in principle and the matter has now been taken up with the Central Public Works Department for preparation of lay-out plans and cost estimates for the building work.

As usual, a large number of improved cotton strains evolved under various research projects were received from the State Departments of Agriculture and tested at the Laboratory. Besides these, some commercial firms and Government and semi-Government organisations continued to avail of the testing facilities at this Laboratory, and a number of samples of fibre, yarn and cloth were received and tested for them on payment of prescribed fees.



The cotton trade and industry continued to appreciate the training facilities at this Laboratory and eight persons employed in the cotton trade and industry were imparted training in Cotton Technology and elements of Statistics.

There was continued demand for the instruments fabricated at the Laboratory and a number of such instruments were made and supplied to interested parties.

A statement showing the budget and expenditure of this Laboratory during the financial year 1967-68 is given in Appendix I. It will be noted that out of a sum of Rs. 15.94 lakhs sanctioned, only a sum of Rs. 11.85 lakhs had been spent during the year. An amount of Rs. 3.54 lakhs out of Rs. 6.00 lakhs provided under capital expenditure for modernisation and expansion of the Laboratory remained unutilised for want of necessary foreign exchange. In addition, an expenditure of Rs. 0.87 lakh was incurred on technological schemes including P.L.480 Projects.

#### Outstanding Achievements

During the year, considerable progress was made in the research activities of this Laboratory. Among the important results observed, a few are indicated below.

(i) Among the new strains evolved under the All-India Co-ordinated Research Project and tested at the Laboratory the following were found to be very promising from the point of view of their technological performance :

|                      |   |   |
|----------------------|---|---|
| <i>G. barbadense</i> | — | Co-Pusa-Egyptian, S.B.289E                    |
| <i>G. hirsutum</i>   | — | A.218, B.59-1684, Hybrid 4, 909-2 and 815-3-1 |
| <i>G. arboreum</i>   | — | C.C.1-1-3                                     |
| <i>G. herbaceum</i>  | — | B.C.3200 and 1482.                            |

(ii) The analysis of seeds of various varieties of cotton tested so far at this Laboratory indicated that the seed weight and oil content of cotton seeds belonging to *G. barbadense* and *G. hirsutum* species were higher than those of the other species and that the seeds of the *G. barbadense* species contained more gossypol than those of the other species. A few *desi* strains like N.R.5, Red arboreum and Garo Hills cottons had very low gossypol.

(iii) While studying the effect of treating cotton with zinc chloride, it was observed that inter-crystalline swelling and decrystallisation brought about by zinc chloride at 65% and 70% concentrations was due to specific hydrate formation rather than due to formation of different types of complexes between zinc chloride and cellulose.

(iv) Under the investigation on the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information on the chemistry of cotton cellulose, it was observed that degradation with increasing irradiation dosage was more or less identical for raw and acetylated samples ; the acry-

lonitrile grafted samples showed some resistance against degradation of irradiation while allylated samples showed substantial radio resistance. The benzylated and benzoylated samples proved more radio-resistant than the other tested samples.

(v) An examination of the density changes at various stages of growth of a fibre revealed that in addition to the thickening of the cell wall of the fibres with increase in the age of the boll, some structural change also was taking place in the fibre, probably increasing the crystallinity of the fibres.

(vi) While preparing colour charts for different grades of Indian cottons, it was observed that the change in the reflectance values of Indian cottons after cleaning was not proportional to the extent of trash removed by Shirley Analyser.

(vii) A formula was evolved with which the spinning capacities of various varieties (except Hybrids) grown in the Middle Gujarat tract can be estimated from their chief fibre properties.

(viii) During the year, two technological reports, six technological publications and three articles were published. Six articles have been sent to various journals for publication. Further, 65 technological circulars were issued on different Trade Varieties and Standard Indian cottons for the benefit of the trade, industry, the Cotton Breeders, etc. On the completion of the P.L.480 Project entitled, "Investigation of the microbial decomposition of cellulose with special reference to the effect of Indian bacterial organisms on cotton and cotton fabrics to provide basic information for the improvement of cotton products", a detailed report of the study was published during the year.

Details of the progress made in the various research projects are explained in the next section.

(ii) The analysis of seeds of various varieties of cotton tested so far at this Laboratory indicated that the seed weight and oil content of cotton seeds belonging to *G. barbadense* and *G. hirsutum* species were higher than those of the other species and that the seeds of the *G. barbadense* species contained more gossypol than those of the other species. A few *das* strains like N.R.5, Red arborum and Goro Hills cottons had very low gossypol.

(iii) While studying the effect of treating cotton with zinc chloride, it was observed that inter-crystalline swelling and decrystallisation brought about by zinc chloride at 65% and 70% concentrations was due to specific hydrate formation rather than due to formation of different types of complexes between zinc chloride and cellulose.

(iv) Under the investigation on the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information on the chemistry of cotton cellulose, it was observed that degradation with increasing irradiation dosage was more or less identical for raw and acetylated samples; the acety-

Table I. Number of Cotton Samples Received from the State Departments of Agriculture

| Year  | 1966  | 1967  | 1968  | Average for the quinquennium 1960-65 |
|-------|-------|-------|-------|--------------------------------------|
| Total | 1,874 | 2,536 | 1,874 | 2,064                                |

## II. Progress of Research

During the year under review, considerable progress has been made in the various research investigations undertaken at this Laboratory. A few papers, based on the research work completed, were published in suitable scientific and technical journals. In the case of a few more investigations, the experimental work had been completed and the results are being analysed. Out of the two P.L.480 Projects, the work relating to the Project on the investigation of microbial degradation of cotton was completed in the beginning of the year and the final report on the Project was submitted to the P.L.480 and Indian Council of Agricultural Research authorities; the work on the other P.L.480 Project dealing with the effect of gamma-ray irradiation on raw and chemically modified cottons was progressing satisfactorily. Some of the important results have been indicated under "Outstanding achievements" in the previous section.

With regard to the Project on the evaluation of quality of new strains of cotton, it may be pointed out that nearly 800 samples were received from various trials under the All-India Co-ordinated Research Project on Cotton. In many cases, the tests had to be carried out urgently so as to have the results ready for discussion at the respective zonal workshop meetings held in April, May and June, 1968. Consequently, there was a heavy pressure of testing work in the earlier part of the year, which caused some dislocation in the progress of other research investigations. As desired by the Project Co-ordinator, the tests on all samples were completed and the reports sent to him by the end of October, 1968.

The progress made in each Research Project is indicated briefly in the following pages.

### 1. Evaluation of the quality of cotton samples received from the State Agricultural Departments

A number of samples are received at the Laboratory for various tests from the State Departments of Agriculture. Some samples are obtained in connection with various research investigations at the Laboratory. The number of samples received during the years 1966, 1967 and 1968 together with the corresponding average figures for the quinquennium 1960-65 are given in Table I.

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TABLE 1. NUMBER OF COTTON SAMPLES RECEIVED FROM THE STATE DEPARTMENTS OF AGRICULTURE

| Type of test   | Average for the quin-<br>quennium<br>ending<br>May 1965 | 1966  | 1967  | 1968  |
|--|---|-------|-------|-------|
| Fibre and full spinning tests .. .. .                      | 857   | 645   | 649   | 632   |
| Micro-spinning tests (with or without fibre tests) .. .. . | 2,064   | 1,695 | 1,874 | 2,536 |
| Fibre tests alone .. .. .                                  | 213   | 191   | 277   | 102   |
| Mill tests .. .. .   | —   | 17    | 11    | 20    |
| Standard cottons .. .. .                                   | 22  | 23    | 17    | 27    |
| Trade varieties (Lint) .. .. .                             | 90  | 26    | 42    | 23    |
| Trade varieties ( <i>Kapas</i> ) .. .. .                   |   | 48    | 24    | 52    |
| Technological Research .. .. .                             | 634   | 820†  | 213   | 39    |
| Miscellaneous .. .. .                                      | 40  | 36*   | 78*   | —     |
| Total  | 3,920   | 3,501 | 3,185 | 3,431 |

† Includes 600 samples for Colorimeter tests.

\* Includes 17 samples and 63 samples for chemical tests during the years 1966 and 1967, respectively.

The samples received from the State Departments of Agriculture are generally tested in the order of their receipt and the test results are sent to the officers concerned as quickly as possible. The results of tests on each of the Trade Variety and Standard Indian Cotton samples are reported in the form of a Technological Circular immediately after tests are completed. Later, the test results are consolidated for the whole season and published as two Technological Reports, one on the Trade Varieties and another on the Standard Indian Cottons. The technological research samples are utilised for the Laboratory's research work; test reports based on the results of tests on these samples are not usually issued, and the results are included in the relevant research papers published by the Laboratory. Besides these, some samples are received for miscellaneous tests, such as determination of quality of ginning, neppiness, oil content in cotton seed, etc. A few of the small samples received for tests are in the form of *kapas* and these are first ginned in the ginning section before they are tested for various properties. During 1968, about 40 samples had been received as *kapas* and were ginned. Further, 51 samples of *kapas* of Trade Varieties were ginned for determining their ginning out-turn.

The State-wise break-up of the number of samples received from the State Departments of Agriculture and tested for different properties, on which reports were issued to the concerned officers in 1968, are given in Table 2.

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TABLE 2. NUMBER OF SAMPLES TESTED AND REPORTED FOR THE STATE DEPARTMENTS OF AGRICULTURE

| State                    | Fibre and full spinning tests |      | Micro-spinning with or without fibre tests |      | Fibre tests alone | Number of reports |
|--------------------------|-------------------------------|------|--|------|-------------------|-------------------|
|                          | Ag.                           | C.P. | Ag.  | C.P. |                   |                   |
| Maharashtra .. .. .      | 146                           | 8    | 484  | 48   | —                 | 67                |
| Gujarat .. .. .          | 86                            | 28   | 519  | 220  | —                 | 85                |
| Madhya Pradesh .. .. .   | 6                             | 8    | —  | 48   | —                 | 9                 |
| Rajasthan .. .. .        | 17                            | 17   | 27   | 49   | —                 | 12                |
| Punjab & Haryana .. .. . | 36                            | 32   | 62   | 47   | —                 | 14                |
| Uttar Pradesh .. .. .    | 3                             | —    | 134  | —    | —                 | 17                |
| Mysore .. .. .           | 72                            | 12   | 183  | 61   | 50                | 50                |
| Andhra Pradesh .. .. .   | 26                            | —    | 73   | 18   | 39                | 25                |
| Tamil Nadu .. .. .       | 37                            | 18   | 70   | 60   | —                 | 30                |
| Others .. .. .           | 14                            | —    | —  | 46   | 12                | 12                |
| Total                    | 443                           | 123  | 1,552                                      | 597  | 101               | 321               |

C.P.=Co-ordinated Project samples. Ag.=Other samples.

In this connection, it may be mentioned that the spinning procedure and strength standards adopted for testing the cotton samples have been revised from the 1967-68 season, the details of which have been given in the previous Annual Report. The H.S.C. values indicated on the 1967-68 season samples will be about 4 counts lower than the H.S.C. expected according to the old system.

The results are discussed in the following sections :

(i) All-India Co-ordinated Research Project on Cotton

An All-India Co-ordinated Research Project on Cotton was initiated by the Indian Council of Agricultural Research with effect from the 1st April, 1967, and the Laboratory is actively associated with this project. The total number of samples received at the Laboratory under this project was 801. Out of these, 720 have been tested so far, 123 samples being for fibre and full spinning tests and 597 samples for fibre and micro-spinning tests. In addition, 46 samples were tested for oil content. Some important test results observed, while testing the samples from the project, are indicated briefly below.

NORTH ZONE

Samples belonging to *G. hirsutum* strains only were received from this zone for tests. The first five varieties arranged according to spinning performance

in the irrigated *G. hirsutum* trial Br.2(a) conducted at five centres are given in Table 3.

TABLE 3. SPINNING TEST RESULTS ON SAMPLES FROM IRRIGATED *G. HIRSUTUM* TRIAL BR.2(a)

| Hissar* |        | Abohar* |        | Sriganganagar* |        | Delhi** |         | Jullundur** |         |
|---------|--------|---------|--------|----------------|--------|---------|---------|-------------|---------|
| Variety | H.S.C. | Variety | H.S.C. | Variety        | H.S.C. | Variety | C.S.P.+ | Variety     | C.S.P.+ |
| A.218   | 53s    | A.218   | 48s    | A.218          | 52s    | A.218   | 2297    | A.218       | 1811    |
| P.B.36  | 40s    | L.L.54  | 41s    | P.B.36         | 47s    | A.231   | 1960    | A.231       | 1745    |
| R.A.18  | 40s    | A.231   | 37s    | R.A.18         | 43s    | H. 14   | 1955    | L.L.54      | 1716    |
| J.127   | 37s    | P.B.36  | 36s    | P.B.30         | 40s    | L.L.54  | 1846    | R.A.18      | 1696    |
| V.2     | 36s    | R.A.18  | 35s    | A.C.138        | 39s    | R.A.18  | 1823    | R.A.16      | 1557    |

\* Full spinning.

\*\* Micro-spinning.

+ For 40s count.

It may be seen that the strain A.218 has given the best spinning performance at all the five centres. On the average, it had good mean fibre length of 26.7 mm. As regards the spinning performance, the other strains worth considering were P.B.36, R.A.18, L.L.54 and A.231. All these five strains had fairly good bundle strength of 44.0 g/t and above.

The following strains were found to be promising in the co-ordinated trial of advanced generation lines [Br.3(a) trial].

*Hissar centre* : J.134, R.A.20, P.B.36, A.C.134, H.165, H.183, P.B.30, H.139, H.162, R.A.14, P.31, J.132, H.177.

*Sriganganagar centre* : K.222-62, H.142, J.130, C.121-138F-USSR, A.11, H.162, A.C.134.

*I.A.R.I., New Delhi* : H.139, R.A.10, P.31, R.A.20, J.134, P.27, J.130, A.C.134, P.B.36, J.150.

It was observed that some of the strains, like A.C.134, J.130, H.162, R.A.20, P.B.36, etc., had good technological properties at the different centres.

#### CENTRAL ZONE

The first six strains from the co-ordinated irrigated varietal trail on *G. hirsutum* strains [Br.2(a) trial] conducted at Surat, Junagadh and Achalpur were ranked according to spinning performance as indicated in Table 4.

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TABLE 4. SPINNING TEST RESULTS ON SAMPLES FROM IRRIGATED  
G. HIRSUTUM [Br.2(a)] TRIAL IN THE CENTRAL ZONE

| Surat*                                  |        | Junagadh** |                      | Achalpur**   |                      |
|---|--------|------------|----------------------|--------------|----------------------|
| Variety                                 | H.S.C. | Variety    | C.S.P. for 40s count | Variety      | C.S.P. for 40s count |
| B.59-1684                               | 43s    | B.59-1684  | 1838                 | B.59-1684    | 2247                 |
| A.56-347                                | 42s    | A.56-347   | 1787                 | Gujarat 67   | 2244                 |
| B.1007,<br>Co-ano-8-3-2<br>and B.56-220 | 37s    | Laxmi      | 1766                 | 170-Co.2     | 2148                 |
| Deviraj and<br>H.B.26-1-2               | 36s    | Deviraj    | 1765                 | Badnawar 1   | 2138                 |
| Gujarat 67 and<br>Buri L.147            | 34s    | B.56-220   | 1760                 | Co-ano-8-3-2 | 2133                 |
| A.S.6                                   | 33s    | B.1007     | 1757                 | B.1007       | 2117                 |

\*Full spinning.

\*\*Micro-spinning.

It may be seen from Table 4 that the strain B.59-1684 has given the best spinning performance, its mean fibre length and bundle strength ranging from 20.4 mm to 27.5 mm and 46.1 g/t to 52.5 g/t, respectively. Next in order of spinning performance came A.56-347, with mean fibre length and bundle strength ranging from 25.2 mm to 26.1 mm and 42.9 g/t to 48.2 g/t, respectively. Although, Gujarat 67 and S.C.8-126 had good mean fibre length of 28.8 and 30.1 mm, respectively, their spinning performance was not satisfactory on account of low maturity and low strength.

The first six strains from the co-ordinated varietal trial on rainfed *G. hirsutum* strains [Br.2(b) trial] ranked on the basis of spinning performance (by micro-spinning) are given in Table 5.

TABLE 5. MICRO-SPINNING TEST RESULTS ON SAMPLES FROM RAINFED *G. HIRSUTUM*  
[Br.2(b)] TRIAL AT BADNAWAR

| Variety    | C.S.P. for 40s count | Variety      | C.S.P. for 40s count |
|------------|----------------------|--------------|----------------------|
| B.59-1684  | 1964                 | B.61-2034    | 1715                 |
| Badnawar 1 | 1933                 | Co-ano-8-3-2 | 1700                 |
| B.61-2096  | 1865                 | B.1007       | 1697                 |

It will be seen that the strain B.59-1684 gave the best spinning performance. It had also a good mean fibre length, viz. 26.6 mm. However,

in similar trials conducted at Indore, all these varieties fared badly and none of them had the required C.S.P. for 40s count.

The other promising strains in this zone are the I.A.N. strains from Surat. Mill and Laboratory tests were carried out on the Hybrid 4 strain raised at Surat in 1967-68 season. Hybrid 4 had a lower mean fibre length of 27.4 mm compared to that of Gujarat 67 (31.0 mm). However, Hybrid 4 had better P.S.I. than the latter and had in addition a distinctly shorter maturation period of about 200 to 210 days as against 260 days of Gujarat 67. According to the mill test results, the spinning performance of Hybrid was very high in the 1966-67 season but was not so good in the 1967-68 season.

The fibre test results on *G. herbaceum* strains grown at Surat and Viramgam showed that strain 1482 had mean fibre length of 23.5 mm and high bundle strength of about 50.0 g/t. Strains B.C.3200 and B.C.6-1 also had good bundle strength ranging from 45.0 g/t to 52.5 g/t at these places.

The first five strains, ranked according to their spinning performance, in co-ordinated varietal trial of *G. arboreum* cottons (Br.16 trial), are given in Table 6.

TABLE 6. MICRO-SPINNING TEST RESULTS ON SAMPLES FROM BR.16  
G. ARBOREUM CO-ORDINATED VARIETAL TRIAL IN CENTRAL ZONE

| Akola              |                      | Indore             |                      |
|--------------------|----------------------|--------------------|----------------------|
| Variety            | C.S.P. for 30s count | Variety            | C.S.P. for 30s count |
| B-AXC.520-Y        | 1759                 | C.C.1-1-3          | 1563                 |
| C.C.1-1-3          | 1696                 | C.J.73             | 1412                 |
| C.J.73             | 1582                 | H.14               | 1347                 |
| C.J.2164-14-Y.N.B. | 1564                 | B.15-23-W          | 1341                 |
| H.4                | 1536                 | C.J.2164-14-Y.N.B. | 1289                 |

Among the new strains, B-AXC.520-Y and C.C.1-1-3 recorded a good performance at Akola. The control, C.J.73, also fared well. These three strains had fairly good strength and maturity.

#### SOUTH ZONE

The only new outstanding *G. hirsutum* strain was 909-2, which had a mean fibre length of 31.9 mm and was found suitable for spinning to 50s. Amongst the others, Reba-B.50, Allen-333-57 and Mc-Nair 1032 fared well. Some of the E.L. strains, viz. E.L.815-3-1, E.L.006, E.L.628 and E.L.123, from Br.2(b) trials in Mysore State, gave good spinning performance.

The first five strains ranked according to micro-spinning performance in the co-ordinated varietal trials on rainfed *G. hirsutum* strains [Br.2(b) trials] conducted at Ranibennur and Dharwar in Mysore State are given in Table 7.



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TABLE 7. MICRO-SPINNING TEST RESULTS ON SAMPLES FROM RAINFED *G. HIRSUTUM* [Br. 2(b)] TRIAL IN SOUTH ZONE

| Ranibennur    |                      | Dharwar       |                      |
|---------------|----------------------|---------------|----------------------|
| Variety       | C.S.P. for 30s count | Variety       | C.S.P. for 30s count |
| Laxmi         | 1833                 | Laxmi         | 1896                 |
| C.C.29-2-3-20 | 1811                 | 71-S.B.6      | 1823                 |
| E.L.156-E     | 1724                 | 1301-DD       | 1815                 |
| P.R.H.30/2    | 1699                 | C.C.29-2-3-20 | 1764                 |
| 71-S.B.6      | 1686                 | A.179         | 1742                 |

It may be seen that no strain has given a better spinning performance than Laxmi at both the places. On an average, Laxmi possessed a mean fibre length of 24.4 mm, micronaire value of 3.6, maturity coefficient of 0.71 and bundle strength of 43.2 g/t. The strain C.C.29-2-3-20 had recorded good performance at Ranibennur and Dharwar. The performance of 71-S.B.6 was better at Dharwar than at Ranibennur.

Only two strains 909-2 and V.14 were found to be suitable for 40s count in the co-ordinated varietal trial Br.2(c) on irrigated *G. hirsutum* (rice fallows) at Tenali.

The first five strains ranked according to micro-spinning performance in the co-ordinated preliminary trial of advanced generation lines (Br.3) are given in Table 8.

TABLE 8. MICRO-SPINNING TEST RESULTS ON SAMPLES FROM PRELIMINARY TRIAL OF ADVANCED GENERATION TRIAL (Br.3)

| Arbhavi  |                      | Coimbatore |                      |
|----------|----------------------|------------|----------------------|
| Variety  | C.S.P. for 40s count | Variety    | C.S.P. for 40s count |
| E.L.628  | 1826                 | A.H.010    | 1866                 |
| 0892-B   | 1717                 | A.101      | 1856                 |
| A.H.010  | 1713                 | 33-III-1   | 1852                 |
| 02298-1  | 1631                 | E.L.735-2  | 1852                 |
| 33-III-1 | 1579                 | E.L.173-B  | 1824                 |

Strain E.L.628 gave good spinning performance at Arbhavi followed by 0892-B and A.H.010. The promising strains at Coimbatore, giving good spinning performance, were A.H.010, A.101, 33-III-1 and E.L.735-2. All these strains had mean fibre length ranging from 25.3 mm to 30.1 mm.

A number of single plant selections from the *G. barbadense* strains, S.B. 298-E and Co-Pusa-Egyptian, were found to have desirable combinations of fibre properties. The bulk material of both S.B.289-E and Co-Pusa-Egyptian gave very satisfactory performance, with the Co-Pusa-Egyptian being slightly better in spinning (Table 9).

TABLE 9. TEST RESULTS OF THREE SAMPLES FROM COIMBATORE

| Variety                              | Mean fibre length, mm | Fibre length irregularity, % | Fineness, Micronaire value | Maturity coefficient | Bundle strength, g/t | H.S.C. |
|--------------------------------------|-----------------------|------------------------------|----------------------------|----------------------|----------------------|--------|
| S.B.289-E                            | 29.0                  | 19.6                         | 4.1                        | 0.78                 | 47.2                 | 80s    |
| Co-Pusa-Egyptian                     | 28.6                  | 18.0                         | 4.1                        | 0.80                 | 46.6                 | 88s    |
| Co-Pusa-Egyptian (new bulk material) | 29.8                  | 19.1                         | 3.4                        | M-H-I<br>52-6-42     | 49.3                 | 99s    |

It will be seen that the new bulk material of Co-Pusa-Egyptian has given the *most outstanding* performance and is capable of being spun to nearly 100s H.S.C.

Only B.C.3200, having a high bundle strength of 49.8 g/t, seemed to be promising amongst the *G. herbaceum* strains tested in Mysore State. It was closely followed by Digvijay, which, however, suffered from low maturity.

Summarising, it may be stated that the most outstanding performance was that of the new bulk material of Co-Pusa-Egyptian, while the performance of S.B.289-E was also very good. It will be worthwhile to carry out further large scale trials with these materials. Amongst the *G. hirsutum* strains, A.218, in the North Zone, B.59-1684 and Hybrid 4 in the Central Zone, and 909-2 and 815-3-1 in the South Zone gave very good performance. It is interesting to note that Laxmi performed uniformly well in the South Zone as well as in the Central Zone. Among the *G. herbaceum* strains, B.C.3200 and 1482 performed well both in the Central and the South Zones. The *G. arboreum* strain C.C.1-1-3 gave good performance in the Central Zone. From the technological point of view the above strains may be considered as the most promising and outstanding materials among the samples received under the Co-ordinated Project during the last season.

It may be further added that the Second All-India Workshop Meeting held at Bangalore in June, 1968, recommended the release of the strain 815-3-1 under the new name of 'M.C.U.5' for general cultivation in Madras State. Further, based on earlier trials, the strain A.C.122 was recommended to be

released under the name 'Krishna' for general cultivation in the rice fallows region of Andhra Pradesh. The pre-release seed multiplication of Co-Pusa-Egyptian, re-named as 'Sujata', was also recommended.

(ii) *Improved Varieties Evolved Under Other State Schemes*

Although the results of tests on samples received from the State Departments of Agriculture are mainly intended for the particular Cotton Breeder or research worker who had sent the sample, a few of them deserve mention, being of general interest, and would give an idea of the progress of work undertaken in the various States. The test results are given in Table 10 and some of the interesting observations are indicated below :

MAHARASHTRA

Strains Acala 4-42, Laxmi, B.147, B.1007 and 1371 had been tried at a number of places and the samples received from Badnapur, Achalpur and Kopergaon had been tested during this year. It is noted that Acala 4-42, B.147 and B.1007 have given nearly the same spinning performance and had practically similar fibre properties.

Strains C.C.1-1-3, C.C.1-1-3-Bk.1, C.C.1-1-3-41, H.4, B.147, B.1007 and C.J.73 had been raised at Nanded, Akola, Dhulia, Kotaki, Yeotmal and Jalgaon in Maharashtra. From the average test results on the samples received during the year, it is observed that B.147 and B.1007 had the best mean fibre length and gave the best spinning performance.

GUJARAT

Varieties Gujarat 67, Co-ano-8-3-2 and N.C.14 had been tested at Surat, Halvad, Derol and Taleja in Gujarat State. The average test results show that these varieties possess very good mean fibre length. Their spinning performance, however, varied very widely. Varieties Co-ano-8-3-2 and N.C.14 are high yielding varieties and their average performance is practically the same as that of Gujarat 67.

Varieties B.15-23-W and Sanjay had been tested at a number of places in Gujarat State. From their average test results on the samples received from Dhari, Lathi and Gadhiyadhar, it is seen that B.15-23-W, which is a high yielding variety, has given almost the same spinning performance as Sanjay and had also similar fibre properties.

MADHYA PRADESH

Among the improved strains received for tests from Madhya Pradesh, the varieties K.W.61-276, K.W.62-501, A.56-347, B.59-1679 and B.59-1684 were promising, being adjudged suitable for spinning into 40s count and above.

**RAJASTHAN**

Among the improved strains received for tests from Rajasthan, the strains L.147, A.218, P.B.30, P.B.46 and R.A.18 were promising, being adjudged suitable for spinning into 40s count and above.

**PUNJAB**

Among the improved strains received for tests from Abohar, the strains A.231, A.243 and A.218 were found to be promising, being adjudged suitable for spinning into 40s count and above.

**HARYANA**

Among the improved strains received from Hissar during 1968, the strains A.C.138, H.139, H.149, H.183, H.193, A.218, R.A.18 and P.B.36 were promising, being adjudged spinnable into 40s count and above.

**MYSORE**

The three varieties S.8-2-2, 4287-1-4-1 and Suyodhar had been received from three places, viz. Jamkhandi, Mudhol and Bagalkot. Both S.8-2-2 and 4287-1-4-1 are high yielding types and their spinning performance and fibre properties are practically the same as Suyodhar.

Among the improved strains received for tests from Arbhavi, the strains A.S.6, A.S.17, A.S.23, E.L.192 and E.L.006 were found to be promising, being adjudged suitable for spinning into 40s count and above. The strain A.S.23 was released during the year for general cultivation under the name 'Vijaya' by the Mysore State authorities.

**ANDHRA PRADESH**

Among the improved strains received from Andhra Pradesh and tested during the year 1968, the strains A.C.122 and L.147 were found to be promising being adjudged suitable for spinning to 40s count and above. The strain A.C.122 was recommended for release for general cultivation under the name 'Krishna' in the rice fallows region.

**MADRAS**

A large number of improved strains were received from Coimbatore and tested during the year 1968. Among them, the strains Co-Pusa-Egyptian, S.B.289-E and 815-3-1 were very good, being adjudged suitable for spinning above 60s count. The strain 815-3-1 was recommended for release for general cultivation under the new name 'M.C.U.5'.

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TABLE 10. TEST RESULTS OF PROMISING IMPROVED VARIETIES

| Variety   | Mean fibre length |      | Fineness      |                          | Maturity coefficient | P.S.I. |       | H.S.C. |
|---|-------------------|------|---------------|--------------------------|----------------------|--------|-------|--------|
|   | mm                | in.  | Milli-<br>tex | Micro-<br>naire<br>value |                      | g/t    | lb/mg |        |
| <i>Badnapur, Achalpur and Kopergaon (Maharashtra)</i>                   |                   |      |               |                          |                      |        |       |        |
| Acala-4-42  | 26.5              | 1.04 | 146           | 3.7                      | 0.72                 | 40.2   | 7.5   | 42     |
| Laxmi   | 25.8              | 1.01 | 137           | 3.5                      | 0.71                 | 40.0   | 7.5   | 36     |
| B.147   | 26.9              | 1.06 | 145           | 3.7                      | 0.74                 | 32.6   | 7.9   | 42     |
| B.1007  | 27.4              | 1.08 | 135           | 3.5                      | 0.72                 | 41.4   | 7.7   | 40     |
| 1371  | 27.7              | 1.09 | 139           | 3.5                      | 0.72                 | 41.5   | 7.7   | 38     |
| <i>Nanded, Akola, Dhulia, Kotaki, Yeotmal and Jalgaon (Maharashtra)</i> |                   |      |               |                          |                      |        |       |        |
| C.C.1-1-3   | 23.2              | 0.92 | 186           | 4.7                      | 0.82                 | 47.3   | 8.8   | 33     |
| C.C.1-1-3-BK.1  | 23.5              | 0.92 | 186           | 4.7                      | 0.80                 | 47.2   | 8.8   | 34     |
| C.C.1-1-3-41  | 23.3              | 0.92 | 188           | 4.8                      | 0.81                 | 46.8   | 8.7   | 34     |
| H.4   | 22.6              | 0.89 | 200           | 5.1                      | 0.83                 | 46.1   | 8.6   | 31     |
| B.147   | 25.1              | 0.98 | 172           | 4.4                      | 0.78                 | 48.0   | 8.9   | 40     |
| B.1007  | 25.4              | 1.00 | 164           | 4.2                      | 0.75                 | 46.5   | 8.7   | 41     |
| C.J.73  | 22.2              | 0.88 | 194           | 4.9                      | 0.80                 | 47.6   | 8.9   | 30     |
| <i>Surat, Halvad, Derol and Taleja (Gujarat)</i>                        |                   |      |               |                          |                      |        |       |        |
| Co-ano-8-3-2  | 28.0              | 1.10 | 155           | 3.9                      | 0.74                 | 42.2   | 7.9   | —      |
| N.C.14  | 28.2              | 1.11 | 135           | 3.4                      | 0.69                 | 41.9   | 7.8   | —      |
| Gujarat 67  | 29.3              | 1.16 | 124           | 3.1                      | 0.65                 | 38.2   | 7.1   | —      |
| <i>Dhari, Lathi and Gadhiyadhar (Gujarat)</i>                           |                   |      |               |                          |                      |        |       |        |
| B.15-23-W   | 21.4              | 0.84 | 176           | 4.4                      | 0.75                 | 48.0   | 9.0   | 27     |
| Sanjay  | 21.0              | 0.83 | 177           | 4.5                      | 0.76                 | 47.2   | 8.8   | 28     |
| <i>Khandwa (Madhya Pradesh)</i>   |                   |      |               |                          |                      |        |       |        |
| K.W.61-276  | 25.0              | 0.98 | 161           | 4.1                      | 0.76                 | 51.5   | 9.6   | 41     |
| K.W.62-501  | 25.2              | 0.99 | 161           | 4.1                      | 0.75                 | 53.1   | 9.9   | 44     |
| A.56-347  | 24.8              | 0.98 | 173           | 4.4                      | 0.78                 | 53.1   | 9.9   | 42     |
| <i>Badnawar (Madhya Pradesh)</i>  |                   |      |               |                          |                      |        |       |        |
| B.59-1679   | 25.0              | 0.98 | 161           | 4.1                      | 0.77                 | 49.8   | 9.3   | 45     |
| B.59-1684   | 25.4              | 1.00 | 161           | 4.1                      | 0.74                 | 47.2   | 8.8   | 41     |

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TABLE 10. TEST RESULTS OF PROMISING IMPROVED VARIETIES—Contd.

| Variety  | Mean fibre length |      | Fineness  |                   | Maturity coefficient | P.S.I. |       | H.S.C. |
|--|-------------------|------|-----------|-------------------|----------------------|--------|-------|--------|
|  | mm                | in.  | Milli-tex | Micro-naire value |                      | g/t    | lb/mg |        |
| <i>Bundi Chatarpur (Rajasthan)</i>             |                   |      |           |                   |                      |        |       |        |
| L.147  | 26.2              | 1.03 | 150       | 3.8               | 0.77                 | 45.0   | 8.4   | 40     |
| <i>Sriganganagar (Rajasthan)</i>               |                   |      |           |                   |                      |        |       |        |
| A.218  | 26.2              | 1.03 | 146       | 3.7               | 0.75                 | 49.3   | 9.2   | 52     |
| P.B.30   | 25.4              | 1.00 | 146       | 3.7               | 0.80                 | 42.9   | 8.0   | 40     |
| P.B.46   | 26.0              | 1.02 | 150       | 3.8               | 0.80                 | 46.6   | 8.7   | 47     |
| R.A.18   | 26.0              | 1.02 | 161       | 4.1               | 0.76                 | 46.1   | 8.6   | 43     |
| <i>Abohar (Punjab)</i>                         |                   |      |           |                   |                      |        |       |        |
| A.231  | 27.0              | 1.06 | 118       | 3.0               | 0.61                 | 43.4   | 8.1   | 40     |
| L.L.54   | 26.0              | 1.02 | 134       | 3.4               | 0.70                 | 46.6   | 8.7   | 42     |
| A.243  | 25.9              | 1.02 | 130       | 3.3               | 0.70                 | 43.4   | 8.1   | 42     |
| A.218  | 26.8              | 1.06 | 150       | 3.8               | 0.74                 | 51.5   | 9.6   | 43     |
| <i>Hissar (Haryana)</i>                        |                   |      |           |                   |                      |        |       |        |
| A.C.138  | 26.0              | 1.02 | 142       | 3.6               | 0.67                 | 44.5   | 8.3   | 41     |
| H.139  | 26.2              | 1.03 | 110       | 2.8               | 0.62                 | 46.1   | 8.6   | 42     |
| H.149  | 25.0              | 0.98 | 114       | 2.9               | 0.65                 | 48.2   | 9.0   | 40     |
| H.183  | 23.4              | 0.92 | 114       | 2.9               | 0.66                 | 48.8   | 9.1   | 40     |
| H.193  | 26.8              | 1.06 | 106       | 2.7               | 0.63                 | 49.3   | 9.2   | 51     |
| A.218  | 26.4              | 1.04 | 161       | 4.1               | 0.82                 | 50.9   | 9.5   | 53     |
| R.A.18   | 24.4              | 0.96 | 173       | 4.4               | 0.77                 | 47.2   | 8.8   | 40     |
| P.B.36   | 24.9              | 0.98 | 169       | 4.3               | 0.77                 | 47.2   | 8.8   | 40     |
| <i>Jamkhandi, Mudhol and Bagalkot (Mysore)</i> |                   |      |           |                   |                      |        |       |        |
| S.8-2-2  | 19.0              | 0.75 | 178       | 4.5               | 0.85                 | 45.9   | 7.6   | 20     |
| 4287-1.4-1                                     | 19.8              | 0.78 | 183       | 4.7               | 0.85                 | 46.1   | 8.6   | 23     |
| Suyodhar                                       | 19.1              | 0.75 | 180       | 4.6               | 0.86                 | 46.1   | 8.6   | 20     |

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TABLE 10. TEST RESULTS OF PROMISING IMPROVED VARIETIES—Contd.

| Variety                        | Mean fibre length |      | Fineness  |                   | Maturity coefficient | P.S.I. |       | H.S.C. |
|--------------------------------|-------------------|------|-----------|-------------------|----------------------|--------|-------|--------|
|                                | mm                | in.  | Milli-tex | Micro-naire value |                      | g/t    | lb/mg |        |
| <i>Arbhavi (Mysore)</i>        |                   |      |           |                   |                      |        |       |        |
| A.S.6                          | 27.0              | 1.06 | 126       | 3.2               | 0.70                 | 37.5   | 7.0   | 45     |
| A.S.17                         | 26.3              | 1.04 | 146       | 3.7               | 0.73                 | 41.3   | 7.7   | 51     |
| A.S.23                         | 30.0              | 1.18 | 138       | 3.5               | 0.72                 | 41.3   | 7.7   | 70     |
| E.L.192                        | 29.2              | 1.15 | 134       | 3.4               | 0.72                 | 38.6   | 7.2   | 45     |
| E.L.006                        | 26.2              | 1.03 | 130       | 3.3               | 0.66                 | 43.4   | 8.1   | 43     |
| <i>Mudhol (Andhra Pradesh)</i> |                   |      |           |                   |                      |        |       |        |
| L.147                          | 24.2              | 0.95 | 165       | 4.2               | 0.79                 | 42.3   | 7.9   | 42     |
| <i>Tenali (Andhra Pradesh)</i> |                   |      |           |                   |                      |        |       |        |
| A.C.122                        | 25.6              | 1.01 | 181       | 4.6               | 0.82                 | 52.5   | 9.8   | 47     |
| <i>Coimbatore (Madras)</i>     |                   |      |           |                   |                      |        |       |        |
| S.B.289-E                      | 29.0              | 1.14 | 161       | 4.1               | 0.78                 | 47.2   | 8.8   | 80     |
| Co-Pusa-Egyptian               | 29.8              | 1.17 | 134       | 3.4               | 0.72                 | 49.3   | 9.2   | 99     |
| 815-3-1                        | 28.5              | 1.12 | 118       | 3.0               | 0.62                 | 43.4   | 8.1   | 70     |

(iii) *Extra-long Staple (27 mm and above) Cottons*

The test results of full scale spinning tests carried out on extra-long staple cotton samples received and tested at the Laboratory during 1968 are shown in Table 11. This would be of help to the Cotton Breeders to draw on the materials for use in their programme.

TABLE 11. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1968

| Variety               | Place    | Mean fibre length |      | Irregularity, % | Millitex | Micro-naire value | Maturity coefficient | P.S.I., lb/mg |
|-----------------------|----------|-------------------|------|-----------------|----------|-------------------|----------------------|---------------|
|                       |          | mm                | in.  |                 |          |                   |                      |               |
| MAHARASHTRA           |          |                   |      |                 |          |                   |                      |               |
| <i>1967-68 Season</i> |          |                   |      |                 |          |                   |                      |               |
| A.P. Buri             | Achalpur | 27.5              | 1.08 | —               | 130      | 3.3               | 0.67                 | 8.2           |
| 1371                  | „        | 27.7              | 1.09 | —               | 130      | 3.3               | 0.68                 | 8.3           |
| Luri 1007             | „        | 27.1              | 1.07 | —               | 130      | 3.3               | 0.69                 | 8.1           |

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TABLE 11. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1968—Contd.

| Variety               | Place     | Mean fibre length |      | Irregularity,<br>% | Millitex | Micro-<br>naire<br>value | Matur-<br>ity<br>coeffi-<br>cient | P.S.I.,<br>lb/<br>mg |
|-----------------------|-----------|-------------------|------|--------------------|----------|--------------------------|-----------------------------------|----------------------|
|                       |           | mm                | in.  |                    |          |                          |                                   |                      |
| A.P. Buri             | Kopergaon | 30.8              | 1.21 | 15.1               | 154      | 3.9                      | 0.74                              | 7.1                  |
| Buri 147              | „         | 29.8              | 1.17 | 16.9               | 150      | 3.8                      | 0.73                              | 7.1                  |
| 1371                  | „         | 29.3              | 1.15 | 20.6               | 138      | 3.5                      | 0.71                              | 6.7                  |
| 107/221               | „         | 30.2              | 1.19 | 19.5               | 142      | 3.6                      | 0.72                              | 7.1                  |
| Acala-4- 42           | „         | 28.2              | 1.11 | 16.4               | 154      | 3.9                      | 0.75                              | 6.6                  |
| 56/23                 | „         | 29.0              | 1.14 | 17.5               | 150      | 3.8                      | 0.73                              | 7.0                  |
| Laxmi                 | „         | 27.6              | 1.09 | 18.8               | 154      | 3.9                      | 0.75                              | 6.6                  |
| GUJARAT               |           |                   |      |                    |          |                          |                                   |                      |
| <i>1966-67 Season</i> |           |                   |      |                    |          |                          |                                   |                      |
| Hybrid 4              | Surat     | 29.0              | 1.14 | 18.8               | 181      | 4.6                      | 0.83                              | 8.4                  |
| Gujarat 67            | „         | 31.7              | 1.25 | 29.7               | 134      | 3.4                      | 0.70                              | 7.8                  |
| <i>1967-68 Season</i> |           |                   |      |                    |          |                          |                                   |                      |
| Co-ano-8-2-1          | Junagadh  | 27.0              | 1.06 | 29.3               | 150      | 3.8                      | 0.74                              | 8.7                  |
| Co-ano-11-3-441       | „         | 27.2              | 1.07 | 26.0               | 142      | 3.6                      | 0.69                              | 8.3                  |
| C.C.V.2               | „         | 27.2              | 1.07 | 27.7               | 146      | 3.7                      | 0.67                              | 7.9                  |
| Gujarat 67            | „         | 29.2              | 1.15 | 26.8               | 126      | 3.2                      | 0.65                              | 7.5                  |
| Co-ano-8-3-2          | Surat     | 27.4              | 1.08 | 23.6               | 146      | 3.7                      | 0.74                              | 8.2                  |
| S.C.8-126             | „         | 29.3              | 1.15 | 24.7               | 146      | 3.7                      | 0.74                              | 7.4                  |
| B.59-1684             | „         | 27.5              | 1.08 | 24.3               | 130      | 3.3                      | 0.67                              | 8.6                  |
| H.B.26-1-2            | „         | 27.7              | 1.09 | 28.5               | 138      | 3.5                      | 0.70                              | 7.2                  |
| Co-ano-8-3-2          | „         | 28.9              | 1.14 | 20.4               | 150      | 3.8                      | 0.75                              | 8.2                  |
| N.C.14                | „         | 28.4              | 1.12 | 24.0               | 126      | 3.2                      | 0.66                              | 7.9                  |
| Gujarat 67            | Broach    | 31.0              | 1.22 | 22.8               | 134      | 3.4                      | 0.70                              | 8.0                  |
| „                     | Halvad    | 29.7              | 1.17 | 26.6               | 138      | 3.5                      | 0.69                              | 7.0                  |
| N.C.14                | „         | 28.2              | 1.11 | 26.8               | 126      | 3.2                      | 0.66                              | 7.3                  |
| Gujarat 67            | Derol     | 27.7              | 1.09 | 29.5               | 110      | 2.8                      | 0.60                              | 7.2                  |
| Co-ano-8-3-2          | „         | 28.0              | 1.10 | 23.9               | 126      | 3.2                      | 0.67                              | 7.8                  |
| N.C.14                | „         | 27.3              | 1.07 | 23.0               | 161      | 4.1                      | 0.76                              | 8.0                  |



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TABLE 11. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1968—Contd.

| Variety               | Place               | Mean fibre length |      | Irregu-<br>larity,<br>% | Millitex | Micro-<br>naire<br>value | Matu-<br>rity<br>coeffi-<br>cient | P.S.I.,<br>lb/<br>mg |
|-----------------------|---------------------|-------------------|------|-------------------------|----------|--------------------------|-----------------------------------|----------------------|
|                       |                     | mm                | in.  |                         |          |                          |                                   |                      |
| I.A.N.579             | Surat               | 30.4              | 1.20 | 18.9                    | 142      | 3.6                      | 0.72                              | 7.4                  |
| „ 716                 | „                   | 29.9              | 1.18 | 17.8                    | 177      | 4.5                      | 0.80                              | 7.0                  |
| „ 355                 | „                   | 29.3              | 1.15 | 20.4                    | 146      | 3.7                      | 0.73                              | 7.1                  |
| „ 604                 | „                   | 29.4              | 1.16 | 23.3                    | 154      | 3.9                      | 0.75                              | 7.1                  |
| „ 741                 | „                   | 31.6              | 1.24 | 19.9                    | 150      | 3.8                      | 0.75                              | 7.1                  |
| „ 560                 | „                   | 29.8              | 1.17 | 19.1                    | 165      | 4.2                      | 0.72                              | 7.1                  |
| „ 564                 | „                   | 27.9              | 1.10 | 21.0                    | 157      | 4.0                      | 0.81                              | 6.9                  |
| „ 10(199)             | „                   | 30.0              | 1.18 | 22.2                    | 146      | 3.7                      | 0.78                              | 7.3                  |
| „ 110(245)            | „                   | 30.2              | 1.19 | 21.9                    | 134      | 3.4                      | 0.72                              | 7.8                  |
| „ 937                 | „                   | 30.0              | 1.18 | 19.9                    | 157      | 4.0                      | 0.80                              | 6.5                  |
| „ 941                 | „                   | 30.7              | 1.21 | 19.2                    | 146      | 3.7                      | 0.75                              | 6.5                  |
| Gujarat 67 (Control)  | „                   | 30.1              | 1.19 | 25.7                    | 134      | 3.4                      | 0.73                              | 7.2                  |
| MYSORE                |                     |                   |      |                         |          |                          |                                   |                      |
| <i>1966-67 Season</i> |                     |                   |      |                         |          |                          |                                   |                      |
| A.S.6                 | Arbhavi             | 27.0              | 1.06 | —                       | 126      | 3.2                      | 0.70                              | 7.0                  |
| A.S.23                | „                   | 30.0              | 1.18 | —                       | 138      | 3.5                      | 0.72                              | 7.7                  |
| E.L.192               | „                   | 29.2              | 1.15 | —                       | 134      | 3.4                      | 0.72                              | 7.2                  |
| <i>1967-68 Season</i> |                     |                   |      |                         |          |                          |                                   |                      |
| E.L.123               | Arbhavi             | 27.1              | 1.07 | 28.3                    | 130      | 3.3                      | 0.69                              | 7.3                  |
| MADRAS                |                     |                   |      |                         |          |                          |                                   |                      |
| <i>1966-67 Season</i> |                     |                   |      |                         |          |                          |                                   |                      |
| 735-2                 | Coimbatore          | 27.6              | 1.09 | —                       | 126      | 3.2                      | 0.68                              | 7.9                  |
| 803-4                 | „                   | 27.0              | 1.06 | —                       | 114      | 2.9                      | 0.65                              | 7.7                  |
| 909-2                 | „                   | 28.6              | 1.13 | —                       | 110      | 2.8                      | 0.65                              | 7.7                  |
| <i>1967-68 Season</i> |                     |                   |      |                         |          |                          |                                   |                      |
| E.L.123               | Srivilli-<br>puthur | 28.5              | 1.12 | 26.1                    | 130      | 3.3                      | 0.70                              | 8.1                  |
| E.L.467-1-1-D         | „                   | 27.0              | 1.06 | —                       | 126      | 3.2                      | 0.68                              | 7.9                  |
| E.L.628               | „                   | 27.2              | 1.07 | 33.0                    | 134      | 3.4                      | 0.69                              | 8.3                  |

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TABLE 11. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1968—Contd.

| Variety          | Place              | Mean fibre length |      | Irregu-<br>larity,<br>% | Millitex | Micro-<br>naire<br>value | Matu-<br>rity<br>coeffi-<br>cient | P.S.I.,<br>lb/<br>mg |
|------------------|--------------------|-------------------|------|-------------------------|----------|--------------------------|-----------------------------------|----------------------|
|                  |                    | mm                | in.  |                         |          |                          |                                   |                      |
| Co-Pusa-Egyptian | Coimbatore         | 29.8              | 1.17 | 19.1                    | 134      | 3.4                      | 0.72                              | 9.2                  |
| S.B.289-E        | "                  | 29.0              | 1.14 | 19.6                    | 161      | 4.1                      | 0.78                              | 8.8                  |
| E.L.123          | "                  | 28.0              | 1.10 | 26.3                    | 126      | 3.2                      | 0.66                              | 7.5                  |
| 11               | "                  | 27.4              | 1.08 | 27.4                    | 134      | 3.4                      | 0.69                              | 7.9                  |
| 815-3-1          | "                  | 28.5              | 1.12 | 27.6                    | 118      | 3.0                      | 0.62                              | 8.1                  |
| RAJASTHAN        |                    | 1967-68 Season    |      |                         |          |                          |                                   |                      |
| A.231            | Sriganga-<br>nagar | 28.4              | 1.12 | 25.0                    | 142      | 3.6                      | 0.78                              | 8.4                  |
| PUNJAB           |                    | 1966-67 Season    |      |                         |          |                          |                                   |                      |
| A.231            | Ferozepur          | 27.0              | 1.06 | —                       | 118      | 3.0                      | 0.61                              | 8.1                  |
|                  |                    | 1967-68 Season    |      |                         |          |                          |                                   |                      |
| A.C.138          | Abohar             | 27.2              | 1.07 | 26.1                    | 138      | 3.5                      | 0.70                              | 8.2                  |
| A.218            | "                  | 27.5              | 1.08 | 29.8                    | 146      | 3.7                      | 0.74                              | 9.5                  |
| A.231            | "                  | 29.0              | 1.14 | 23.4                    | 134      | 3.4                      | 0.68                              | 8.5                  |
| A.245            | "                  | 28.0              | 1.10 | 25.9                    | 138      | 3.5                      | 0.71                              | 8.8                  |
| A.247            | "                  | 29.5              | 1.16 | 26.6                    | 142      | 3.6                      | 0.73                              | 8.6                  |
| A.231            | "                  | 27.2              | 1.07 | 25.1                    | 142      | 3.6                      | 0.71                              | 7.6                  |
| A.228            | "                  | 29.1              | 1.15 | 26.9                    | 150      | 3.8                      | 0.74                              | 8.4                  |

(iv) Mill Tests

Selected improved varieties of cotton which possess promising characteristics and are considered superior to the current ones on the basis of the Laboratory tests are subjected to actual mill tests for their performance at the mills. Only after the superiority of the new varieties is confirmed by mill tests, at least for two seasons, the varieties are recommended for large scale propagation. Necessary arrangements for carrying out mill tests are made by this Laboratory. A few mills have been co-operative enough to undertake such tests on the samples sent to them.

During the year, mill tests were carried out on 19 samples. The comparative test results at the mills and the Laboratory are given in Table 12.

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TABLE 12. COMPARATIVE MILL AND LABORATORY TEST RESULTS

| Place                 | Variety              | Mill test results |                        |       |                      |      | Laboratory test results |       |                      |      |
|-----------------------|----------------------|-------------------|------------------------|-------|----------------------|------|-------------------------|-------|----------------------|------|
|                       |                      | Waste,<br>%       | Yarn<br>reco-<br>very, | Count | Stren-<br>gth,<br>lb | t.m. | Waste,<br>%             | Count | Stren-<br>gth,<br>lb | t.m. |
| <i>Gujarat</i>        |                      |                   |                        |       |                      |      |                         |       |                      |      |
| Surat                 | Hybrid 4*            | 21.4†             | 78.6                   | 40s   | 57.2                 | 4.1  | 10.8                    | 40s   | 46.9                 | 4.0  |
|                       | Gujarat 67*          | 23.1†             | 76.9                   | 40s   | 52.8                 | 4.1  | 13.2                    | 40s   | 41.9                 | 4.0  |
|                       | Hybrid 4             | 20.2†             | —                      | 40s   | 53.0                 | 4.19 |                         |       | (Not tested)         |      |
|                       | Gujarat 67           | 16.3†             | —                      | 40s   | 47.8                 | 4.19 |                         |       | (Not tested)         |      |
|                       | 3943                 | 10.1              | —                      | 28s   | 67.5                 | 4.0  | 8.7                     | 28s   | 60.1                 | 4.25 |
|                       | Digvijay             | 9.6               | —                      | 28s   | 69.8                 | 4.0  | 9.2                     | 28s   | 63.6                 | 4.25 |
| <i>Madhya Pradesh</i> |                      |                   |                        |       |                      |      |                         |       |                      |      |
| Khandwa               | A.56-347             | 7.1               | —                      | 30s   | 67.0                 | —    | 11.5                    | 30s   | 57.0                 | 4.0  |
|                       | A.51-9               | 9.3               | —                      | 30s   | 58.0                 | —    | 13.5                    | 30s   | 50.3                 | 4.0  |
| Badnawar              | B.59-1684            | 11.0              | 87.5                   | 40s   | 46.5                 | 4.2  | 10.2                    | 40s   | 42.7                 | 4.0  |
|                       | Badnawar 1           | 10.7              | 87.8                   | 40s   | 41.3                 | 4.2  | 9.1                     | 40s   | 37.3                 | 4.0  |
| <i>Andhra Pradesh</i> |                      |                   |                        |       |                      |      |                         |       |                      |      |
| Nandyal               | 1301-DD              | 13.1              | —                      | 34s   | 37.2                 | 4.02 | 11.2                    | 34s   | 35.8                 | 4.0  |
|                       | Laxmi                | 14.7              | —                      | 34s   | 48.5                 | 4.02 | 15.5                    | 34s   | 36.0                 | 4.0  |
| <i>Madras</i>         |                      |                   |                        |       |                      |      |                         |       |                      |      |
| Kovilpatti            | E.L.156-E            | 8.2               | —                      | 30s   | 56.7                 | 3.96 | 9.0                     | 30s   | 60.0                 | 4.0  |
|                       | Laxmi                | 9.4               | —                      | 30s   | 65.7                 | 3.96 | 9.1                     | 30s   | 51.3                 | 4.0  |
| Coimbatore            | 815-3-1              | 8.0               | —                      | 34s   | 64.2                 | 4.02 | 10.2                    | 40s   | 45.8                 | 4.0  |
|                       | M.C.U.3              | 9.7               | —                      | 34s   | 57.5                 | 4.02 | 7.3                     | 40s   | 40.6                 | 4.0  |
|                       | Co-Pusa-<br>Egyptian | 24.0†             | —                      | 70s   | 37.6‡                | —    |                         |       | (Not tested)         |      |
| <i>Uttar Pradesh</i>  |                      |                   |                        |       |                      |      |                         |       |                      |      |
| Bulandshahr           | Shyamali             | —                 | —                      | 14s   | 69.4                 | 4.0  | 12.4                    | 14s   | 106.3                | 4.25 |
| Raya                  | Pramukh              | —                 | —                      | 30s   | 41.6                 | 4.0  | 13.8                    | 30s   | 44.1                 | 4.0  |

\*1966-67 season sample. † Combed. ‡ Full spinning particulars not available.

N.B. The spinning system employed by mills is in many cases different from the one adopted by this Laboratory and hence the strength values obtained are not strictly comparable.

It will be seen from Table 12 that in both the seasons, viz. 1966-67 and 1967-68, Hybrid 4 has given better spinning performance than Gujarat 67. The variety 3943 which is a high yielder has been found to give nearly the same spinning performance as Digvijay. A.56-347, an improved variety received from Khandwa, gave better spinning performance than A.51-9. Another improved variety B.59-1684 from Badnawar was also found to give better spinning performance than Badnawar 1. But in the cases of 1301-DD and Laxmi at Nandyal, E.L.156-E and Laxmi at Kovilpatti, and 815-3-1 and M.C.U.3 at Coimbatore, the mill results were not in conformity with the Laboratory test results. Hence, fresh samples of these varieties are proposed to be tested at different mills in the next season. Among the samples tested at the mills during the year, Co-Pusa-Egyptian gave outstanding performance.

(v) *Extension of Improved Varieties*

Usually, improved varieties are cultivated on the Government Farms or under departmental supervision for collection of pure seeds, and the seeds are distributed for general cultivation. In order to verify whether the crops raised in several stages of propagation maintain their characteristics or not, a number of samples of improved varieties are received at this Laboratory for tests. It was generally observed that in the case of most varieties, the samples from different stages of propagation possessed practically the same characteristics.

(vi) *Standard Indian Cottons*

In order to assess the seasonal fluctuations in the characters of Indian cottons and with a view to judging the comparative superiority or otherwise of the newly evolved strains, a number of selected varieties of Indian cottons—called Standard Indian Cottons—are tested at the Laboratory every year. These are grown under identical conditions from year to year in the Government Farms under departmental supervision. Extensive fibre and spinning tests are regularly carried out on such samples. The results obtained on 18 samples received from the 1966-67 season were published as Technological Report No. 4 entitled, "Technological Report on Standard Indian Cottons—1966-67 season". The performance of the various cottons in each State during the 1966-67 season as compared to the previous season is indicated below :

| State          | Definitely better | Approximately same | Definitely poorer   |
|----------------|-------------------|--------------------|---------------------|
| Maharashtra    | B.147             | Virnar, G.22       | Jarila, G.6, B.0394 |
| Gujarat        | —                 | Surat 1027 A.L.F.  | Digvijay            |
| Madhya Pradesh | —                 | Narmada            | —                   |
| Mysore         | —                 | —                  | Jayadhar, Laxmi     |
| Madras         | —                 | K.6                | M.C.U.1             |

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Most of the samples of the Standard Indian Cottons of the 1967-68 season have been received and tested. From the 1967-68 season, the test results on each Standard Indian Cotton were published in the form of a Technological Circular as soon as the test results were ready, without waiting for the completion of the tests on all the cottons of the season, as in the past, so that they could be made available to the Cotton Breeders early. During 1968, such circulars were issued on 16 cottons.

(vii) Trade Varieties

Lint samples of fair average quality of the major Trade Varieties of Indian cottons are being obtained through the East Indian Cotton Association Ltd., each season. Representative *kapas* samples of the varieties are procured from the State Departments of Agriculture for determination of ginning percentage. The fibre and spinning test results, ginning percentage and other test results on each variety of cotton were published as a Technological Circular as early in the season as possible, for the information of the cotton trade and industry. Such circulars were issued during 1968 on 55 Trade Varieties. The test results on all the Trade Varieties of the 1966-67 season were compiled and published as Technological Report No. 3 entitled, "Technological Report on Trade Varieties of Indian Cottons—1966-67 season".

Most of the samples of the 1967-68 season have also been received and tested.

(viii) Testing Work Done at Outstations

The Laboratory maintains suitably trained research staff at important cotton breeding stations in the major cotton growing States to help the Cotton Breeders by testing various cotton samples for fibre properties and to assist them in their research work. The number of samples tested at the various outstations during 1968 is given in Table 13.

TABLE 13. NUMBER OF COTTON SAMPLES TESTED AT OUTSTATIONS

| Station    | Mean fibre length | Fibre fineness | Fibre maturity | Fibre strength |
|------------|-------------------|----------------|----------------|----------------|
| Abohar     | 830               | 826            | 836            | 763            |
| Coimbatore | 1,355             | 1,791          | 1,235          | 1,202          |
| Dharwar    | 918               | 918            | 573            | 605            |
| Indore     | 898               | 936            | 920            | 396            |
| Nanded     | 679               | 753            | 382            | 382            |
| Nandyal    | 435               | 275            | 70             | 275            |
| Surat      | 2,958             | 2,763          | 2,784          | 3,080          |

It may be mentioned that in the above table, the number of samples tested for each fibre property is shown separately as the samples belonging to various experimental strains are tested only for certain specified fibre properties at the outstations. However, at the Laboratory, all the chief fibre properties are determined on all the samples regularly, by carrying out duplicate or more tests for greater accuracy.

## **2. Effect of chemical treatment on physical and chemical properties of cotton fibres**

In the last Annual Report, the effect of treatment with various chemicals on the properties of Goarani and Deviraj (170-Co.2) cottons had been reported. During the year under review, the study was extended to cover the effect of different concentrations of the chemicals and temperatures of treatment using Deviraj cotton and keeping a constant time of 4 hours for each treatment. The treatments using different concentrations of chemicals were tried at 0°C in the case of ethylamine and at about 30°C in the cases of ethylene diamine (EDA), potassium hydroxide (KOH) and lithium hydroxide (LiOH). In the cases of KOH and LiOH, the treatments were carried out at four different temperatures, viz. 20°, 30°, 40° and 55°C. It was observed that marked changes in crystallinity and some other properties were observed at concentrations of 70% and above of ethylamine, 70% to 90% of EDA, 20% and above of KOH and 7% to 10% of LiOH. The treatments reduced crystallinity, degree of polymerisation (D.P.), tensile strength and birefringence, and increased moisture absorption, elongation and toughness of the fibres. Amongst the chemicals, KOH and ethylamine produced the maximum changes, while EDA produced the least effect.

As regards the effect of temperatures on treatments with KOH and LiOH, it was observed that crystallinity decreased and moisture absorption increased with decrease of temperature. Relative viscosity, bundle strength at zero gauge length, elongation and toughness were found to be higher for samples treated at 20°C than for those treated at higher temperatures.

Analysis of the results showed high positive correlation between crystallinity values measured by two different methods, viz. iodine adsorption and moisture sorption ratio. Further, crystallinity was found to be positively correlated with bundle strength at zero and 3 mm gauge lengths, stiffness, D.P. and birefringence, while it was negatively correlated with moisture regain, elongation and toughness. Similarly, D.P. and birefringence were found to be positively correlated with bundle strength and stiffness but negatively with elongation and toughness.

## **3. Evaluation of linter, oil and gossypol content of various genetic stocks for evolving varieties with higher oil content and low gossypol content**

During the year under report, a large number of seed samples were studied for seed weight, oil content, linter per cent, protein content and gossypol

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TABLE 14. MEAN VALUE (AND RANGE) OF SEED WEIGHT, LINTER %, OIL %, PROTEIN % AND FREE GOSSYPOL % OF COTTON-SEEDS

| Species   | No. of samples tested | Seed weight          | Whole seeds            |                            | Kernel                 |                            |                        |                     |
|---|-----------------------|----------------------|------------------------|----------------------------|------------------------|----------------------------|------------------------|---------------------|
|   |                       |                      | Linter %               | Oil % (10% moisture basis) | Protein %              | Oil % (10% moisture basis) | Protein %              | Free gossypol %     |
| <i>G. arboreum</i><br>(excluding samples of Garo Hills) | 8                     | 5.06<br>(4.43-6.18)  | 5.47<br>(2.60-6.54)    | 17.27<br>(16.30-18.54)     | 20.64<br>(16.60-23.59) | 31.34<br>(30.08-32.84)     | 35.49<br>(33.05-37.20) | 1.30<br>(0.57-1.86) |
| Garo Hills ( <i>G. arboreum</i> )                       | 3                     | 5.59<br>(5.35-5.87)  | 16.24<br>(14.34-17.71) | 9.01<br>(8.70-9.22)        | 18.00<br>(16.69-18.71) | 22.65<br>(21.15-23.62)     | 43.96<br>(42.61-46.31) | 0.81<br>(0.78-0.85) |
| <i>G. herbaceum</i>                                     | 8                     | 5.69<br>(5.12-6.76)  | 4.66<br>(2.59-7.88)    | 16.75<br>(15.21-18.33)     | 20.30<br>(18.40-22.36) | 30.43<br>(28.23-32.58)     | 34.38<br>(31.56-37.57) | 1.51<br>(1.16-1.88) |
| <i>G. hirsutum</i>                                      | 16                    | 9.09<br>(6.65-12.55) | 11.44<br>(8.39-15.48)  | 19.53<br>(16.70-21.98)     | 21.62<br>(17.78-25.39) | 33.70<br>(30.19-36.56)     | 35.17<br>(30.27-39.78) | 1.34<br>(0.96-2.35) |
| <i>G. barbadense</i>                                    | 8                     | 9.50<br>(8.87-9.99)  | —                      | 18.98<br>(17.17-23.03)     | 24.91<br>(22.51-26.27) | 28.88<br>(25.47-34.38)     | 35.38<br>(31.97-37.16) | 1.85<br>(1.35-2.41) |

content. These results along with the preceding year's data were classified according to species and were statistically analysed. Mean values and range are given in Table 14 from which the following conclusions can be derived.

Seed weight of *G. hirsutum* varieties showed a very wide range but in general the mean seed weight was same as that of *G. barbadense*. The seed weight was higher in both these species than in the other species. Linter content in the case of *G. hirsutum* was significantly higher than in *G. arboreum* and *G. herbaceum*; however it was the highest\* in Garo Hills cotton (*G. arboreum*). Oil content in the whole seed of *G. hirsutum* and *G. barbadense* was of the same order, while both these species showed significantly higher oil content than the other two species. On the other hand, *G. hirsutum* varieties showed significantly higher oil content in the kernel than the other species. Oil content in Garo Hills cotton was the lowest. When the entire seed was taken for analysis, the protein content was higher in the case of seeds of *G. barbadense* varieties than in other cases; however, when only the kernels (after dehulling) were taken for analysis, there was very little difference in the average protein content between the different species. Gossypol content in the whole seed as well as in the kernel of *G. barbadense* was significantly higher than that of *G. arboreum* and *G. hirsutum*. Garo Hills varieties had very low gossypol content compared with the other strains, while Badnawar Glandless had the least gossypol content (0.13%).

Cotton seed samples received from Coimbatore and Siruguppa, under the All-India Co-ordinated Research Project (A.I.C.R.P.) [Br.2(a) trial] were studied for seed weight and oil content. Samples from Coimbatore generally showed higher seed weight and percentage of oil in the seed than the seeds of same variety from Siruguppa. Similarly, cotton seed samples of Br.2(b) trial (A.I.C.R.P.) from Dharwar and Ranibennur showed that the Dharwar samples had higher oil content than Ranibennur samples. Seed weight of Br.3 samples from Coimbatore varied from 9.58 g (E.735-2) to 11.77 g (33-III-2) and oil content varied from 19.31% (A.101) to 21.79% (M.C.U.1).

#### 4. Study of the effect of different concentrations of alpha-naphthalene acetic acid and times of application on fibre quality

As stated in the last report, an agronomic experiment was being carried out on M.C.U.2 variety at Srivilliputhur, combining two concentrations of alpha-naphthalene acetic acid (0, 10 and 20 ppm), three times of application at leaf and flowering stages and two doses of NPK fertilizers with two controls and four replications. 56 samples belonging to the 1966-67 season were tested for mean fibre length and uniformity ratio by Digital Fibrograph. In addition, 20 samples were tested for fibre fineness and maturity coefficient by Micronaire. The data will be analysed on completion of tests on all the three seasons' samples.

\* Probably due to faulty ginning.



**5. Effect of pests and diseases on the quality of cotton**

In order to assess the extent of deterioration of the quality of cottons as a result of attack by pests and diseases and to assess the effect of various insecticidal treatments on physical properties of cotton, samples were obtained from different Agricultural Research Stations in India and were tested for fibre properties.

During the period under report, four samples of Nandicum variety from Nandyal (Andhra Pradesh) belonging to 1965-66 season and one sample of Sea-Island (Andrews) from Yemmiganur belonging to 1966-67 season were tested for ginning percentage, mean fibre length by Balls Sorter, Micronaire fineness and maturity coefficient by Micronaire and bundle strength at zero and 3 mm gauge lengths by Stelometer. In addition, six samples of Y.1 (1966-67 season) from Poona (Maharashtra) were tested for ginning percentage, mean fibre length by Balls Sorter and bundle strength at zero gauge length by Stelometer.

The data will be analysed after completing the test on samples from three seasons.

**6. Comparison of fibre length as measured by different instruments**

It had been mentioned in the last Annual Report that 25 samples belonging to four botanical species had been tested for different parameters of length and length uniformity, using various types of instruments. During 1968, the data were statistically analysed with a view to finding out the interrelationship between the various length parameters. The following correlation coefficients were obtained :

|              |   |           |                    |   |              |
|--------------|---|-----------|--------------------|---|--------------|
| $r_{X_1X_2}$ | = | +0.9927** | $r_{X_5X_8}$       | = | +0.9901**    |
| $r_{X_1X_3}$ | = | +0.9925** | $r_{X_6X_7}$       | = | +0.9852**    |
| $r_{X_1X_4}$ | = | +0.9924** | $r_{X_9X_{10}}$    | = | +0.4955*     |
| $r_{X_1X_5}$ | = | +0.9904** | $r_{X_9X_{11}}$    | = | +0.2821 N.S. |
| $r_{X_1X_6}$ | = | +0.9941** | $r_{X_{10}X_{11}}$ | = | +0.7978**    |
| $r_{X_1X_7}$ | = | +0.9858** | $r_{X_{12}X_{11}}$ | = | -0.5864**    |
| $r_{X_5X_6}$ | = | +0.9901** | $r_{X_{12}X_{13}}$ | = | +0.5204**    |
| $r_{X_5X_7}$ | = | +0.9927** |                    |   |              |

Where the symbols used are :

- $x_1$  = Mean length from Balls Sorter tests.
- $x_2$  = Mean length from Baer Sorter tests.
- $x_3$  = Mean length by A. N. Stapling Apparatus tests.
- $x_4$  = U.H. mean length from Manual Fibrograph.
- $x_5$  = 2.5% span length from Digital Fibrograph.
- $x_6$  = Effective length from Baer Sorter Array.
- $x_7$  = Effective length from "Uster" Stapler.
- $x_8$  = Upper quartile length from Balls Sorter.
- $x_9$  = Dispersion percentage from staple diagram (Baer Sorter).
- $x_{10}$  = C.V. from Balls Sorter distribution.
- $x_{11}$  = Irregularity percentage from Balls Sorter.
- $x_{12}$  = Uniformity ratio from Digital Fibrograph.
- $x_{13}$  = Uniformity ratio from Manual Fibrograph.
- \* = Significant at 5% level.
- \*\* = Significant at 1% level.
- N.S. = Non-significant.

Further analysis of data is in progress.

**7. Fabrication of an extractor for improving the ginning of kapas containing large quantities of immature locks and hulls by separating them before the ginning process**

The fabrication work of the extractor has been practically completed. Trials were being taken of the machine with some samples and suitable adjustments were being made.

**8. Secondary cell wall development of *G. herbaceum* and Indo-American cottons**

The effect of water stress and other treatments on fibre developments and fibre properties is being investigated. During the year, the degree of thickening was determined on fibres extracted from bolls of Digvijay and Gujarat 67 cottons, ranging in age from 7 to 63 days, picked at intervals of 7 days, during the season 1966-67. The determination of important fibre properties such as fibre length, maturity, fineness and strength of fibres of full grown samples (70 days) of these two cottons was also completed during the year.

**9. Structural peculiarities of Indian *G. hirsutum* and *G. herbaceum* cottons**

Earlier studies at this Laboratory had indicated that certain structural peculiarities probably contributed to the unexpected technological performance of Indian *hirsutum* and *herbaceum*s. A comparative study of these groups with

American Upland cottons, has, therefore, been undertaken. Large number of *herbaceum* cottons were screened for maturity and about 12 samples covering wide range of maturity (maturity coefficient 0.68 to 0.89) were selected from this group, in addition to 10 samples each from Indian *hirsutum*s and American Upland cottons, for further study. Methods for determination of propanol retention and alkali centrifuge values have been standardised with a view to determining indirectly void space or average pore size in cotton. Determination of propanol retention values for 20 samples (10 Indian *hirsutum* and 10 American Upland cottons) has been completed.

Other structural properties are being determined.

#### 10. Study of structural properties of chemically modified cottons by optical methods

Cotton treated with aqueous solutions of zinc chloride under different conditions of concentration and temperature were examined for changes in physical and structural characteristics. Results indicate that zinc chloride solutions at critical concentrations of 65% and 70% bring about considerable swelling and decrystallization and the extent of changes produced are dependent on the conditions of treatment as revealed by lateral-order distribution of cotton cellulose treated with aqueous zinc chloride solutions. The mechanism of swelling has been proposed from the evidence of formation of specific hydrates at specific concentrations of zinc chloride on the basis of conductivity measurements and UV absorption characteristics. UV and IR spectroscopic measurements indicate the formation of complexes between zinc chloride and cellulose.

#### 11. Investigation of the microbial decomposition of cellulose

The P.L.480 Project, which was undertaken to investigate the microbial destruction of cotton fibres and fabrics by organisms indigenous to the Bombay area with a view to providing basic information needed for development of satisfactory protective treatments for cotton fabrics, was completed and a detailed report was published. The results obtained have already been indicated with the progress of work in the annual reports during the last five years. A brief summary is given below :

About 76 bacteria, 29 actinomycetes and 38 fungi were isolated from a large number of cotton and fabric samples suspected of micro-biological damage. The study of collulolytic microflora of Bombay has indicated that, although the micro-biological flora of air and soil are nearly the same in different parts of the world, there seem to be important specific differences. Well known cellulolytic fungi belonging to genera *Myrothecium*, *Chaetomium*, *Trichoderma*, *Memnoniella*, etc., and *Myxobacteria* were conspicuously absent, whereas *Streptomyces* sp., which were encountered in fairly large numbers, seem to have an important role in the degradation of cotton along with *Aspergilli*.

Quantitative evaluation of cellulolytic activity of isolates from cellulose enrichments has been rewarding. Bacteria, though incriminated in large number, were mostly feeble in cellulolytic activity with the exception of isolates like *Cellovibrio* and *Nocardia*. Of particular interest were the large number of highly cellulolytic *Streptomyces*. This group has been isolated in a large number for the first time from cotton and fabric, though they are known as cellulose digesters since long. Fungi too, as expected, were highly cellulolytic. *Aspergilli* were most dominant. *Penicillia* and certain other fungi, even though not highly cellulolytic, were found in large numbers and were responsible for bad appearance, musty odour and stains on cotton and fabric.

The ecological pattern emerging from this study shows that cellulolysis in nature is a synergetic process, where fungi and streptomyces have major role in bringing about degradation of cellulose, while bacteria, with few exceptions, seem to help mainly in the further decomposition of degraded cellulose.

Enzyme kinetic studies were carried out on two promising *Streptomyces*, *S. ruber* and *S. scabies*, and fungus *Aspergillus terreus*. The activity of enzyme filtrate was determined against carboxymethylcellulose (CMC) and dewaxed cotton. Between the two streptomyces, *S. ruber* was more active. But, *A. terreus* was far more active as compared to both the streptomyces.

The streptomyces enzyme assayed against CMC had two pH optima at pH 5.8 and 7.3. The bimodal nature of pH curve was unique and the enzyme activity was about the same at both the peaks. The optimum conditions for the enzyme activity of *A. terreus* was pH 5.6 at 50°C.

Characteristic of cotton fibre treated with enzyme filtrate revealed appreciable fall in strength accompanied by increase in reducing sugar and microscopic damage count. The three cultures, therefore, produce both carboxymethylcellulase and cellulase. The breakdown products of cellulose were glucose, cellobiose, cellotriose and traces of higher oligosaccharides.

Experiments of exploratory nature to isolate marine cellulolytic microorganisms from sea water of Bombay were completed. A large number of bacteria, streptomyces and fungi have been isolated.

## 12. Investigation of the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information of the chemistry of cotton celluloses

Gamma-ray irradiation is known to cause oxidation of cellulose. Attempts were made to investigate the nature of such oxycelluloses. Studies were also undertaken to examine the effect of the introduction of double bonds in cellulose through allylation treatment on its radiation stability. The effect of varying degrees of substitution (D.S.) of allyl groups was also studied. Further, the polyacrylonitrile (PAN) grafts were separated from the cellulose backbone and the degradation in both the isolated PAN grafts and cellulose was

evaluated. Acetylated samples of increasing D.S. were prepared using Buras' method. Analysis of acetylated samples by chromatographic technique was also undertaken to identify their degradation products. Lastly, a preliminary screening of various probable protective and sensitizing reagents, on the basis of tensile strength, viscosity and copper number, was also made. The radio-protective effect of ethylene diamine (EDA) was studied in detail.

The oxycelluloses produced by gamma-ray irradiation of cotton after chlorus acid and  $\text{NaBH}_4$  treatments showed a continuous fall in tenacity, although the D.P. values remain unchanged. They had a copper equivalence of 11.45. These characteristics are similar to those of oxycellulose produced by oxidation of cellulose with potassium dichromate-oxalic acid reagent when oxidation takes place at the  $\text{C}_6$  position. Hence, it is concluded that the oxycelluloses produced by gamma-ray irradiation of cotton are also oxidised at  $\text{C}_6$  position.

Allylation treatment was found to offer substantial radio protection to cellulose against fall in tenacity. In fact, at low dosages of  $1 \times 10^5 \text{r}$  and  $1 \times 10^6 \text{r}$ , there was even an increase noted in the tenacity and other mechanical properties. This protective effect against degradation seems to be due to the presence of double bonds in the allylated samples. The fall in iodine number from an initial value of 111 to zero at higher dosages indicated saturation of double bond. Allylated cellulose of three different D.S., viz. 0.33, 0.59 and 1.04, were prepared. The variation in strength values, in case of allylated cellulose of lower D.S. was found to be greater. Attempts are being made to reduce the variation by suitably modifying the procedure.

Various attempts were made to remove the PAN grafts from the cellulose backbone. The isolated PAN grafts and the cellulose backbone yielded 2.5 and 6.1 as the 'G' values for their bond breakages. The ratio of molecules of cellulose to the molecules of PAN grafts increases with increasing dosage due to the higher chain breakages in cellulose than in the PAN grafts.

Acetylated samples of different D.S., viz. 0.74, 1.02 and 1.60, were prepared following Buras' method. The degradation in strength due to the treatment was observed to be lower as compared to those prepared by Cooper's method.

Analysis of the degradation products of the raw and the acetylated samples (D.S. 1.17 and 2.34) showed that the acetylated samples with D.S. 1.17 had the highest water soluble fraction. The loss in the acetyl content of this sample after irradiation ( $1 \times 10^8 \text{r}$ ) followed by water washing indicated deacetylation during irradiation. However, on irradiation, the acetylated samples (D.S. 2.34) showed predominant oxidation and also increase in acetyl content, probably due to ion exchange reaction on account of the formation of large number of carboxyl groups. Both the acetylated samples yielded acetic acid, cellobiose and glucose as their irradiation products. The sample with higher acetyl content, in addition, showed traces of arabinose.

Preliminary screening with various chemical reagents, both under air and nitrogen atmosphere, on the basis of tensile strength showed amines and alcohols to be radio-protective. The protective effect of amines has been attributed to their swelling behaviour and also to the formation of intermediate irradiation product,  $\text{NH}_2$ . In the case of alcohols, methanol proved to be the maximum radio-protective reagent, probably both due to its swelling action and the likelihood of its behaviour as a radical scavenger. The values of copper number and viscosity of the screened samples showed very little change in the degradation between the samples irradiated in air and nitrogen atmosphere.

The radio-protective effect of amines was studied further by irradiating the cellulose in the presence of different concentrations of EDA. The values of strength, viscosity and copper number indicated that the degradation due to irradiation was the lowest in case of the yarn treated with 80% EDA.

### 13. Studies on the changes in density of cotton and others textile fibres with changes in temperature and relative humidity

This investigation was taken up with a view to get information on the structural changes taking place inside the fibre as a result of changes in humidity and temperature. About sixty floats had been calibrated last year. During 1968, hundred more floats were calibrated to complete the entire range of density of cellulosic and other common textile fibres, viz. from 1.00 to 1.56 g/cc. In order to study the changes in density of cotton fibres at various stages of growth, fibres were collected from bolls of 170-Co.2 and Laxmi cottons at six different growth stages picked at weekly intervals. In the case of 170-Co.2, fibres from side and chalazal regions separately were also collected and tested. All the fibres were tested as raw and after purification. For purification, the fibres were dewaxed and bleached. It was observed that even after removal of non-cellulosic contents, which were found in appreciable quantities at earlier stages of growth, the fibres from different stages of growth gave significant changes in density values. These density values increased as the fibres advanced in growth. Further, the density values changed significantly for fibres from side and chalazal regions. As the density value is a good indicator of the crystallinity of a fibre sample, these changes in density values suggest that during growth the fibres undergo, to some extent, other structural changes in addition to thickening of the cell walls.

Seven different samples of widely varying crystallinities were prepared by chemical treatment, such as hydrolysis, treatment with ethylene diamine, etc., and their densities determined. It was observed that in the case of all the fibres, a gradual decrease in density was observed (suggesting a fall in crystallinity) with increasing moisture absorption at high relative humidities. This change varied in magnitude from fibre to fibre though the trend was the same. Further work is in progress.

#### 14. Effect of swelling and decrystallising treatment on the strength-length gradient of cottons in relation to changes in structural parameters

Fifteen cottons having sufficiently wide range in strength were selected, care being taken to include cottons having extreme values in bundle strength. These included 9 Egyptian cottons and 6 strains of Indian cottons. Bundle strength at zero gauge of the samples varied from 48 to 34 g/t. Bundle strength tests at 0, 1, 2, 3, 4 and 6 mm gauge lengths were carried out in the raw state. When the results were graphically plotted, a gradual fall with increasing gauge lengths was observed. Later, the samples were dewaxed and kier-boiled and strength tests at zero and 3 mm gauge lengths were carried out; no change was observed in the strength values due to these treatments. All the samples were then mercerised at room temperature in the slack state, using 25% solution of NaOH. Bundle strength tests at all the above-mentioned gauge lengths were carried out wherever possible. It was observed that at zero and 1 mm gauge lengths, there was a sharp fall in strength values as compared to the values in the raw state, but at higher gauge lengths, the mercerised samples showed significant improvement in strength as compared to the raw samples.

#### 15. Studies in physical characteristics of blends of cotton and other fibres

The procedure for uniform blending was standardized during the period under report. In order to study the resultant mean length (1) of the blended samples, 3 short staple cottons (1=16.0 mm, 16.8 mm and 19.0 mm) and 3 long staple cottons (1=23.3 mm, 24.9 mm and 27.9 mm) were selected and each short staple cotton was blended with each long staple cotton in 50:50 proportion. The Balls Sorter distribution of the 9 blends thus obtained showed that the mean length of the blended sample was almost equal to the arithmetic mean of the mean length values of the individual cottons. The coefficient of variation in length calculated from weight-length distribution of each blended sample was found to be higher than that of individual cottons. Further work will be carried out to study the resultant strength and fineness of the blends.

#### 16. Preparation of colour charts for different grades of Indian cottons

Last year, about 1,400 samples from 1964-65 season had been tested on Nickerson-Hunter Colorimeter. Out of these, 180 samples were cleaned through Shirley Analyser and tested on the colorimeter in order to study the effect of removal of trash on reflectance (Rd) values. Although there was, in general, an increase in Rd values, this increase was not found related to the extent of trash removed. The maximum increase in Rd was as high as 15.2% and the maximum trash content was 23%.

Further analysis is in progress.

### 17. Studies on the changes in shape of cotton fibres due to different chemical treatments

In order to investigate whether the shape factor is a varietal property, 20 cottons, five each from the four important botanical species, namely *G. arboreum*, *G. herbaceum*, *G. hirsutum* and *G. barbadense*, were selected. All these cottons had about 60% mature fibres. 500 cross-sections for each sample were traced out and then were grouped into three categories of shape, viz.: (i) round shapes having circularity of 0.80 and above, (ii) elliptical having circularity between 0.50 and 0.80, and (iii) flat shapes having circularity of 0.50 and less. The analysis of the data indicated that cottons belonging to *G. arboreum* had the maximum round fibres (i.e. about 30%), while cottons belonging to *G. barbadense* had the least round fibres (i.e. 17%).

This study was further extended to investigate the variations in cross-sectional shapes within the same variety. For this, fibres of different length groups were sorted out with Baer Sorter and the circularity as well as the maturity (NaOH method) for each group length were determined. It was observed that within the same sample, longer fibres were mature as well as circular.

Further work is in progress.

### 18. Studies on the effect of some chemical treatments on the yarn characteristics

These investigations were undertaken with a view to study whether chemical treatments, such as mercerisation, etc., change the regularity or evenness of cotton yarns. 5 samples spun to three different counts (20s, 30s and 40s) were mercerised with and without tension. These samples along with the control samples were tested on the Uster Evenness Tester. Significant increase in Uster mean deviation value was observed for both the mercerised treatments. In order to confirm this rather unexpected trend, the regularity in terms of coefficient of variation mass per unit length was determined by weighing small fragments, 1 cm in length, on a specially fabricated Quartz Micro-balance. The coefficient of variation of weight per unit length calculated from 500 observations on each of 3 different samples (each spun into 20s and 30s count) indicated that there was no tendency for a yarn to become more irregular on mercerisation either in slack or stretched condition.

These samples (control, slack mercerised and stretch mercerised) were then visually examined by 7 observers for yarn appearance. It was observed that the yarn became more regular on mercerisation; when mercerisation was carried out under tension, this effect was more pronounced.

The changes in regularity were further studied by determining the coefficient of variation of strength and twist per unit length. It was observed from the data analysed for 7 samples (3 counts each) that there was an increase in strength on mercerisation (either slack or stretched).

The data are being analysed.



**19. Estimation of spinning value of cotton from its chief fibre properties in the cotton tracts of Punjab, U.P., Rajasthan, Vidarbha and Middle Gujarat**

For the estimation of spinning value of cotton from its chief fibre properties, data relating to mean fibre length (l in mm), fineness (f in millitex), maturity coefficient (m), bundle strength (s in g/tex) and H.S.C. (c) of 109 samples from the Middle Gujarat tract pertaining to the four seasons 1963-64, 1964-65, 1965-66 and 1966-67 were collected with a view to fit a regression equation for predicting the H.S.C. from the chief fibre properties.

Places : Broach, Hansot, Bardoli, Dabhoi, Tanchha and Achhalia.

The data available related to the test results on the samples of Digvijay, 3200, 3000, 2827, 3-2-15, 11-1, 1914, 1482, 1861, 1336, 179, 199, 1474, 2255, 3997, 3943, 2087, 2113, 3270, 2162, 1567, 632, 92, Vijay, Co-ano-8-3-2 and Gujarat 67.

The data were statistically analysed and the results are :

| <i>Correlation coefficients</i> |             | <i>Regression coefficients</i> |            |
|---------------------------------|-------------|--------------------------------|------------|
| $r_{lc}$                        | = +0.4561** | $b_l$                          | = + 2.1214 |
| $r_{fc}$                        | = -0.7699** | $b_f$                          | = - 0.2984 |
| $r_{mc}$                        | = -0.5812** | $b_m$                          | = +40.6539 |
| $r_{sc}$                        | = +0.1827   | $b_s$                          | = + 0.2656 |
| $R^2$                           | = 0.7409    | $R$                            | = 0.8607   |

The following regression equation was worked out on the basis of the data:

$$C = 2.1214 l - 0.2984 f + 40.6539 m + 0.2656 s + 9.0401.$$

Error of estimate of C = 3.05 counts.

This equation is considered suitable for predicting the spinning value of new strains (other than hybrids) evolved in the Middle Gujarat tract.

Regarding other tracts, very few samples from those tracts had been received and tested. Hence, no further analysis could be carried out.

With a view to observing the relationship of C.S.P. for 20s and 30s with the chief fibre properties of cotton (l, f, m and s) and examining whether the rate of fall (k) of C.S.P. was related to l, f, m and s, data relating to the chief fibre properties of cotton (l, f, m and s) and the C.S.P. values for 20s and 30s (p and p') pertaining to 112 samples for four seasons 1963-64, 1964-65, 1965-66 and 1966-67 from Maharashtra State were collected and statistically analysed.

Varieties : H.4, A.K.235, A.K.277, G.22 and G.46.

Places : Dhulia, Jalgaon, Kukana, Shevgaon, Buldana, Akola, Yeotmal, Nagpur, Nimbala, Badnapur, Parbhani, Washim and Nanded.

## Results :

| C.S.P. for 20s (p) |             | C.S.P. for 30s (p') |             | Rate of fall of C.S.P. |           |
|--------------------|-------------|---------------------|-------------|------------------------|-----------|
| $r_{lp}$           | = +0.1649   | $r_{lp}'$           | = +0.1676   | $r_{lk}$               | = -0.1252 |
| $r_{fp}$           | = +0.1014   | $r_{fp}'$           | = -0.0624   | $r_{fk}$               | = +0.0301 |
| $r_{mp}$           | = -0.0631   | $r_{mp}'$           | = -0.0648   | $r_{mk}$               | = +0.0259 |
| $r_{sp}$           | = +0.4994** | $r_{sp}'$           | = +0.3740** | $r_{sk}$               | = +0.0892 |
| R                  | = 0.2332    | R                   | = 0.2157    | R                      | = 0.1450  |

The correlation coefficient of C.S.P. with bundle strength was significant, while the correlation coefficient of C.S.P. with the other properties was not significant. There was no uniform relationship between the rate of fall of C.S.P. with the fibre properties. As this observation is somewhat strange, further data will be collected and analysed.

#### 20. Fabrication of a miniature spinning plant with O.M. system of super high drafting

Further progress was made in the fabrication of the miniature spinning plant by getting some parts for the lifting mechanism made locally and fitting them up. The work is in progress.

#### 21. Preliminary study of the characteristic curve connecting count and C.S.P.

It is known that the yarn strength decreases with higher counts for all cottons. However, the rate of fall varies differently for different cottons. In order to investigate the rate of fall of C.S.P. at different counts for different cottons, ten cottons capable of spinning above 40s were selected and spun into about ten counts. The yarns obtained were also tested. The yarn test results were being examined.

#### 22. Study of spinning of mixings of different cottons and other natural and synthetic fibres

In order to study the spinning performance and yarn characteristics of cotton mixings in relation to their individual performance, some cottons had been selected. These were grouped into three categories based on their fibre properties and spinning performance. From each group several mixings were prepared by taking three cottons at a time and mixing them thoroughly in equal proportion (1.5 kg each). About 17 such mixings had been prepared and processed earlier. During 1968, six more such mixings were processed and the yarns spun were tested. Table 15 shows the chief fibre properties and spinning capacity of the cottons from which the mixings were made.

PROGRESS OF RESEARCH

TABLE 15. CHIEF FIBRE PROPERTIES AND SPINNING CAPACITY OF COTTONS TAKEN UP FOR MIXING AND PROCESSING

| Cotton   | Store No. | Mean fibre length, mm | Micronaire value | Maturity coefficient | H.S.C. |
|--|-----------|-----------------------|------------------|----------------------|--------|
| <i>(a) Mixings suitable for spinning about 20s count</i> |           |                       |                  |                      |        |
| Raniben  | 68966     | 20.0                  | 5.6              | 78                   | 16s    |
| Wagad  | 71227     | 20.2                  | 5.2              | 79                   | 17s    |
| Westerns (Bellary)                                       | 71890     | 19.2                  | 5.4              | 74                   | 24s    |
| <i>(b) Mixings suitable to spin about 30s count</i>      |           |                       |                  |                      |        |
| Westerns (Adoni)   | 71236     | 21.0                  | 5.4              | 78                   | 27s    |
| Maljari  | 70468     | 21.6                  | 5.5              | 78                   | 24s    |
| P.A.320F   | 70997     | 21.6                  | 5.2              | 76                   | 30s    |
| N.14   | 72973     | 21.0                  | 5.0              | 78                   | 33s    |
| Westerns (Adoni)   | 71236     | 21.0                  | 5.4              | 78                   | 27s    |
| Maljari  | 70468     | 21.6                  | 5.5              | 78                   | 24s    |
| <i>(c) Mixings suitable to spin about 40s count</i>      |           |                       |                  |                      |        |
| Narmada  | 69610     | 21.8                  | 3.6              | 71                   | 40s    |
| Sanjay   | 69633     | 22.2                  | 5.4              | 74                   | 36s    |
| Laxmi  | 71267     | 22.6                  | 3.3              | 69                   | 42s    |
| Narmada  | 69610     | 21.8                  | 3.6              | 71                   | 40s    |
| L.S.S.   | 70998     | 21.6                  | 4.4              | 75                   | 37s    |
| Digvijay (Kapadvanj)                                     | 69678     | 21.6                  | 4.4              | 76                   | 43s    |
| Sanjay   | 69633     | 22.2                  | 5.4              | 74                   | 36s    |
| Laxmi  | 71267     | 22.6                  | 3.3              | 69                   | 42s    |
| L.147  | 68898     | 23.2                  | 4.1              | 75                   | 40s    |

23. Effect of fibre length distribution and fibre strength on yarn strength

As indicated in the last report, 27 varieties were tested for mean fibre length and bundle strength at zero and 3 mm gauge lengths and the factor termed "effective weight" at each of 1/8, 1/4, 3/8 and 1/2 in. critical lengths was computed from the Balls Sorter frequency distribution diagram. During the period under review, the statistical analysis of the data was being carried out.

**24. Variation of yarn strength with relative humidity**

The object of this investigation is to study the influence of the humidity under which yarn samples are conditioned and tested, on the yarn strength. For this purpose, twelve cottons had been spun to three suitable counts each, and all the 36 samples of yarn thus obtained were conditioned and tested for metric skein strength at six different levels of relative humidity, viz., 35 %, 45 %, 55 %, 65 %, 75 % and 85 %. This work was in progress during the last few years. During the year under review the test results were statistically analysed. The following regression equations for Yarn Strength Index have been obtained for estimating the yarn strength at 65 % r.h. from the values obtained at other levels of humidity.

|   |   |        |                           |                          |           |
|---|---|--------|---------------------------|--------------------------|-----------|
| Y | = | 1.0103 | Y <sub>1</sub> + 107.6760 | for tests carried out at | 35 % r.h. |
| Y | = | 0.9996 | Y <sub>2</sub> + 86.3196  | " " " "                  | 45 % "    |
| Y | = | 0.9714 | Y <sub>3</sub> + 88.7785  | " " " "                  | 55 % "    |
| Y | = | 1.0370 | Y <sub>4</sub> - 97.6106  | " " " "                  | 75 % "    |
| Y | = | 1.0487 | Y <sub>5</sub> - 189.1145 | " " " "                  | 85 % "    |

where Y, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub>, Y<sub>4</sub> and Y<sub>5</sub> refer to values of yarn strength index at 65 %, 35 %, 45 %, 55 %, 75 % and 85 % r.h., respectively.

Further analysis is in progress.

### III. Publications

During the year, two technological reports, six technological bulletins and three articles were published. Six articles have been sent to various journals for publication. On the completion of the P.L.480 Project entitled, "Investigation of the microbial decomposition of cellulose with special reference to the effect of Indian bacterial organisms on cotton and cotton fabrics to provide basic information for the improvement of cotton products", a detailed report of the study was published during the year. Further, a book entitled, "Handbook of Methods of Tests for Cotton Fibres, Yarns and Fabrics", describing the methods of tests employed and containing a wide bibliography of relevant literature, useful to students of cotton technology and to those engaged in the cotton trade, industry and research, was published.

Besides the above, sixty-five Technological Circulars were issued on different important Trade Varieties and Standard Indian Cottons for the benefit of the trade and industry, the Cotton Breeders, etc.

A list of the various publications issued during the year is given below.

#### A. Technological Reports

1. "Technological Report on Trade Varieties of Indian Cottons, 1966-67 season".
2. "Technological Report on Standard Indian Cottons, 1966-67 season".

#### B. Technological Bulletins (C.T.R.L. Publications—New Series)

- (i) Studies on Lustre in Textiles. Part I: Instrumental evaluation of lustre and the design and performance of a locally fabricated lustre-meter, by P. G. Oka and Jai Prakash.
- (ii) Studies on Lustre in Textiles. Part III: Contribution of structural elements towards the lustre behaviour of cotton fibres, by Jai Prakash, P. G. Oka and R. L. N. Iyengar.
- (iii) Note on the influence of picking intervals on the quality of cotton, by L. R. Jambunathan and R. L. N. Iyengar.
- (iv) Note on the effect of alpha-naphthalene acetic acid on the physical properties of 320F cotton, by V. G. Munshi and R. L. N. Iyengar.
- (v) Inter-crystalline and fine structural properties of chemically modified cottons by infra-red spectroscopy, by S. N. Pandey.

- (vi) Studies on Cellulolytic Micro-organisms. Part I: Microflora associated with the degradation of cotton in Bombay, by S. M. Betrabet, Usha P. Dasani and Indira G. Bhatt.

**C. Articles and Papers**

*(a) Published*

- (i) Lab plays key role in development of long staples, by V. Sundaram. Published in Cotton—International Edition, 1968.
- (ii) Ginning of kapas in relation to cotton quality, by V. Sundaram. Published in the Bombay Cotton Merchants and Muccadams' Association Ltd., Golden Jubilee Supplement of the Financial Express, dated the 2nd March, 1968.
- (iii) Training in Cotton Technology given at the Cotton Technological Research Laboratory, by V. Sundaram. Published in the Souvenir issued by the Federation of Gujarat Cotton Associations, Ahmedabad.

*(b) Sent for Publication*

- (i) A study on the effect of agronomic treatments on the seed and oil content of cotton seed, by S. N. Pandey.
- (ii) Studies on Chemically Modified Cotton. Part I: Effect of chemical treatments for varying periods on crystallinity and certain other properties of cotton, by S. N. Pandey and R. L. N. Iyengar.
- (iii) Studies on Chemically Modified Cotton. Part II: Effect of different concentrations of chemicals on crystallinity and certain other properties of cotton, by S. N. Pandey and R. L. N. Iyengar.
- (iv) Studies on Cellulolytic Micro-organisms. Part II: Cellulolytic enzymes of *Streptomyces* sp. and *Aspergillus terreus*, by S. M. Betrabet and Usha I. Patel.
- (v) Studies on Chemically Modified Cotton. Part IV: Studies on relationship between the properties of untreated and chemically modified cotton fibre, by S. N. Pandey and R. L. N. Iyengar.
- (vi) Cotton Technological Research Laboratory—Its role in the improvement of cotton production in India, by V. Sundaram.

**D. Miscellaneous Publications**

- (i) Investigation of the microbial decomposition of cellulose with special reference to the effect of Indian bacterial organisms on cotton and cotton fabrics to provide basic information for the improvement of cotton products, by S. M. Betrabet.
- (ii) Handbook of Methods of Tests for Cotton Fibres, Yarns and Fabrics, by V. Sundaram and R. L. N. Iyengar.

PUBLICATIONS

**E. Technological Circulars**

*Standard Indian Cottons—1967-68 Season*

|                                      |                     |
|--------------------------------------|---------------------|
| 1 M.C.U.2 (Summer)                   | 9 Gaorani 46        |
| 2 Virnar                             | 10 A.K.235          |
| 3 Sanjay                             | 11 Gaorani 22       |
| 4 Deviraj (Gujarat)                  | 12 Gujarat 67       |
| 5 Buri 147                           | 13 Narmada          |
| 6 Kalyan                             | 14 Deviraj (Mysore) |
| 7 Laxmi (Irrigated)<br>(Maharashtra) | 15 A.K.277          |
| 8 Digvijay                           | 16 Jayadhar         |

*Trade Varieties—1967-68 Season*

|                           |                           |
|---------------------------|---------------------------|
| 1514 Virnar (Khandesh)    | 1539 Kalyan (Viramgam)    |
| 1515 Y.1                  | 1540 U.P. Desi (Shyamali) |
| 1516 Laxmi (Baramati)     | 1541 Comillas             |
| 1517 Buri 147 (Vidarbha)  | 1542 Sanjay (Botad)       |
| 1518 Bengal Desi (Punjab) | 1543 Digvijay (Kapadvanj) |
| 1519 " " (Rajasthan)      | 1544 Adonicum             |
| 1520 320F (Punjab)        | 1545 Wagad (Saurashtra)   |
| 1521 H.14                 | 1546 Oomras (Barsinagar)  |
| 1522 Gaorani 6 (Bhainsa)  | 1547 Kalyan (Bavla)       |
| 1523 Buri 1007 (Vidarbha) | 1548 Laxmi (Gadag)        |
| 1524 Deviraj (Nagar)      | 1549 L.147 (Adilabad)     |
| 1525 A.K.277              | 1550 Jayadhar (Bagalkot)  |
| 1526 A.K.235              | 1551 Nandicum             |
| 1527 Jayadhar (Hubli)     | 1552 Nandyal 14           |
| 1528 Digvijay (Petlad)    | 1553 L.S.S.               |
| 1529 " (Dabhoi)           | 1554 Badnawar 1           |
| 1530 " (Palej)            | 1555 Suyodhar             |
| 1531 Gujarat 67 (Idar)    | 1556 P.216F (Madras)      |
| 1532 Maljari              | 1557 Karunganni 6         |
| 1533 Narmada              | 1558 Laxmi (Adoni)        |
| 1534 Westerns             | 1559 " (Madras)           |
| 1535 C. Indore 1          | 1560 Coconadas White      |
| 1536 Sanjay (Maharashtra) | 1561 M.C.U.2 (Summer)     |
| 1537 Gaorani 46           | 1562 H.420 (Bellary)      |
| 1538 Gaorani 22           |                           |

## IV. Extension

This Laboratory has no farm attached to it and no field work is carried out directly under its own charge. All the field work is carried out at various agricultural research stations in the States and the samples of the improved cotton strains evolved under various research projects are tested for their properties by this Laboratory at its headquarters as well as the outstations maintained under its charge. This Laboratory does not directly help the farmers but indirectly helps them through the State Departments of Agriculture. The Technological Circulars issued on Trade Varieties of cotton are useful to the growers, the trade and the industry inasmuch as these Circulars indicate the quality of the commercially grown crop.

Further, the Laboratory renders considerable assistance to those engaged in cotton trade, to other Government and Civic Organisations, etc., by undertaking tests on samples received from these organisations, by imparting training in cotton technology and by supply of useful testing instruments.

### Testing Work

Apart from the research samples received from various agricultural stations, this Laboratory continued to receive a number of samples of cotton, yarn and cloth for special tests, from commercial firms, and Government and semi-Government organisations. Such samples are tested on payment of the prescribed fees. The number of such samples received for various tests during the year 1968, together with the corresponding figures for 1967 and for the quinquennium 1960-65 are given in Table 16.

(TABLE 16. NUMBER OF SAMPLES RECEIVED FOR PAID TESTS)

| Type of test      | Average for the quinquennium ending May, 1965 | 1967 | 1968 |
|-------------------|---|------|------|
| Spinning          | 52  | 18   | 22   |
| Fibre (E.I.C.A.)* | 148   | 126  | 46   |
| „ (Others)        | 155   | 72   | 81   |
| Yarn              | 168   | 108  | 147  |
| Cloth             | 158   | 75   | 97   |
| Moisture          | 933   | 12   | 34   |
| Miscellaneous     | 16  | —    | 11   |
| Total             | 1,630   | 411  | 438  |

\*These samples, from the East India Cotton Association Limited, Bombay, are tested free of charge as the E.I.C.A. reciprocates by supplying free of charge a number of samples (6 kg each) of the Trade Varieties and also the Garder's valuation reports on samples of improved cotton strains sent to them by this Laboratory.



### EXTENSION

The total test fees realised during 1968, for carrying out tests on these samples, amounted to Rs. 11,058.50 against Rs. 8,484.00 during 1967.

#### Training Facilities

The Laboratory was conducting, in the past, two training courses for persons employed in the cotton trade and co-operative marketing societies, viz. a full time course for persons from the mofussil centres and a part-time course for persons employed in Bombay city. The former was for a duration of two months and the latter spread over six months for two half days in a week. During the year, the part-time course for persons employed in Bombay city was also converted into a full time course of two months' duration. Three persons were selected from the mofussil centres and given training from the 18th March to the 17th May, 1968, and two persons were selected from Bombay city and given training from the 1st July to the 31st August, 1968. Four officers deputed by the Delhi Cloth Mills, Delhi, were given special training in fibre testing and application of statistical methods.

#### Supply of Equipments

The following items were fabricated and supplied to the parties who had asked for them.

|                               |    |
|-------------------------------|----|
| Laboratory Model Gin          | 3  |
| Ginning Percentage Balance    | 2  |
| Quartz Micro-balance          | 1  |
| Halo Length Disc (Small Size) | 16 |
| Halo Length Disc (Large Size) | 47 |

## V. Conferences and Symposia

The Laboratory participated in the following scientific and technical conferences and meetings connected with this Laboratory's work and deputed the officers mentioned below for the purpose.

| Date                          | Meeting   | Place     | Attended by  |
|-------------------------------|---|-----------|--|
| 30.1.1968                     | 15th meeting of the Standing Working Committee of the Textile Division Council of Indian Standards Institute. | Bombay    | Dr. V. Sundaram  |
| 22.2.1968<br>and<br>23.2.1968 | Second meeting of the Advisory Board of the ICAR.   | New Delhi | Dr. V. Sundaram  |
| 8.3.1968                      | First All India Seminar on Indian Wool.   | Bombay    | Dr. V. Sundaram<br>Dr. Jai Prakash<br>Dr. S. M. Betrabet<br>Shri R. P. Neogi<br>Dr. V. G. Munshi<br>Dr. S. N. Pandey |
| 8.3.1968                      | TDC 33—Sampling Sub-Committee of ISI.   | Bombay    | Shri G. S. Rajaraman   |
| 8.4.1968<br>and<br>9.4.1968   | Workshop meeting of Cotton Research Workers—Northern Region.  | New Delhi | Dr. V. Sundaram  |
| 7.5.1968                      | Meeting of the <i>ad hoc</i> Working Groups of the Fourth Five Year Plan (New).                               | Bombay    | Dr. V. Sundaram  |
| 15.5.1968<br>to<br>17.5.1968  | Workshop meeting of Cotton Research Workers—Central Region.   | Bombay    | Dr. V. Sundaram<br>and senior scientific<br>staff of the Laboratory  |
| 11.6.1968<br>to<br>13.6.1968  | Second All India Workshop meeting of Cotton Research Workers (including Southern Zone).                       | Bangalore | Dr. V. Sundaram<br>Dr. V. G. Munshi  |
| 24.6.1968                     | 27th meeting of TDC 2 in joint session with TDC 2:1 and TDC 2:3 of ISI.                                       | Bombay    | Dr. V. G. Munshi   |
| 27.9.1968                     | Meeting of the Scientific Panel on Agricultural Science Technology of the ICAR.                               | New Delhi | Dr. V. Sundaram  |
| 28.9.1968                     | Nucleus and Foundation Cotton Seed Certification Programme.   | Nanded    | Shri C. A. S. Aiyar  |
| 17.10.1968                    | 35th Meeting of TDC 1 in joint session with TDS 1:1 and TDC 1:2 of ISI.                                       | Bombay    | Dr. V. G. Munshi   |

## VI. Summary of the Report

This is the Forty-Fifth Annual Report of the Laboratory and pertains to the year 1968.

The research activities and the testing work progressed satisfactorily as in the past. During the year, a sum of Rs. 15.94 lakhs had been provided in the budget. Out of this, Rs. 11.85 lakhs only was actually spent. A sum of Rs. 3.54 lakhs provided for capital expenditure under the programme of expansion and modernisation of this Laboratory remained unutilised for want of necessary foreign exchange. During the year, the temperature and humidity control plant was installed in the testing sections. However, as some control parts are still to be procured from abroad, to put the plant in working order, the Government has been approached for releasing the necessary foreign exchange.

Satisfactory progress was made in the various research projects under investigation. Some of them were completed and the results published in Scientific and Technical Journals in India and abroad. In a few investigations, the experimental work only has been completed and the results were being examined. The results of the research investigations are indicated briefly below:

(i) Among the samples received from various trials under the All-India Co-ordinated Research Project on Cotton, tests were completed on 720 samples. The most outstanding technological performance was that of the new bulk material of Co-Pusa-Egyptian, which could be spun to almost 100s count. The performance of S.B.289-E was also very good. It will be worthwhile to carry out further large scale trials with these materials. Amongst the *G. hirsutum* strains, A.218 in the North Zone, B.59-1684 and Hybrid 4 in the Central Zone, and 909-2 and 815-3-1 in the South Zone gave very good performance. It is interesting to note that Laxmi performed uniformly well in the South Zone as well as in the Central Zone. Amongst the *G. herbaceum* strains, B.C.3200 and 1482 performed well both in the Central and the South Zones. The *G. arboreum* strain C.C.1-1-3 gave good performance in the Central Zone but had low yield. The above strains may be considered as the most promising and outstanding materials from the technological view point that have come out of the last season's experiments. It may be mentioned here that the strain 815-3-1 has been recommended for release for general

cultivation as 'M.C.U.5' in Tamil Nadu while the strain A.C.122 has been released for cultivation as 'Krishna' in the rice fallows regions of Andhra Pradesh.

(ii) During the year, in addition to samples received from trials under the All-India Co-ordinated Research Project on Cotton, a large number of samples of improved varieties belonging to various research projects on cotton breeding, agronomy, etc., were received for tests at the Laboratory from the State Departments of Agriculture and Agricultural Universities. In all, 321 reports had been issued during the year on 2,616 samples, out of which 566 related to fibre and full spinning tests, 1,959 related to micro-spinning tests with or without fibre tests and 101 related to fibre tests only. In addition, the Laboratory continued to receive samples for tests from semi-Government organisations, Excise Department, the cotton trade and industry, etc. These tests were carried out on payment of the prescribed fees and the total amount collected during the year as fees was Rs. 11,058.50.

(iii) The effects of different concentrations of various chemical reagents as well as the effects of different temperatures of treatment were studied in relation to the changes brought about in the physical and structural properties of the cotton fibres. Treatments with concentrations of 70% to 90% of ethylene diamine, 70% and above of ethylamine, 20% of potassium hydroxide and 7% to 10% of lithium hydroxide were observed to produce marked changes in the crystallinity and physical properties of the fibres. In the case of treatments with the above two hydroxides, a slight decrease in crystallinity was observed on decreasing the temperature at which treatment was carried out.

(iv) The data obtained till now on the analysis of cotton seeds have revealed that the seed weight and oil content of seeds of strains belonging to *G. barbadense* and *G. hirsutum* species were higher than those of strains belonging to the other two species. Seeds of strains of *G. barbadense* contained more gossypol than those of the other species. A few *desi* (*G. arboreum*) strains, namely, N.R.5, Red Arboreum and Garo Hills cotton, had surprisingly low gossypol content.

(v) Most of the work relating to the fabrication of an extractor has been completed. The equipment will now be tested using large samples of trashy *kapas* which have been specially called for from various Cotton Specialists.

(vi) In connection with the study of the secondary cell wall development of *G. herbaceum* and Indo-American cottons, the degree of thickening was observed on the fibres extracted from bolls of Digvijay and Gujarat 67 cottons ranging in age from 7 to 63 days picked at intervals of 7 days. The data will be analysed after the results for three seasons become available.

(vii) Further studies were carried out on the swelling and other changes brought about in cotton by treatment with zinc chloride. The results have conclusively shown that inter-crystalline swelling and decrystallization brought about by zinc chloride at 65% and 70% concentrations was due to specific

## SUMMARY OF THE REPORT

hydrate formation rather than due to formation of different types of complexes between zinc chloride and cellulose.

(viii) The data collected in connection with the P.L.480 Project on the investigation of microbial decomposition of cellulose, were analysed and the results presented in the form of a final report on the Project. The study of the cellulolytic microflora of Bombay has indicated that although the microbiological flora of air and soil are nearly the same in different parts of the world, there seem to be important specific differences. Well known cellulolytic fungi belonging to genera *Myrothecium*, *Chaetomium*, *Trichoderma*, *Memnoniella*, etc., and Myxobacteria were conspicuously absent, whereas *Streptomyces* sp. were encountered in fairly large numbers along with *Aspergilli*. The ecological pattern emerging from this study shows that cellulolysis in nature is a synergetic process, where fungi and *Streptomyces* have a major role in bringing about degradation of cellulose, while bacteria, with a few exceptions, seem to help mainly in the further decomposition of degraded cellulose.

Enzyme kinetic studies were carried out on two promising *Streptomyces*, *S. ruber* and *S. scabies*, and the fungus *Aspergillus terreus*, which was far more active than both the *Streptomyces*. Cotton fibres treated with enzyme filtrate revealed appreciable fall in strength accompanied by increase in reducing sugar and microscopic damage count. The breakdown products of cotton cellulose were glucose, cellobiose, cellotriose and traces of higher oligosaccharides.

(ix) In an investigation undertaken for the preparation of radio-resistant and radio-sensitive celluloses to obtain basic information on the chemistry of cotton cellulose, some interesting results were obtained. Out of the five chemical modifications of cotton, viz., Acetylation, Benzoylation, Benzoylation, Graft Polymerisation and Allylation, it was noticed that degradation with increasing irradiation dosage was, more or less, identical for raw and acetylated samples; the acrylonitrile grafted samples showed some resistance against degradation on irradiation, while allylated samples showed substantial radio resistance. The benzoylated samples proved more radio-resistant than the other treated samples.

(x) An examination of the density changes at various stages of growth of a fibre revealed that the density increased gradually with increase in the age of the boll and these changes were significant even after removing the non-cellulosic contents from these fibres. It was inferred from the data collected that in addition to the thickening of the cell wall of the fibres with increase in the age of the boll, some structural changes appeared to be taking place in the fibre, probably increasing the crystallinity of the fibres.

(xi) Experimental work relating to the fabrication of a torsion balance at this Laboratory, similar to the imported types at present in use, has been initiated.

(xii) The procedure for uniform blending was standardised and nine blends were obtained using three long staple cottons and three short staple cottons. The mean length of the blended sample was almost equal to the

average of the mean lengths of the individual cottons in each case. Further tests are in progress.

(xiii) 180 samples of cotton were cleaned by Shirley Analyser and tested on the Nickerson-Hunter Colorimeter. It was observed that the change in the reflectance values was not proportional to the extent of trash removed from the sample.

(xiv) Studies on the changes on the shape factor of textile fibres due to different chemical treatments were continued. From the experiment conducted during the year, it was observed that dewaxing of the fibres did not have any effect on the circularity measurements. Samples from *G. arboreum* species had the largest number of fibres with circular cross-sections while the samples of *G. hirsutum* had the least.

(xv) Some further progress had been made in the fabrication of a miniature spinning plant with O.M. system of super high drafting which will be useful for spinning small samples for tests.

(xvi) For studying the spinning performance and yarn characteristics of cotton mixings, some more mixings of the selected cottons had been spun and were being tested.

(xvii) For estimating the spinning value of cottons from their chief fibre properties, a formula had been worked out which would be applicable for the varieties (except hybrids) grown in the Middle Gujarat tract.

(xviii) The yarn strengths at different levels of r.h. were studied and formulae had been worked out to obtain thelea strength at the standard level of 65% r.h. from the strength values observed at 35%, 45%, 55%, 75% and 85% r.h.

*Publications* : During the year, two technological reports, six technological bulletins and three articles were published. Six articles have been sent to various journals for publication. A detailed report on a P.L.480 Project entitled, "Investigation of the microbial decomposition of cellulose with special reference to the effect of Indian bacterial organisms on cotton and cotton fabrics to provide basic information for the improvement of cotton products" was published. Besides the above, 65 Technological Circulars were issued on different Trade Varieties and Standard Indian Cottons for the benefit of the trade, the industry, the Cotton Breeders, etc.

*Training* : During the year, training courses for persons employed in the Cotton Trade and Co-operative Marketing Societies, etc., were conducted and five persons completed the course successfully. Further, four officers deputed by the Delhi Cloth Mills, Delhi, were given special training in fibre-testing and application of statistical methods.

*Fabrication and supply of instruments* : There was continued demand for the instruments fabricated at the Laboratory. During the year, 3 Laboratory Gins, 2 Ginning Percentage Balances, 1 Quartz Micro-balance, 16 halo length discs (small size) and 47 halo length discs (large size) were fabricated and supplied to those who had asked for them.

## VII. Personnel

During the year under report, Dr. Jai Prakash, Senior Scientific Officer, was relieved from this Laboratory on the 24th October, 1968, to take up the appointment as Director, Central Testing Laboratory, under the Textiles Committee, Bombay. Dr. S. M. Betrabet, Senior Scientific Officer, proceeded to the U.S.A. on the 26th August, 1968, on foreign assignment, to take up the Post-Doctoral Associateship of the National Academy of Sciences. Dr. V. G. Munshi, Junior Scientific Officer, was appointed as Junior Physicist at the Laboratory under the All-India Co-ordinated Research Project on Cotton, with effect from the 18th March, 1968, on an *ad hoc* basis.

One post each of Senior Research Assistant and Sliver Maker were sanctioned at Sriganaganagar under the All-India Co-ordinated Research Project on Cotton and are yet to be filled up. Two posts of Senior Research Assistants, one each in Microbiology and Bio-chemistry, were sanctioned by the Indian Council of Agricultural Research in February, 1968. The former was filled with effect from the 20th August, 1968, while the latter is still to be filled up. Two posts of Senior Research Assistants (Testing) fell vacant as the incumbents were selected for posts under other Institutes of the Indian Council of Agricultural Research. One post of Senior Research Assistant (Testing) under the All-India Co-ordinated Research Project on Cotton and one of Senior Research Assistant (Spinning) were filled by open competition, with effect from the 17th September and the 14th October, 1968, respectively, and one post of Senior Research Assistant (Testing) in this Laboratory was filled from the 5th February, 1968, by promotion. One Research Assistant was promoted as Senior Research Assistant under the scheme for breeding extra-long staple cotton at Abohar from the 24th January, 1968, and on his relinquishing the post due to his transfer to the Indian Agricultural Research Institute, under the India Council of Agricultural Research, another Research Assistant was promoted to that post with effect from the 16th December, 1968.

One post of Research Assistant (Testing) was converted into Research Assistant (Spinning). Further, three posts of Research Assistants, two in Testing and one in Statistics, were filled during the year under report. The Research Assistant (Statistics) subsequently resigned in August, 1968. The Research Assistant (Workshop) at the Laboratory and two Research Assistants

(Testing) who were working at Abohar and Nanded resigned in May, July and August, 1968, respectively.

The Microbiologist working in the P.L.480 Project (Grant No. FG-In-155) had resigned his post from the 1st January, 1968, i.e. one day before the termination of the Project.

The Technical Assistant (Hindi) resigned the post in February, 1968. One post of Assistant Librarian was created and the post was filled up in November, 1968. One post each of Pump Attendant-cum-Plumber and Conditioning Plant Operator was also sanctioned by the Council in August, 1968.

It is recorded with deep sorrow the sad demise of two members of the staff of the Laboratory (one Stenographer and one Spinning Operative) during the year.

A list of the technical and scientific staff of the Laboratory as on the 31st December, 1968, is attached (Appendix II).

V. SUNDARAM  
Director



## APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on the 31st December, 1968

Dr. V. Sundaram, M.Sc., Ph.D., A.R.C.S.

Director

Dr. S. M. Bhatnagar, M.Sc., Ph.D., for foreign assignment

Senior Scientific Officer

## VIII. Appendices

## APPENDIX I

## COTTON TECHNOLOGICAL RESEARCH LABORATORY

## Budget Estimates of Expenditure of the Laboratory and Outstations including the Actual Expenditure and Receipts during 1967-68

## A. Expenditure

|   | Sanctioned Grant (Rs.) | Actual Expenditure (Rs.) | Savings (—) Deficit (+) (Rs.) |
|---|------------------------|--------------------------|-------------------------------|
| <b>I. TECHNOLOGICAL RESEARCH</b>                            |                        |                          |                               |
| Technological Laboratory including outstations              |                        |                          |                               |
| (a) Capital expenditure including expansion of Laboratory   | 6,00,000               | 2,45,884                 | (—) 3,54,116                  |
| (b) Working Expenses  | 9,93,800               | 9,39,001                 | (—) 54,799                    |
|   | <u>15,93,800</u>       | <u>11,84,885</u>         | <u>(—) 4,08,915</u>           |
| <b>II. Technological Schemes including P.L.480 Projects</b> | 1,95,604               | 87,168                   | (—) 1,08,436                  |

## B. Receipts

|  | (Rs.)         |
|--|---------------|
| 1. Sale of Products (gins, etc.)                   | 9,112         |
| 2. Analytic and Testing fees                       | 7,330         |
| 3. Rents   | 8,628         |
| 4. Fees for training, Application fees, etc.       | 5,569         |
| 5. Sales of Publications                           | 2,480         |
| 6. Interest on loans and advances                  | 49            |
| 7. Miscellaneous (including sales of waste cotton) | 14,050        |
|  | <u>47,218</u> |

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APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory  
as on the 31st December, 1968

|                                      |   |
|--------------------------------------|---|
| Director                             | Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C.   |
| Senior Scientific Officers           | Dr. S. M. Betrabet, M.Sc., Ph.D. (on foreign assignment)<br>Shri R. P. Neogi, B.Sc., B.Sc. (Tech.) (Manch.), A.M.C.T.<br>(Two posts vacant) |
| Junior Scientific Officer (Spinning) | (Post vacant)   |
| Junior Scientific Officers           | Dr. S. N. Pandey, M.Sc., Ph.D.<br>Shri G. S. Rajaraman, M.A.<br>Shri P. G. Oka, M.Sc.<br>(One post vacant)                                  |
| Senior Research Assistants (Testing) |   |
| Shri P. D. Vakil                     | Shri S. R. Ganatra, B.Sc.   |
| Shri C. A. S. Aiyar, B.Sc.           | Shri S. G. Nayar, B.Sc., LL.B.  |
| Shri S. Ramanathan                   | Shri A. Rajagopalan, B.Sc.  |
| Shri P. N. Elayathu, B.Sc.           | Shri A. V. Ukidve, B.Sc.  |
| Smt. S. B. Pai, B.Sc. (Hons.)        | Shri B. M. Petkar, B.Sc.  |
| Smt. K. L. Datar, B.Sc.              |   |
| Senior Research Assistant (Ginning)  | Shri D. G. Shete, L.M.E.  |
| "    "    "    (Electrical)          | Shri H. V. Tamhankar, L.M.E., L.E.E.  |
| "    "    "    (Spinning)            | Shri K. S. Bhyrappa, L.T.T.   |
| "    "    "    (Statistics)          | Shri S. Raghupathi, D.T.T.  |
| "    "    "    (Microbiology)        | Shri K. Venkateswaran, B.A.   |
| "    "    "    (Bio-chemistry)       | Kum. R. D. Jayalakshmi, M.Sc.<br>(Post vacant)  |
| Research Assistants (Testing)        |   |
| Shri K. R. Kamath, B.Sc.             | Kum. T. T. Annamma, B.Sc.   |
| Shri P. K. Jairam, B.Sc.             | Shri A. K. Gupta, B.Sc. (Hons.)*  |
| Shri V. Venugopalan, B.Sc.           | Smt. J. K. S. Warriar, B.Sc.  |
| Shri N. Thejappa, B.Sc.              | Shri T. K. Madhusudana Das, B.Sc.   |
| Shri K. V. Babu, B.Sc.               | Shri V. Jose Joseph, B.Sc.  |
| Kum. Indira K. P. Iyer, B.Sc.        | Shri Varghese Paul, B.Sc.   |
| Smt. S. D. Pai, B.Sc.                | Shri C. P. Venugopalan, B.Sc.   |

\* Temporarily working under Retired Scientists' Scheme.

APPENDIX II

|                                    |   |
|------------------------------------|---|
| Shri K. Vijayan, M.Sc.             | Shri C. R. Sthanu Subramoni Iyer, B.Sc. |
| Smt. Shaila P. Bhatawdekar, M.Sc.  | Shri K. S. Shama Rao, B.Sc.             |
| Shri P. K. Chidambareswaran, M.Sc. | Shri K. V. Anantha Krishnan, B.Sc.      |
| Shri P. Bhaskar, M.Sc.             | Shri S. Vasudevan, B.Sc., B.Tech.       |
| Shri Y. Subramanyam, M.Sc.         | Kum. T. K. Girija, B.Sc.                |
| Smt. Prema Nair, M.Sc.             | Kum. Radhika R. Nayak, B.Sc.            |
| Shri S. Venkata Raman, B.Sc.       | (Two posts vacant)                      |
| Research Assistants (Statistics)   | Shri K. Chandran, B.A.                  |
|                                    | Shri Vijay Bahadur Singh, M.Sc.         |
|                                    | (One post vacant)                       |
| Research Assistants (Spinning)     | Shri N. K. Haridas, D.T.T.              |
|                                    | Shri H. R. Laxmi Venkatesh, D.T.T.      |
| Research Assistant (Workshop)      | (Post vacant)                           |

P.L.480 PROJECT (GRANT No. FG-IN-186)

|  |                                |
|--|--------------------------------|
| Junior Scientific Officer (Textile Chemist)    | Kum. Indira G. Bhatt, M.Sc.    |
| „ „ „ (Organic Chemist)                        | Shri N. S. Shah, M.Sc.         |
| Senior Research Assistant (Analytical Chemist) | Smt. Vatsala Iyer, M.Sc.       |
| „ „ „ (Physicist)                              | Shri A. W. Shringarpure, B.Sc. |

OUTSTATIONS

| <i>Station</i> | <i>Senior Research Assistant</i>             | <i>Research Assistant</i> |
|----------------|--|---------------------------|
| Coimbatore     | Shri S. K. Iyer, B.A.                        | Shri A. K. Antony, B.Sc.  |
| Dharwar        | Shri M. S. Sitaram, B.Sc.                    | Shri E. S. Abraham, B.Sc. |
|                |  | (One post vacant)         |
| Nandyal        | Shri R. Dwarkanath, B.Sc.                    | —                         |
| Nanded         | Shri W. R. Sharma, B.Sc.                     | Shri S. P. Ingole, M.Sc.  |
| Surat          | Shri L. R. Jambunathan, B.Sc.,<br>A.M.I.E.T. | Shri R. C. Sankalia       |
| Sriganganagar  | —  | (Post vacant)             |
| Abohar         | Shri S. N. Nagwekar, B.Sc.                   | (Two posts vacant)        |
| Indore         | Shri N. C. Chiplonkar, M.Sc., D C.T.         | Shri G. S. Patel, B.Sc.   |

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ALL-INDIA CO-ORDINATED RESEARCH PROJECT ON COTTON

(a) *Laboratory*

Junior Physicist Dr. V. G. Munshi, M.Sc., Ph.D.  
 Senior Research Assistant Shri Radha Ballabha, M.Sc.

(b) *Outstations*

| <i>Station</i> | <i>Senior Research Assistant</i> | <i>Research Assistant</i>                          |
|----------------|----------------------------------|--|
| Coimbatore     | —                                | Smt. Santa V. Nayar, B.Sc.                         |
| Nandyal        | —                                | Shri G. Varadraj Rao, M.Sc.                        |
| Nanded         | —                                | (Post vacant)                                      |
| Surat          | —                                | Shri S. S. Iyer, B.Sc.<br>Shri M. C. Bhalod, B.Sc. |
| Sriganganagar  | (Post vacant)                    | —  |
| Hissar         | (Post vacant)                    | (Post vacant)                                      |

