COTTON TECHNOLOGICAL RESEARCH LABORATORY, BOMBAY

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Contents

I. Introduction

This Laboratory was founded by the Indian Central Cotton Committee in 1924, to study 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 the Laboratory are :

(i) To help the Agricultural Departments in evaluating the quality of new strains evolved,

(ii) To help the trade and industry by furnishing true valuation of different trade varieties cultivated,

(iii) To issue authoritative reports on the samples received for tests from the trade and other sources,

(iv) To carry out basic research in physical and chemical properties of cotton in relation to quality and spinning performance of cotton,

(v) To carry out investigations on the ginning problems of Indian cottons,

(vi) To investigate the greater and better utilisation of cotton, cotton wastes, linters, cotton seed, etc. , and

(vii) To disseminate technical information.

The Laboratory consists of several sections for 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. The Laboratory maintains a good up to date library of books on cotton technology. In the library are about 2161 books, 104 of which were added during the year under report. The number of bound volumes was 2039. The library also receives regularly about 112 journals dealing with textile and allied subjects, 52 of which are subscribed for and the others received on exchange or complimentary basis. The Indo-American Survey and Study Team visited this library in October, 1967.

During the year under review, the following equipments were acquired for the use in the Laboratory.

(i) "Bijou-ADCO" constant temperature circulating water bath.

(ii) ELICO Mains operated direct reading pH Meter Model LI-10.

(iii) ELICO Mains operated Portable type pH Meter Model LI-12.

(iv) Titration Potentiometer stand with Magnetic Stirrer.

(v) Quadrant Yarn Balance.

(vi) "DOMESTIC" Micro-pulverisor Machine.

(vii) P.W. 1024/10 Large Power Camera for X-ray crystallography.

(viii) "Bausch and Lomb"—Spectronic 20′ Colorimeter.
(ix) Rotary Shaker, Emenvee Make.
(x) Leonard Refrigerator.
(xi) One "Thermolab" hot-air-oven.
(xii) Toshniwal Fibre Fineness Tester.

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

Dr. J.S. Kanwar	..	Deputy Director General (SAE), Indian Council of Agricultural Research, New Delhi.
Dr. A.B. Joshi	..	Deputy Director General (Crop Science), Indian Council of Agricultural Research, New Delhi.
Mr. Ward Morehouse	..	Director, Educational Resources Centre, University of the State of New York (State Education Department), D-53, Defence Colony, New Delhi-3.
Mr. T.L.W. Bailey	..	United States Department of Agriculture, Foreign Agricultural Service, Washington D.C.
Dr. N. Patnaik	..	Deputy Agricultural Commissioner, Indian Council of Agricultural Research, New Delhi.
Shri G.D. Parikh	..	Rector, University of Bombay, Bombay-1.
Dr. G.M. Nabar	..	Director, University Department of Chemical Technology, Bombay-19.
Shri R.K. Ram		Additional Secretary, Indian Council of Agricultural Research, New Delhi.
Dr. T.M. Paul	..	Officer-in-Charge, Western Regional Station of the National Diary Research Institute, Aarey Colony, Bombay 65.
Shri C.S. Shridharan	..	Deputy Agricultural Commissioner (eng.), Indian Council of Agricultural Research, New Delhi.
*Miss Dorothy Parker	..	Associate Director of Rockefeller Foundation, III West 50th Street, New York, N.Y.
*Miss A.J. Carabelli	..	Retired Assistant Director, National Agricultural Library, Washington D.C.
*Mr. Ming-Yu-Loi	..	Library Specialist, University of California, U.S.A.
*Shri S.R. Banerjee	..	Chief Librarian, Indian Council of Agricultural Research, New Delhi.
*Shri S.P. Phadnis	..	Chief Librarian, Indian Agricultural Research Institute, New Delhi-12.
*Shri D.H. Kalia	..	Director of Public Libraries, Delhi Public Library, Delhi.
Mr. G.W. Walls	..	Asssistant Chief, C.S.I.R.O., Box 21, Belmount, Galaray, Australia.

*Members of the Indo-American Survey and Study Team.

Two meetings of the Staff Research Council were held during the year. At the first meeting, the Research Programme of Work of the Laboratory for 1967 was considered and finalised. The instructions received from the Indian Council of Agricultural Research on "Uniform system for maintaining records of Research Projects, in the Central Research Institutes" were considered at the second meeting.

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 at the various outstations where specially trained staff have been posted.

Projects

A number of projects are being undertaken in collaboration with other organisations whenever opportunity arises. During the year, the following projects were functioning in collaboration with other departments.

(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 cottons by optical methods (in collaboration with Prof. E.H. Daruwala, Department of Chemical Technology, Bombay University).
(iii) Inheritance of X-ray angle and bundly strength (in collaboration with Dr. V. Santhanam, Head of the Regional Research Centre, Indian Agricultural Research Institute, Coimbatore).

Two projects undertaken at this Laboratory are being financed from P.L. 480 funds. The first 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", which commenced from the 3rd January 1963, has been practically completed; the second 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) Bombay University: (a) Senate, (b) Acadamic 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.

The Director and other scientific officers of the Laboratory have been appointed as members 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 convener of

TDC 1::1 (Textile Standards Sub-committee) for Physical Methods of Tests for Cotton and also for TDC 1 :1 :12 (Panel for Yarn Appearance Standard).

The University of Bombay has extended the recognition granted to the Laboratory as a Post-graduate Institution for guiding students for the M.Sc. and Ph.D. degrees in Textile Physics for a period of two years from the 2nd July 1967.

Dr. V. Sundaram, Director, and Dr. Jai Prakash, Senior Scientific Officer, have been recognised as teachers for guiding students for the Ph.D. and M.Sc. degrees, respectively, of the University of Bombay, in Textile Physics. Two members of the staff, Dr. V.G. Munshi and Dr. S.N. Pandey, were awarded Ph.D. degrees of the University of Bombay on the basis of the theses submitted by them on the research work done at the Laboratory. At present, three students are being guided at the Laboratory for M.Sc., in Textile Physics of the Bombay University.

The expansion and modernisation programme of the Laboratory, could not make much progress during the year under report as the foreign exchange, vitally required for importing certain parts for setting up the Humidity Controlled Plant for the Testing Section in the New Research Laboratory Building, was released by the Government of India in September, 1967. Necessary further action for procurement of this Plant has now been instituted with a view to ensure that the installation of the plant is completed expeditiously.

Three buildings under construction on a plot of land about one and a half miles from the Laboratory, which were originally acquired for then the Indian Central Cotton Committee, were taken over by the Indian Council of Agricultural Research and transferred to this Laboratory. Construction of these buildings was completed during this year and 24 quarters in these buildings were available for allocation. Of these 22 quarters were released for occupation to the needy members of the Laboratory staff, one was converted into a Guest House for visiting officials to Bombay, and one was allotted to a member of staff of the Regional Office (Cotton Development).

The Indian Council of Agricultural Research has also sanctioned construction of 16 Type I quarters for class IV staff at the Laboratory and the construction work has been assigned to the Central Public Works Department, Bombay, for execution.

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, Government and semi-Government organisations continued to avail of the testing facilities at the Laboratory, and a number of samples of cotton, yarn and cloth were received and tested for them on payment of prescribed fee.

The cotton trade and industry appreciate the training facilities available at the Laboratory. Four trainees of the cotton trade were given training in cotton technology and elements of statistics.

There was much 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 the Laboratory during the financial year 1966-67 is given in the Appendix I. It will be noted that out of a sum

of Rs. 17.10 lakhs sanctioned, only a sum of Rs. 8.14 lakhs had been spent during the year. A sum of Rs. 8.34 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. 0.81 lakh was incurred on technological schemes including P.L. 480 Projects.

Outstanding achievements

During the year, considerable progress was made in the research activities. Some of the important results observed are briefed below.

(i) Studies on treatment of cotton with certain chemicals showed that the degree of crystallinity could be reduced partially by these treatments and thereby the extensibility and moisture absorption capacity and chemical accessibility of the cotton fibres improved.

(ii) A formula was worked out to adapt the Micronaire for determining the fineness of coarse cottons by blending these with a fine cotton.

(iii) The study of cellulolytic microflora of Bombay, under a P.L. 480 Project, has led to many interesting findings. It was observed that well-known cellulolytic fungi and myxobacteria reported by workers abroad were absent, whereas *Streptomyces* and some *Aspergilli* seem to have important role in the degradation of cotton. Enzyme studies on *Streptomyces* have shown that the pH optima was of bimodal nature (pH 5.8 and pH 7.3).

(iv) Under another P.L. 480 Project, various chemically modified cotton samples were prepared and subjected to gamma-ray irradiation. It has been observed that certain treatments on cotton, *viz.* acrylonitrite grafting, benzylation and benzoylation, offered appreciable protection against fall in tenacity on irradiation with gamma-rays.

(v) From the results of the study on the relationship between cotton roving strength and fibre properties, an equation was developed to predict the value of the minimum twist of cohesion of the roving from the values of fibre length, fibre length irregularity, fibre fineness and the number of fibres in the cross-section of the roving.

(vi) A formula was worked out for predicting the spinning value of improved strains of cotton grown in Vidarbha tract from their chief fibre properties, *viz.* mean fibre length, fineness, maturity coefficient and strength.

(vii) A number of samples of improved cotton strains evolved under various research projects on cotton breeding, agronomy, etc., were received at this Laboratory for tests. The test results on the samples were sent to the officers concerned as quickly as possible. In all, 317 test reports were issued during the year, containing fibre and full spinning test results on 591 samples, micro-spinning test results on 1579 samples and fibre tests (alone) on 347 samples.

(viii) During the year, two technological reports and four research bulletins were published. Five articles have been sent to different journals for publication or read at various conferences. Thirty-nine technological circulars have been issued on different major trade varieties of cotton for the information of the mills and the trade. A book entitled "Handbook of Methods of Tests for Cotton Fibres, Yarns and Fabrics" is under publication.

II. Progress of Research

During the year under review considerable progress has been made in various research investigations undertaken at the Laboratory. Some of the research investigations were completed and the results published in scientific and technical journals in India and abroad. In a few investigations, the experimental work has been completed and the results are being examined. Some investigations are held up for want of necessary facilities. Two of these research investigations are being financed out of P.L. 480 funds. One of these is concerned with the microbial decomposition of cotton textile materials, while the other deals with the effect of gamma-ray irradiation on raw and chemically treated cottons. In all, about 31 research projects were in progress, while the results of another 13 projects, already completed, were under analysis. Some of the main results are summarised below.

Studies on treatment of cotton with ethylamine, diethylamine, pyridine, NaOH and KOH showed that the degree of crystallinity could be reduced partially by these treatments and thereby the extensibility, moisture absorption capacity and chemical accessibility of the cotton fibres could be improved. However, it was noted that the tensile strength was considerably decreased due to these treatments.

A regression equation connecting the theoretical harmonic mean of the micronaire values of the individual components with the experimental values of the blend (1 : 1) of two varieties was worked out in order to adapt the Micronaire for determining the fineness of coarse cottons.

The study of cellulolytic microflora of Bombay, carried out under a P.L. 480 Project, 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 and myxobacteria reported by workers abroad were conspicuously absent, whereas *Streptomyces* and some *Aspergilli* seem to have important role in the degradation of cotton. *Streptomyces* were isolated for the first time in such a large number from cotton and fabric. Enzyme studies on *Streptomyces* have also been rewarding. The pH optima was of bimodal nature (pH 5.8 and pH 7.3) which was unique.

In another P. L. 480 Project, various chemically modified cotton samples were prepared and subjected to gamma-ray irradiation. It was observed that acrylonitrite grafted samples showed some resistance against degradation by gamma-rays as they could be tested for strength even after receiving a dosage of 5×10^7 r at which raw, partially acetylated and fully acetylated cotton samples had become brittle and powdery. The benzylated and benzoylated samples, however, proved much more radio-resistant, while the allylated samples also showed an

appreciable radio protection against fall in tenacity. On the basis of the analysis by paper chromotographic technique of the decomposition products caused by irradiation of raw cotton, a mechanism for this degradation process was being worked out.

The results of the study on the relationship between cotton roving strength and fibre properties showed that the minimum twist of cohesion was highly correlated positively with the fibre length and negatively with fibre fineness, while there was a low negative correlation with fibre length irregularity. Further, an equation was developed to predict the value of the minimum twist of cohesion from the above fibre properties, taking into consideration the number of fibres in the cross-section of the rovings.

A regression equation was worked out for predicting the spinning value of improved strains of cotton grown in Vidarbha tract from their chief fibre properties *viz.* mean fibre length, fineness, maturity coefficient and strength.

A number of samples of improved cotton strains evolved under various research projects on cotton breeding, agronomy, etc., were received at the Laboratory for test. The test results on the samples were sent to the officers concerned immediately. In all, 317 test reports were issued during the year, containing the fibre and full spinning test results on 591 samples, micro-spinning test results on 1,579 samples and fibre tests (alone) on 347 samples.

The progress of work in the case of other research projects has also been satisfactory. The detailed reports on all the research projects are given below.

Effect of chemical treatment on the physical and chemical properties of cotton fibres

High crystallinity of cellulose, while it is responsible for high tensile strength and low extensibility of cotton is also the cause of undue stiffness and brittleness as well as low absorption and chemical reactivity. With a view to overcoming these defects and bringing about changes in the elastic and various other properties of cotton fibres, treatments on two cottons, Gaorani and 170-Co. 2, were carried out with anhydrous ethylamine, diethylamine, pyridine and aqueous solutions of sodium hydroxide (30%) and potassium hydroxide (40%) for varying periods of time ranging from 15 minutes to 50 hours. Modified lint samples showed certain interesting changes with some of the treatments (Table 1). In brief, it may be stated that cellulose crystallinity was reduced to certain extent by treatment with ethylamine, KOH and NaOH. The extent of reduction of crystallinity depended not only upon the chemical used, but also upon the period of treatment and various other factors. Consequent on the decrystallization, the amorphous component of cellulose was increased which was reflected in increased moisture regain. While the bundle strength at zero gauge length generally decreased for all the treatments, it was particularly marked for treatments with NaOH and KOH. However, changes in fibre bundle strength at 3 mm gauge length did not follow the same pattern as in the case of zero gauge test. The percentage of extension before break and toughness were found to be the highest and stiffness the lowest, with the treatment of KOH.

TABLE 1. CRYSTALLINITY AND VARIOUS OTHER PHYSICAL PROPERTIES OF RAW AND CHEMICALLY MODIFIED COTTON (170-Co. 2)

Sl. No.	Treatment	Crystallinity % α	Crystallinity % β	Moisture regain at 85% R.H.	Bundle strength (g/tex) Zero gauge	Bundle strength (g/tex) 3 mm gauge	Extension %	Toughness	Stiffness	D.P.	Birefringence ($n_{\parallel}-n_{\perp}$)	Axial ratio
1.	Control (raw)	62	90	8.03	40.9	21.8	5.3	57.8	4.11	2867	0.0469	2.29
2.	Anhydrous ethylamine	40	56	12.60	35.4	20.4	8.5	86.5	2.39	2271	0.0405	1.66
3.	Diethylamine	59	86	8.48	35.9	19.2	6.5	62.3	2.95	2474	..	2.12
4.	Pyridine	57	83	8.99	36.6	20.5	5.7	58.0	3.61	2402	..	2.03
5.	NaOH (30%)	40	53	12.63	32.7	20.7	7.7	79.2	2.70	2423	0.0340	1.34
6.	KOH (40%)	38	50	12.83	31.5	22.8	13.2	150.8	1.72	2378	0.0305	1.46

α = Crystallinity % by sorption ratio method.
β = Crystallinity % by iodine adsorption method.

Other treatments also showed similar changes in these characters but to a lesser extent. The degree of polymerisation, D.P. showed a fall with all the treatments. Fibrillar orientation as measured by the birefringence showed a reduction with the treatment; this reduction was particularly high for treatments with KOH and NaOH. Maximum swelling was observed in the case of NaOH treated samples while treatment with KOH and ethylamine showed high degree of swelling. Generally, it was observed that most of the swelling and changes in the physical, chemical, structural and optical properties had resulted within a quarter or half an hour of the treatments with the reagents.

Study on gossypol content and chemical composition of cotton seeds

From a study of 27 samples belonging to different species, it was observed that the seeds of *G. hirsutum* strains showed higher seed weight, protein content and oil content compared with seeds of *G. arboreum* strains.

The ranges of values obtained for seed weight in grams and of oil, gossypol and protein contents as percentages of seed weight, for various species are given below:

TABLE 2. SUMMARY OF TEST RESULTS ON ANALYSIS OF COTTON SEEDS

Species	Number of samples tested	Seed weight (wt. of 100 seeds in g)	Oil content (on 10% moisture basis) per cent	Gossypol per cent	Protein per cent
G. hirsutum	17	6.65-10.2	16.7-21.3	0.13-1.47	19.7-25.4
G. herbaceum	2	5.5 - 6.0	15.0-18.0	1.40-1.60	18.0-20.0
G. arboreum	8	4.4 - 6.0	8.7-17.5	0.78-1.86	16.2-23.0

It was observed that the percentage of gossypol was as low as 0.13 in the seeds of the glandless Badnawar strain, while it varied from 0.78 per cent (in Garo Hill cotton) to 1.86 per cent (in Adonicum) in the case of the other varieties.

Adaptation of micronaire instrument for the determination of fibre weight per unit length of very coarse *desi* cottons

Over 70 samples of coarse types of cottons were collected from various sources. The samples were cleaned by passing through Shirley Analyser. In order to determine their micronaire value, these cottons were blended in a 50:50 proportion with a finer cotton, *viz.* P. 216F, which had a low micronaire value of 3.25 after cleaning with Shirley Analyser. The procedure of blending was first standardised for ascertaining the number of passes required through the blender to get a uniform blend. For this purpose an experiment was conducted on 10 samples of cotton blended with the standard sample, and the micronaire value was determined on the blended material after each of the successive five passes through the blender. The statisti-

cal analysis showed that four successive passes through the blender gave a fairly uniform blend. Using this procedure a uniform blend was prepared for each of the samples and the micronaire value of the blended material determined. The micronaire values of the individual components were also determined separately, wherever possible, after Shirley cleaning. When the values of the theoretical harmonic mean, calculated from the micronaire values of the individual components, were plotted against the experimental micronaire values of the blends, the following regression equation was obtained.

$y=1.065, x=0.233$ (where y=micronaire value of the blend and x=theoretical harmonic mean).

Further work is under progress.

Comparison of fibre length as measured by different instruments

Twenty-five cottons belonging to four botanical species and ranging in mean fibre length from 17.5 mm to 34.3 mm (by Balls Sorter), were tested for various length parameters and uniformity using different instruments, *viz*. Balls Sorter, Baer Sorter, A.N. Stapling Apparatus, Uster Stapler and Fibrographs (Manual, Servo and Digital models).

The results are being analysed to find out the interrelationships between the various length parameters as determined by the above instruments.

Effect of pests and diseases on the quality of cotton

With a view 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 insecticide treatments, samples of affected crop, crop treated with various insecticides and healthy crop from a few agricultural stations were procured and tested for fibre properties.

During this period, 12 samples of Nandicum and Laxmi cottons of 1965-66 season received from Nandyal station were tested for ginning percentage, fibre length, fibre fineness, fibre maturity and bundle strength at zero and 3 mm gauge lengths. Further work is in progress.

The statistical analysis of the results will be done on completing the tests on three seasons' samples.

Study of the effects of different agronomic treatments on fibre properties

A large number of planned agronomic experiments are being carried out at various cotton breeding stations in India, with a view to increase the yield. It was, therefore, proposed to make use of this material for finding the effect of various agronomical treatments on fibre properties. Hence, the samples from Model Experiments conducted at Faridkot, Patiala and Srivilliputtur were obtained and tested. The important observations made in each experiment are indicated below.

Expt. 1. Effect of differential irrigation and nitrogen treatments: This experiment was carried out on 320F cotton at Faridkot in three seasons (1957-60) combining three frequencies of irrigation, three intensities of irrigation, three levels

of nitrogen and three replications. The system of lay out was split-plot with intensities of irrigations and frequencies of irrigation in main plot and the levels of nitrogen in the subplots. All the 81 samples obtained during each of the three seasons were tested for the following: seed weight, lint weight, ginning percentage, mean fibre length, fibre length irregularity percentage, micronaire fineness, maturity coefficient and bundle strength (zero gauge length). The following important observations have been made.

i. Seed weight, lint weight and ginning percentage were unaffected by the treatments. However, the season had pronounced effect on lint weight and seed weight, the values being much higher in the middle season. There was little variation in the ginning percentage.

ii. Mean fibre length was affected by the irrigation treatments in the middle season but no specific trend was observed in relation to the quantum of water supplied.

iii. Fibre length irregularity percentage decreased significantly at 66 kg/ha of nitrogen as compared to the control in the first and second seasons.

iv. The effect of season was considerable on micronaire fineness, the fibres being much coarser in the middle season as compared to the other two seasons. This factor partially accounts for the increase in the lint weight noted above for this season.

v. Fibre maturity responded significantly to the irrigation treatments in two seasons. However, no definite trend was noticed in relation to the quantum of water supplied.

vi. Significant effect on the bundle strength was caused by the irrigation treatments in the initial two seasons. Although some of the individual values showed significant variation, no definite trend was noticed.

vii. The yield increased significantly with the increase of irrigation water in the last season only. Nitrogen had no appreciable effect on the yield.

Expt. 2. Effect of frequency of irrigation and manurial treatments. LL. 54 cotton variety, grown at Faridkot during 1957-60 seasons, was studied in this experiment. There were 12 treatments comprising three frequencies of irrigation and four levels of nitrogen and four replications. The lay out in this experiment was split-plot, with the irrigation, treatments allotted to the main plots and the nitrogen treatments to the subplots. Forty-eight samples available for each of the three seasons were tested for ginning percentage, mean fibre length, fibre length irregularity percentage, maturity coefficient and bundle strength (zero gauge length).

The statistical analysis of the results of three seasons showed that most of the fibre properties were not affected by any one of the treatments.

It was observed that in both the above experiments the effect of irrigation and nitrogen on fibre properties was not consistent, although two varieties were grown at the same place during the same season. Besides, variety and season appeared to play an important part in regard to response to manure and irrigation.

Expt. 3. Effect of α-naphthalene acetic acid (α-NAA) on the physical properties. The investigation was made on samples of 320F cotton grown at Patiala during 1957-60 seasons in randomized blocks with the treatments of two doses of α-naphthalene acetic acid at two stages, combined with the control. The samples were tested for lint weight, seed weight, ginning percentage, mean fibre length, fibre length irregularity percentage, fibre bundle strength (zero gauge length), fibre fineness and fibre maturity. The results of all the physical properties were subjected to the statistical analysis of variance for each season separately. The data for three seasons could not be combined as the number of treatments in the first season was five, while it was increased to seven by the addition of two treatments of water spray in the later two seasons. It was concluded that the physical properties of 320F cotton on the whole were not significantly influenced by α-NAA treatments.

Expt. 4. Effect of α-naphthalene acetic acid and times of application. This experiment is being conducted on M.C.U.2 variety at Srivilliputtur (Madras State) under the Co-ordinated Agronomic Scheme on Cotton. The treatments are two concentrations of α-naphthalene acetic acid, three times of application at leaf and flowering stages, two doses of NPK fertilizers with two controls. The system of lay out is split-plot with concentration × time of application and controls assigned to main plots and fertilizers to sub-plots. There are four replications. The samples of two seasons (1963-65) have been tested for the fibre properties. The tests are in progress for the third season. No conclusions have been drawn as the data are yet to be analysed.

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

During the year under report, the cleaning effect of the extractor on trashy cottons was tried using various speeds and positions of rollers. From the trials, it was observed that apart from the position of various rollers, their working speeds and the development of air pressure and partial vacuum at certain portions the machine had an influence on the cleaning efficiency of the machine. Further, the ratio of the speed of big band saw drum to that of the reclaimer cylinder played an important part in the cleaning effect, especially on those cottons which contained hulls and immature locks in large quantities. The removal of fine trash, however, could not be clearly judged because the machine was open from all the sides and the partial vacuum which is required for extracting fine trash and dust from the *kapas* was not developed.

It is proposed to carry out further trials after making necessary parts to enclose the machine from various sides so that necessary vacuum can be developed for removal of fine trash.

Investigation on the microbial decomposition of cellulose

i. **Enzyme kinetics and purification of enzyme.** The enzyme kinetic

studies were completed on *Streptomyces ruber*, *S. scabies* and *Aspergillus terreus*. The activity of enzyme filtrate was determined against CMC (carboxymethyl cellulose) and dewaxed cotton.

Between the two *Streptomyces*, *S. ruber* was more active than *S. scabies*. But, *Aspergillus terreus* was far more active as compared to both the *Streptomyces*.

The *Streptomyces* had two pH optima at pH 5.8 and pH 7.3. The bimodal nature of pH curve was unique inasmuch as the activity was approximately same at both the peaks and the enzyme was active even at pH 8.0. The optimum temperature for the activity was 55°-60°c. In general, more information is needed on celluloytic enzyme characteristics of *Streptomyces*, particularly those which are active at high pH.

The optimum condition for the enzyme activity of *A. terreus* filtrate was pH 5.6 at 50°C.

Characteristics of cotton fibre treated with enzyme filtrate revealed appreciable fall in strength accompanied by increase in reducing sugar and microscopic damage count.

The above studies demonstrated that all the three cultures produce both carboxymethylcellulose and cellulose, and the break-down products of cellulose as revealed by chromatographic analysis were glucose, cellobiose, cellotriose and traces of higher oligosaccharides.

Partial purification of enzyme was carried out for *S. scabies* by ammonium sulphate precipitation. The 60 per cent fraction had about 20-fold increase in its specific activity.

ii. **Modification of medium.** Incorporation of NH_4Cl in place of $NaNO_3$ in the medium for growing *S. scabies* substantially increased the cellulolytic activity of the enzyme. However, on solid medium containing NH_4Cl, the culture did not sporulate well. On the other hand, $NaNO_3$ supported high sporulation.

iii. **Marine cellulolytic micro-organisms.** Preliminary experiment on isolation of cellulolytic microbes from the sea-water were completed. About 43 bacteria, 9 streptomyces and 20 fungi have been isolated. Work on taxonomy and indexing of cellulolytic activity of each isolate is in progress.

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

Effect of water stress and other treatments on fibre development and fibre properties is being investigated. During the year 1967, 40 samples of Digvijay and 40 samples of Gujarat 67 were tested for degree of thickening for the growth period 42 to 63 days. Full-grown samples of Digvijay were tested for length, fineness and maturity. Further work is in progress.

Structural peculiarities of Indian *hirsutum* and *herbaceum* cottons

After determining the maturity of a large number of Indian *hirsutum* and American Upland cottons, about 10 cottons representing each group, covering wide range in maturity (maturity coefficient 0.57 to 0.97) were selected for further study. Methods of dyeing and propanol retention technique have been standardised

to determine indirectly the interfibrillar void space in the cotton. Further work is in progresss.

Study of structural properties of chemically modified cottons by optical methods

To study the effect of swelling, cotton samples were treated with four amines, *viz.* morpholine, piperidine, ethylenediamine and piperazine, at 20°C/1 hr, 20°C/5 hr and 35°C/1 hr. The treated cotton samples were analysed for birefringence, density, moisture regain, accessibility to formylation and acid hydrolysis, infra-red crystallinity index, strength and extent of swelling. Electron micrographs and X-ray diffractograms were also taken for samples treated at the most effective concentration of the swelling agents.

The two monoamines, morpholine and piperidine, induced only intercrystalline swelling, whereas the two diamines, ethylenediamine and piperazine were effective as intracrystalline swelling agents.

Among the four amines studied, morpholine and ethylenediamine were most effective as swelling agents. Piperazine was less effective as compared to ethylenediamine and piperidine was the least effective.

The interesting swelling behaviour of morpholine could be attributed to the solubility parameter comparable to cellobiose unit and reaction of its terminal NH and O groups. Morpholine has structure similar to piperidine and piperazine except that it has O in place of CH_2 or NH, showing thereby the importance of O in morpholine molecule. The swelling brought about by the two diamines is due to the formation of monohydrates, particularly at the critical concentrations, when the free NH group can combine with OH groups of cellulose.

Reduction of neps in neppy Indian cottons

Many of the *G. hirsutum* cottons are neppy and, therefore, for the last few years investigation is being carried out in co-operation with certain cotton breeders to see whether the neppiness could be reduced by selection.

Single plant produce obtained from the breeding stations was tested for nep content and the seeds from the samples with the lowest nep content were sown in the succeeding years. The tests for nep content had been completed last year.

During the year under review, maturity determinations were carried out on about 85 samples. With this, the experimental work has been completed. The results will be analysed.

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

Presence of certain specific groups, particularly aromatic ones, is known to offer substantial radio protection to the polymeric molecules. In order, therefore, to assess the protection offered to the cellulosic molecule, the benzylated and benzoylated samples of increasing degree of substitution were prepared. In addition, acrylonitrile (AN) grafted samples and allylated samples were also prepared. All

the chemically modified samples, including partially acetylated samples prepared last year were subjected to the same dosages of gamma-ray irradiation. The benzylated and benzoylated samples having different degrees of substitution were irradiated at a constant dosage of 1×10^7r. Physico-chemical properties were determined for all the samples.

It was noticed that the fall in tenacity with increasing irradiation dosage was, more or less, identical for raw and partially acetylated samples. The AN grafted samples showed some resistance against degradation as they could be tested for strength even after receiving a dosage of 5×10^7r at which raw and partially acetylated samples had become brittle and powdery. The benzylated and benzoylated samples, however, proved much more radio-resistant, the percentage loss in tenacity being comparatively much less. The allylated samples (DS=1.14) also showed an appreciable radio protection against fall in tenacity due to the presence of double bonds in allyl groups. It was, in fact, confirmed by iodine number determination that the degree of unsaturation progressively fell with increase in irradiation dosage, suggesting thereby that a portion of the incident energy was absorbed in saturating the double bond by some process of polymerisation.

The number of links broken with increasing dosages, calculated from data relating to the degree of polymerisation (D.P.) showed that the maximum damage took place in raw cotton followed in decreasing order by partially acetylated and benzoylated samples, the corresponding *G* values for bond breakage being 6.22, 3.18 and 2.36. The D.P. tests for benzylated and allylated samples could not be done as suitable solvents were not available.

Partially acetylated samples showed a similar pattern of reducing group formation and alkali solubility with increasing irradiation dosage as the untreated irradiated samples. Benzylation and benzoylation treatments showed a marked resistance to formation of reducing groups. With increasing dosage of irradiation, the allylated samples did not show a very significant change up to a dosage of 1×10^7r, but higher dosages caused a steep rise in both, the alkali solubility and the reducing groups.

Retention of tenacity was found to increase and that of reducing group formation to decrease substantially on irradiation with increase in the D.S. of the benzylated and benzoylated samples. In the case of benzoylated samples radio protection coefficients were calculated from *G* values for the intramolecular bond rupture. A radio protection of about 50 per cent was found possible with as low a D.S. as 0.5 of the benzoyl groups.

The analysis of the decomposition products of untreated irradiated (1×10^8r) cotton by paper chromatographic technique showed the presence of glucose, cellobiose, xylose and arabinose. In addition, the presence of 2-keto-gluconic acid and glucuronic acid was also indicated. Degradation mechanism responsible for the formation of these degradation products was suggested.

Studies on the changes in density of cotton and other textile fibres with temperature and relative humidity

After an exhaustive literature survey on this problem, the design and fabrica-

tion of a density gradient tube was completed. The main design feature of this tube is that it can be ready for use immediately after filling and there is no need to keep it undisturbed for long periods to enable the diffusion of the two liquids to take place and to attain steady equilibrium condition.

Over 200 glass floats, covering a density range of all the usually available textile fibres were fabricated to serve as reference points in the column. Comparison of the various calibration methods showed that the Archimedes method gave fairly accurate and reproducible results. All the floats were, therefore, calibrated by using this method and the necessary corrections for temperature and the buoyancy of air were applied.

Some preliminary studies were undertaken to compare the density of some cellulosic fibres by: (i) centrifuge method, (ii) floatation method, and (iii) modified floatation method. The values obtained at room temperature and under dry condition, were found to be somewhat low in each case. The technique for drying the samples and removing the air from the pores is being standardised at present and further work will be taken up afterwards.

Studies on lustre behaviour of cotton fibres and yarns

In order to study the effect of treatment of cotton fibres with alkali under different conditions of temperatures and concentrations on the changes in lustre, 11 cottons (5 Indian, 2 American Upland, 2 West Indies and 2 Egyptian) were selected. All these samples were treated under slack conditions with caustic soda and potassium hydroxide at 30°C for 15 minutes, the concentrations of the liquors used being 5%, 18% and 25% in the case of NaOH, and 5% and 15% in the case of KOH. After determining the lustre of these treated samples, the plan of further work will be finalised.

Cotton roving strength in relation to fibre properties

In order to make the textile fibres spinnable it is necessary that they should hold together and be capable of transmitting tension along the whole length of the yarn. The adherence and transmission of tension are simultaneously achieved by usually twisting the fibres around the central axis. From the point of view of productivity, however, it is desirable to obtain the maximum yarn strength with mimimum of twist. The rate of development of cohesion and strength with twist, which in turn depends upon the fibre properties, therefore, constitutes a very important investigation. In these investigations, the cohesive properties of rovings were determined in terms of "minimum twist of cohesion", as suggested by Barella and co-workers.[3] The "minimum twist of cohesion" or "residual twist" simply means the turns per unit length remaining in the material at the point of break brought about by fibre slippage, when subjected simultaneously to the actions of axial pulling and untwisting.

The data collected on this problem were analysed during the period under review. Simple correlation coefficients between the minimum twist of cohesion (x_1) on the one hand and mean fibre length (x_2), fibre fineness (x_3) and fibre length irregularity (x_4) on the other were as follows:

$r_{13}=+0.95^{**}$, $r_{12}=-0.94^{**}$, $r_{14}=-0.41^{*}$.

An equation was developed connecting all the important fibre parameters to predict the value of minimum twist of cohesion from the fibre properties. The equation was:

$$\text{Log } T = 4.3914 + 0.0106 \log M - 0.6571 \log L - 0.0158 \log I - 0.4334 \log N$$

where T=Minimum twist of cohesion.
L=Length of fibres in mm.
M=Fineness in micronaire units.
I=Irregularity per cent of fibre length.
N=Number of fibres in the cross-section of rovings.

The four parameters taken together accounted for more than 80 per cent variation in the values of minimum twist of cohesion.

During the period under report, experiments were also undertaken to determine the dependence of cohesive property of slivers, rovings, etc., on the fibre configuration in the strand. For this purpose, a device was fabricated at the Laboratory to measure the cutting and combing ratios of the slivers based on the principle of modified Lindslay's method. Orientation index and the cutting ratio values were determined both in the forward and the reverse directions on six samples on which minimum twist of cohesion values were determined earlier. These samples comprised material collected from the slubber, inter and roving stages of processing. In agreement with other workers, the results showed that the direction of drawing had a great effect on the orientation of the fibre in the slivers.

In the case of the samples tested, however, the sequence of processing was not properly known and also the samples had been kept stored for a very long time, hence the results could not be properly correlated with the MTC values.

Preparation of colour charts for different grades of Indian cottons

About 1,400 samples pertaining to 1964-65 season and comprising of 15 varieties of Indian cotton classified into different grades were selected for tests on the basis of the data collected from the East India Cotton Association. These samples were tested for reflectance and yellowness on the Nickerson-Hunter Colorimeter. From the results on the samples tested so far, it was observed that the reflectance value ranged from 75 per cent to 55 per cent while the yellowness values were between 7 and 13.

Further work is in progress.

Effect of swelling agents on the structural and mechanical properties of cotton fibres

Investigations during the period under report were undertaken with a view to study whether immature fibres (having less cellulose) show similar changes in circularity as mature fibres. For this, two samples of cotton NC. 14, differing widely in maturity (55% and 25%), were taken and were treated with different concentrations of NaOH and KOH solutions. One hundred cross-sections of each treated sample and 200 cross-sections of each control sample were traced out and their circularity determined by measuring the area and the perimeter of the cross-sections.

It was observed that both the samples (mature as well as immature) showed almost similar changes when treated with alkalies. In the case of NaOH treatment the maximum changes were noticed at 30 per cent (w/w), while in the case of KOH treatment the maximum changes were at 40 per cent (w/w). It may be pointed out that these changes were at the same molar concentration, namely 10 molar concentration of the alkalies. Further, the changes in circularity were more pronounced when the treatment was carried out with NaOH than with KOH. It was also observed that the mature fibres attained more circularity than the immature fibres. However, the percentage increase in circularity for both the cottons was of the same order. Further work is in progress.

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

The main object of fabricating this miniature spinning plant is to secure quicker micro-spinning test results. Incidentally this will also be useful if any other small-scale spinning is to be done with O.M. system of super high-drafting.

During this year, as per previous programme, parts of the "building motion" were fitted. The fixing of the building motion neared completion. A list of the parts fitted is given below.

Cop motion lever, Cop motion steadying bracket, Cop motion shaping bracket with stud, Cop motion steel bowl, Cop motion wheel, Cop motion stud for rachat wheel, Ratchet wheel, Cop motion double wheel, Cop motion cover with stud, Cop motion chain wheel, Cop motion ratchet pawl, Ratchet pawl bracket, Cop motion handle.

Cop motion regulating finger, Cop motion lifting chain, Gearing end chain pulley bracket, Stud wheel, Chain pulley handle, Chain pulley quadrant with bush, Chain pulley with bush, Lifting lever rail brackets, Lifting lever rod, Lifting levers gearing end quadrant, Quadrant upright, Lifting lever two-bar bracket, Lifting lever quadrant to clip lifting lever.

After finishing the complete building motion mechanism, the fixing of the creel of the plant will be taken up. The creel will be of the drawing sliver feeding type.

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

Seven more Indian cottons, *viz.* Deviraj, Devitej, Suyodhar, Laxmi (Adoni), M.C.U. 1, M.C.U. 3 and L.S.S., were selected and spun into about 10 counts in each case, with a twist multiplier of 4.25. Their yarns were tested for lea strength. The values of C.S.P. (corrected) obtained for the yarns of the seven cottons spun earlier are indicated in Table 3.

Further work is in progress. After testing a few more samples, the results will be analysed for fitting up suitable equations connecting count and count strength product.

Study of spinning of mixings of different cottons

In order to study the spinning performance and yarn characteristics of cotton

TABLE 3. VALUES OF CORRECTED C.S.P. FOR VARIOUS COUNTS

Cotton	Store No.	Sample No	20s	22s	24s	26s	28s	30s	32s	34s	36s	38s	40s	42s	44s	46s	50s
Digvijay	60120	26402/3	2230	2227	2275	2272	2189	2132	1893	1834	1840	1760	1871	1823	1817	—	—
Laxmi	60628	26404/5	2010	2031	2080	1941	1989	1856	1869	1747	1735	1672	1674	1712	1696	—	—
Deviraj	59850	26410/11	2265	2212	2163	2100	2011	1968	—	1919	1864	1855	1840	1823	1803	—	1610
Devitej	69890	26412/13	2258	1990	2020	1986	1924	1944	—	1785	1742	1723	1680	1640	1737	1674	1619
Suyodhar	73025	26416/17	2058	2094	2142	2051	2092	1936	—	1861	1800	1737	1663	1685	1617	—	1496
Laxmi (Adoni)	71237	26419/20	2187	2134	2114	1997	1999	1942	—	1880	1850	1787	1788	1823	1809	—	1734
M.C.U. 1	73022	26423/24	2190	2067	2044	2077	1940	1885	—	1842	1821	1763	1707	1643	1659	1622	—
M.C.U. 3	73023	26426/27	2102	2073	2053	1978	1992	1956	—	1790	1764	1750	1788	1767	1731	—	1628
L.S.S.	70998	26430/31	2060	2010	1991	1897	1850	1854	—	1756	1688	1686	1678	1599	1584	1547	—
M.C.U. 2	73789	26434/35	2280	2089	2027	1994	1970	1965	—	1925	1831	1812	1790	1711	1725	—	1693
Buri 147	68899	26439/40	2186	2101	2125	2038	2034	2004	—	1721	1701	1629	1634	1671	1605	—	1539

mixings in relation to the performances of the individual cottons, a number of Indian cottons were selected. The cottons were classified into three groups according to 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 of each component). The chief fibre properties and the spinning capacity of some of the typical individual cottons selected for this investigation are shown in Table 4.

A number of cotton mixings have been processed and the yarns spun are under test. The test results will be examined.

TABLE 4(a). MIXINGS SUITABLE FOR SPINNING TO ABOUT 20s COUNT

Cotton	Store No.	Mean fibre length (mm)	Micronaire value	Maturity coefficeint	H.S.C.
Wagad	71227	20.2	5.2	0.79	17s
Westerns (Bellary)	71890	19.4	5.4	0.74	24s
Gaorani 22	69612	19.4	5.5	0.74	18s
Raniben	68966	20.0	5.6	0.78	16s
Jarila	74173	20.8	5.0	0.77	21s
Wagad	71227	20.2	5.2	0.79	17s
Mungari	69712	20.3	3.7	0.74	24s
Wagad	71227	20.2	5.2	0.79	17s
Gaorani 22	69612	19.4	5.5	0.74	18s
Raniben	68966	20.0	5.6	0.78	16s
Wagad	71227	20.2	5.2	0.79	17s
Maljari	70468	21.6	5.5	0.78	24s
Raniben	68966	20.0	5.6	0.78	16s
Gaorani 22	69612	19.4	5.5	0.74	18s
Mungari	69712	20.3	3.7	0.74	24s

TABLE 4(b). MIXINGS SUITABLE FOR SPINNING TO ABOUT 30s COUNT

Cotton	Store No.	Mean fibre length (mm)	Micronaire value	Maturity coefficient	H.S.C.
N. 14	72973	21.0	5.0	0.78	33s
AK .277	70700	21.4	5.2	0.77	25s
Gaorani 22	74307	21.7	5.1	0.76	30s
Mathio	69634	21.0	5.2	0.75	24s
Gaorani 22	74307	21.7	5.1	0.76	30s
Westerns (Adoni)	71236	21.0	5.4	0.78	27s
P.A. 320F	70997	21.6	5.2	0.76	30s
N. 14	72973	21.0	5.0	0.78	33s
Maljari	70468	21.6	5.5	0.78	24s
Jayadhar	73016	20.4	5.4	0.76	28s
Kalyan	71226	20.8	4.4	0.77	29s
A.K. 277	70700	21.4	5.2	0.77	25s
Mathio	69634	21.0	5.2	0.75	24s
H. 14	69643	22.4	4.1	0.74	29s
P.A. 320F	F70997	21.6	5.2	0.76	30s

TABLE 4 (c). MIXINGS SUITABLE FOR SPINNING TO ABOUT 43s COUNT

Cotton	Store No	Mean fibre length (mm)	Micronaire value	Maturity coefficient	H S.C.
Devitej	69890	23.9	3.4	0.69	38s
L. 147	68898	23.2	4.1	0.75	40s
H. 14	65433	24.6	4.1	0.77	34s
Digvijay	69711	22.8	3.9	0.75	43s
L. 147 (Pathorat)	64959	23.4	4.1	0.77	36s
Deviraj	70462	23.4	4.4	0.74	39s
M.C.U. 3	73023	23.8	4.5	0.77	40s
L. 147 (Pathorat)	64959	23.4	4.0	0.77	36s
H. 14	65433	24.6	4.1	0.77	34s
Devitej	69890	23.9	3.4	0.69	38s
Narmada	69610	21.8	3.6	0.71	40s
Digvijay	69711	22.8	3.9	0.75	43s
Narmada	69610	21.8	3.6	0.71	40s
Laxmi	71267	22.6	3.3	0.69	42s
Digvijay	70001	21.7	3.4	0.70	48s
Badnawar	74540	27.0	4.0	0.74	50s
Digvijay	70001	21.7	3.4	0.70	48s
Deviraj	49642	25.9	4.2	0.75	46s
Digvijay	70001	21.7	3.4	0.70	48s
Laxmi (Adoni)	71237	22.6	3.7	0.72	44s
Badnawar 1	74540	27.0	4.0	0.74	50s

Estimation of spinning value of cotton from its chief fibre properties in the cotton tracts of Punjab, Uttar Pradesh, Rajasthan, Vidarbha and Middle Gujarat

The necessary data were collected for the tracts of Vidarbha, Punjab, Uttar Pradesh and Rajasthan for three seasons (1963-64, 1964-65 and 1965-66). The properties considered were: *l*, the mean fibre length in mm; *f*, the fineness in millitex, *m*, the maturity coefficient; *s*, the fibre bundle strength in g/tex; and *c*, the Highest Standard Count that can be spun from the cotton.

Suitable regression equations for predicting the spinning value from the fibre properties were obtained for the Vidarbha tract only. For other tracts more data will be collected and studied. The results of the study are indicated below.

Vidarbha. The number of samples for which data were available was 150. The data were statistically analysed and the results are as follows.

Correlation coefficients

$r_{lc} = +0.7692^{**}$

$r_{fc} = -0.7662^{**}$

$r_{mc} = -0.6321^{**}$

$r_{sc} = +0.0519$

Regression coefficients

$b_l = +3.3798$

$b_f = +0.1583$

$b_m = -219.3473$

$b_s = +0.6288$

Regression equation

C = 3.3790 l + 0.1583 f — 219.3473, m + 0.6288 s + 64.99

R^2 = 0.9617, R = 0.9806**, error of estimate = 1.05 counts.

This equation is suitable for the prediction of the spinning value for cottons grown in the tract.

Punjab. The number of samples for which data were available was 110. The data were statistically analysed and the results are as follows.

Correlation coefficients		*Regression coefficients*	
r_{lc}	= +0.0455	b_l	= —0.9209
r_{fc}	= —0.2346*	b_f	= —0.0305
r_{mc}	= —0.2217*	b_m	= —13.9730
r_{sc}	= +0.4884**	b_s	= +1.6489

Regression equation

C = —0.9209 l — 0.0305 f — 13.9730 m + 1.6489 s — 0.8660.

R^2 = 0.3479, R — 0.5899**, error of estimate = 4.84 counts.

The above equation is not considered satisfactory. Data for a few more seasons will be collected and analysed.

Uttar Pradesh. The number of samples for which data were available was only 29. The data were statistically analysed and the results are griven below.

Correlation coefficients		*Regression coefficients*	
r_{lc}	= +0.7012**	b_l	= +0.1349
r_{fc}	= —0.5661**	b_f	= —0.1338
r_{mc}	= —0.2094	b_m	= +4.1412
r_{sc}	= —1.0129	b_s	= +0.5992

Regression equation

C = 3.1349 l — 0.1338 f + 4.1412 m + 0.5992 s — 46.9286.

R^2 = 0.7183, R = 0.8475**, error of estimate = 4.42 counts.

This equation is not quite satisfactory. Data for more samples will be collected and studied.

Rajasthan. The number of samples for which data were available was only 40. The data were statistically analysed and the results are as follows.

Correlation coefficients		*Regression coefficients*	
r_{lc}	= +0.6601**	b_l	= +2.6661
r_{fc}	= —0.2497	b_f	= —0.0290
r_{mc}	= +0.0342	b_m	= —0.0901
r_{sc}	= +0.3138*	b_s	= +0.7657

Regression equation

C = 2.6661 l — 0.0290 f — 0.0901 m + 0.7657 s — 56.5659.

R^2 = 0.5600, R = 0.7470**, error of estimate = 4.35 counts.

This equation also is not quite satisfactory. Data for some more samples will be collected and studied.

Effect of fibre length distribution and fibre strength on yarn strength

It was observed from an earlier investigation at this Laboratory that single fibre strength and bundle strength at different gauge lengths were not significantly correlated with yarn strength. The partial correlation coefficients after eliminating the effict of fibre length and fibre fineness also showed the same trend. In order to investigate the cause of such low correlation among these properties, it was proposed to study the influence of "effective weight" of various length groups on the yarn strength. For this purpose, 27 varieties were tested for mean fibre length by the Balls Sorter and for bundle strength at zero and 3 mm gauge lengths by the Stelometer. The above mentioned numerical value "effective weight" was computed at 1/8, 1/4, 3/8 and 1/2 in. critical lengths from the Balls Sorter distribution for each of 27 cottons, in order to investigate the effect of this value in conjunction with bundle strength on the yarn strength.

Further statistical analysis of the data will be carried out.

Comparison of the results of single strand tests made on Uster Automatic Tester and Scott Inclined Plane Tester

In order to compare the results obtained by the Uster Automatic Tester and the Scott Inclined Plane Tester, the yarn samples of various counts are being tested

TABLE 5. SINGLE YARN STRENGTH AND PERCENTAGE BREAKING ELONGATION VALUES DETERMINED BY USTER AUTOMATIC TESTER AND SCOTT INCLINED PLANE TESTER

Sl. No.	Cotton	Count	Uster Automatic Tester		Scott Inclined Plane Tester	
			Breaking strength (g)	Extension %	Breaking strength (g)	Extension %
1.	(Vijay × 4282) Vijay	20s	408.0	7.1	381.1	5.1
2.	A.K. 277	,,	344.4	7.6	335.0	5.6
3.	Jarila	,,	291.0	6.3	296.8	4.4
4.	E. 22 × 1802	,,	363.0	7.0	357.6	5.4
5.	(V × C.J. 73) 21-1	,,	325.2	7.5	314.8	5.2
6.	515	30s	177.2	6.0	160.6	4.1
7.	(Vijay × 4282) Vijay	,,	261.6	6.9	233.1	5.0
8.	Gaorani	,,	185.6	6.4	193.3	4.7
9.	Digbijay	,,	222.8	6.2	214.4	4.6
10.	A.K. 277	,,	208.8	7.1	203.6	5.2
11.	115 × 2334	40s	157.2	5.4	147.7	4.3
12.	(Vijay x 4282) Vijay	,,	164.8	6.8	162.4	4.3
13.	Laxmi	,,	183.2	7.2	193.6	6.0
14.	Mysore 14	,,	159.6	5.7	146.7	5.0
15.	92 × 4282	,,	149.6	6.6	151.5	4.2

for single yarn strength and elongation at break by these instruments. During this period, the tests for single yarn strength and percentage breaking elongation were carried out on five samples each of 20s, 30s and 40s counts on both the Uster Automatic Tester and Scott Inclined Plane Tester.

It can be seen from the Table 5 that both the instruments gave practically the same values for single yarn strength, while the Uster Automatic Tester gave slightly higher values of percentage breaking elongation than the Scott Inclined Plane Tester.

Revised strength standards adopted for yarn tests at the Laboratory

It had been mentioned in the last Annual Report that a seminar was held in September 1966 to discuss the appropriate strength standards for various counts of yarn spun at the Laboratory. During the discussion, various suggestions were offered for the upward revision of the yarn strength standards in use at the Laboratory, with suitable changes in the twist multiplier used for spinning different counts of yarn. It was also decided that the question of revising the strength standards might be taken after carefully examining the various suggestions put forward at the seminar and looking into the consequential repercussions that would be caused, especially in cotton breeding work, by adopting the changes in the strength standards and processing factors at the Laboratory.

Accordingly, a small sub-committee consisting of Dr. V. Sundaram (Director), Dr. R.L.N. Iyengar, Shri Harirao Navkal, Dr. Jai Prakash, Shri R.P. Neogi and Shri G.S. Rajaraman was constituted to consider the entire matter in detail. This sub-committee observed that the procedure and standards adopted by the mills varied widely depending on the machinery in use at each mill and the end-uses of the yarns spun. As against this, the Laboratory has to test a number of improved cotton strains under identical conditions so that the test results could be compared amongst themselves and over a period of years. Further, it was noted that there had been a considerable decrease in the number of samples spinning below 20s received at the Laboratory during recent years while there had been an appreciable increase in the number of samples spinning to 60s and finer counts. Taking all these factors into account, the sub-committee recommended that the procedure for spinning tests should be modified as under :

	Old procedure	*Revised procedure*
1.	The standard values of C.S.P. adopted at the Laboratory are indicated in col. 2 of the Table 6 on next page.	The standard values of C.S.P. for different counts of yarn should be revised upwards as indicated in col. 3 of the Table 6 on next page.
2.	The twist multipliers used for spinning yarns of different counts are : Below 10s — 4.25 or 4.5 above 10s up to 50s — 4.0 60s and above — 3.75 (with double rovings).	The following twist multipliers should be used for spinning the counts of yarns indicated : Below 16s — 4.5 16s to 28s — 4.25 30s to 50s — 4.0 60s and above — 3.75 (with double rovings).
3.	For cottons having H.S.C. below 12s, no H.S.C. is indicated but yarns of three counts are spun and their C.S.P. values reported to give a comparative idea.	For cottons having H.S.C. below 16s, it is not necessary to indicate the H.S.C., but the samples may be spun into two counts only and their C.S.P. values reported for giving a comparative idea.

The main advantage in the revised strength standards is that the corresponding standard C.S.P. values increase uniformly with the counts (c) in the entire range from 16s to 120s and is given by the relation C.S.P=7 (C+200). The twist multiplier used for spinning coarse cottons has been raised to bring it closer to the mill practice. The combined effect of the above mentioned changes in the spinning procedure and strength standards at this Laboratory would bring the Laboratory test results closer to the mill performance.

To observe the difference in the H.S.C. values obtained by the two procedures, about 15 cotton samples were spun adopting both the procedures. It was noted that generally, the H.S.C. values estimated by adopting the revised twist multiplier and strength standards were about 3 to 4 counts lower than the corresponding H.S.C. values determined by the old procedure and standards. The revised standard strength values being higher than those adopted earlier are expected to ensure that the new improved strains selected on the basis of the Laboratory tests will be more acceptable to the textile industry than before.

The above revised procedure and standards have been adopted with effect from the 1967-68 cotton season.

TABLE 6. STRENGTH STANDARDS FOR YARN TESTS AT COTTON TECHNOLOGICAL RESEARCH LABORATORY
(Old and Revised)

Count	C.S.P.		Count	C.S.P.	
	Old	Revised		Old	Revised
16s	1296	1512	38s	1539	1666
18s	1318	1526	40s	1560	1680
20s	1340	1540	44s	1610	1708
22s	1366	1554	50s	1650	1750
24s	1392	1569	60s	1680	1820
26s	1408	1582	70s	1750	1890
28s	1424	1596	80s	1840	1960
30s	1440	1610	90s	1920	2030
32s	1468	1624	100s	2000	2100
34s	1496	1638	120s	—	2240
36s	1518	1652			

TESTING WORK

Evaluation of the quality of cotton samples received from the State Agricultural Departments, etc.

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 and 1967 together with the corresponding average figures for the quinquennium 1960-1965 are given in Table 7.

TABLE 7. NUMBER OF COTTON SAMPLES RECEIVED FROM THE STATE DEPARTMENTS OF AGRICULTURE

	Average or the quinquennium ending May 1965	1966	1967
Fibre and full spinning tests	857	645	649
Micro-spinning tests (with or without fibre tests)	2,064	1,695	1,874
Fibre tests alone	213	191	277
Mill tests	—	17	11
Standard cottons	22	23	17
Trade varieties (Lint)	90	26	42
Trade varieties (Kapas)	—	48	24
Technological Research	634	820†	213
Miscellaneous	40	36*	78*
Total	3,920	3,501	3,185

†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 test results on the Standard Indian Cotton Samples are published in the form of a Technological Report at the end of each season. The results of tests on each of the trade variety samples are reported in the form of a Technological Circular. Later, these circulars are consolidated and published as a Technological Report. 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 as the results are included in the relevant research papers published from 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 they are first ginned in the Ginning Section before they are tested for various properties. During 1967, about 172 such samples had been received and were ginned. In addition, 39 samples of *kapas* of trade varieties were ginned and the ginning percentages determined.

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 1967 is given in Table 8.

TABLE 8. NUMBER OF SAMPLES TESTED AND REPORTED FOR THE STATE DEPARTMENTS OF AGRICULTURE

State	Fibre and full spinning	Microspinning with or without fibre tests	Fibre tests alone	Others	Number of reports
Maharashtra	192	503	50	—	84
Gujarat	175	364	14	3	83
Madhya Pradesh	31	100	—	1	9
Rajasthan	11	18	—	—	6
Punjab & Haryana	20	39	37	—	14
Uttar Pradesh	3	83	6	—	11
Mysore	79	261	77	—	57
Andhra Pradesh	35	71	102	—	22
Madras	37	83	—	—	20
Others	8	57	61	—	11
Total	591	1,579	347	4	317

TEST RESULTS

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 at the Government Farms. Extensive fibre and spinning tests are regularly carried out on such samples. The results obtained on 14 samples received from the 1965-66 season were published as a Technological Report No. 2 entitled "Technological Report on Standard Indian Cottons—1966". The comparative performance of the various cottons in each State during 1965-66 and 1964-65 seasons is given below.

State	Definitely better	Approximately same	Definitely poorer
Maharashtra	Jarila, B. 147	Virnar, G. 6, G. 12, G. 22, B. 0394	—
Gujarat	—	Vijalpa, 1027 A.L.F.	Digvijay, Vijay L.S.S.
Punjab	320F	—	Westerns (H.1)
Mysore	Jayadhar, Laxmi	—	—
Andhra Pradesh	—	N. 14	—
Madras	M.C.U. 1, M.C.U. 3	M.C.U. 2, K. 6	

A few samples of the Standard Indian Cottons of the 1966-67 season have also been received. Some of these have been tested and tests are in progress on others.

Trade varieties

Lint samples of fair average quality of the major trade varieties of Indian and foreign cottons are being obtained through the East India Cotton Association Ltd., in each season. Representative *kapas* samples of the Indian 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 are published as a Technological Circular as early in the season as possible, for the information of the cotton trade and industry. The trade varieties on which such circulars were issued during 1967 are shown in Appendix II. The test results on all the trade varieties of the 1965-66 season were compiled and published as a Technological Report No. 1 entitled "Technological Report on Trade Varieties of Indian Cottons—1966".

Some more samples of the 1966-67 season have been received recently and tests on them are in progress.

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 16 samples. The comparative test results at the mill and the Laboratory are given in Table 9.

It will be seen that Buri 1007 has given practically the same spinning performance as B. 147 at the mill. Buri 1007 being a very promising variety, it may be worthwhile testing it for one or two seasons more. 69-2 is a new improved variety evolved in Gujarat and its mill test results are encouraging. Of the two varieties, A.C. 122 and 216F, grown in the rice fallows of Andhra Pradesh, A.C.122 gave better spinning performance than 216F at the mill. The two extra-long staple improved varieties from Madras State, *viz.* E.L. 123 and 815-3-1, showed very good spinning performance at the mill as compared to their respective control varieties, while the *desi* variety K. 7. was practically similar to the control variety K. 6. Pramukh, an improved variety grown in Uttar Pradesh, has given consistently better spinning performance than 320F at the mill during the last two seasons.

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 1967 are given in

TABLE 9. COMPARATIVE MILL AND LABORATORY TEST RESULTS ON 16 COTTONS

Place	Variety	Mill test results					Laboratory test results				
		Waste %	Yarn recovery %	Count	Strength (lb)	t.m.	Waste %	Count	Strength (lb)	t.m.
Maharashtra										
Achalpur	Buri 1007	21.5*	78.5	40s	48.3	4.0	16.2	40s	45.5	4.0
,,	Buri 147 (Control)	22.3*	77.7	40s	49.3	4.0	12.5	40s	43.0	4.0
Gujarat										
Viramgam	69-2	24.6*	76.4	40s	41.2	4.0	17.9	40s	38.0	4.0
Haryana										
Hissar	216F	14.4	83.2	30s	62.7	4.3	14.0	30s	59.4	4.0
Uttar Pradesh										
Raya	Pramukh	—	—	30s	54.1	4.0	11.9	30s	55.0	4.0
	320F (Control)	—	—	30s	46.4	4.0	11.6	30s	56.3	4.0
Bulandshahr	Shyamali	—	—	14s	63.6	4.0	12.1	14s	87.3	4.0
Andhra Pradesh										
Tenali	A.C. 122	8.3	84.0	44s	44.3	3.96	10.6	44s	40.5	4.0
	P. 216F (Control)	8.9	79.0	44s	35.6	3.96	10.9	44s	37.6	4.0
Madras										
Srivilliputtur	E.L. 123	12.6	80.4	50s	46.3	3.94	12.0	50s	41.0	4.0
	M.C.U. 2 (Control)	13.3	77.1	50s	29.6	3.94	12.2	50s	34.2	4.0
Kovilpatti	K. 7	9.3	83.8	30s	46.1	3.94	11.6	30s	57.1	4.0
	K. 6 (Control)	11.7	80.6	30s	43.9	3.94	11.0	30s	55.3	4.0
Srivilliputtur	E.L. 123	26.9*	—	60s	40.9	3.91	13.1	60s	31.9	5.75†
Coimbatore	815-3-1	27.0*	—	60s	38.3	4.3	11.2	60s	30.8	3.75†
	M.C.U. 3 (Control)	18.6*	—	40s	50.8	4.0	10.5	40s	40.6	4.0

*Combed

†With double roving

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

Table 10. This would be of help to the cotton breeders to draw on the material for use in their programme.

Extension of improved varieties

Usually, improved varieties are cultivated at the Government Farms or under departmental supervision for collection of pure seeds. The seeds are then 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.

Other improved varieties

Test results on samples received from the State Departments of Agriculture are sent to the officers concerned. Although the results are mainly intended for the particular cotton breeder or research worker who had sent the samples, 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 (Table 10).

TABLE 10. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1967

Variety	Place of growth	Mean fibre length		Fibre weight		Maturity coefficient	Pressley strength index (lb/mg)	Highest standard count
		mm	in.	Millitex	Micronaire value			
1	2	3	4	5	6	7	8	9
Maharashtra								
200 Bulk	Parbhani	28.9	1.14	118	3.0	0.62	8.4	60s
I.S.C. 67	,,	28.2	1.11	122	3.1	0.61	8.3	60s
		1966-67 Season						
1371	Achalpur	27.4	1.08	150	3.8	0.75	8.3	46s
Buri 1007	Somnathpur	27.5	1.08	161	4.1	0.74	8.3	44s
Buri 1007	Nagpur	27.0	1.06	161	4.1	0.78	8.9	55s
		1965-66 Season						
Gujarat								
I.S.C. 67	Surat	30.3	1.19	126	3.2	0.67	6.9	38s
I.S.C. 67-(735)	,,	29.3	1.15	146	3.7	0.71	7.1	40s
Co-ano-8-3-2-(999)	,,	28.9	1.14	130	3.3	0.68	7.7	above 60s
Co-ano-8-3-2(1003)	,,	28.6	1.13	142	3.6	0.70	7.7	70s
Co-ano-8-3-2(1521)	,,	29.6	1.17	142	3.6	0.69	7.5	46s

1	2	3	4	5	6	7	8	9
N.C. 14 (1303)-1	Surat	28.8	1.13	114	2.9	0.61	8.1	above 80s
N.C. 38 (1385)	,,	28.7	1.13	150	3.8	0.72	7.6	55s
N.C. 40 (1400)	,,	28.8	1.13	146	3.7	0.72	7.6	50s
H.B. 53-4 (1197)	,,	28.8	1.13	134	3.4	0.67	7.3	60s
Deviraj	,,	28.6	1.13	154	3.9	0.74	7.4	38s
Co-ano--8-3-2	,,	29.9	1.18	146	3.7	0.72	8.4	50s
Gujarat 67	,,	30.8	1.21	134	3.4	0.71	8.3	49s
I.S.C. 77-1	,,	30.1	1.19	154	3.9	0.78	7.4	43s
N.C. 14	,,	29.6	1.17	118	3.0	0.66	7.9	47s
N.C. 38	,,	30.5	1.20	134	3.4	0.72	7.4	44s
Gujarat 67 × Y.S-2	,,	28.8	1.13	126	3.2	0.67	8.9	above 70s
Gujarat 67 × Nectariless	,,	30.1	1.19	201	5.1	0.83	8.2	above 60s
Gujarat 67 × Am. Bigboll	,,	30.9	1.22	169	4.3	0.77	8.8	above 70s
B.C. 68 × Giza	,,	34.5	1.36	134	3.4	0.68	7.8	below 60s
B.C. 68 × Moco	,,	31.2	1.23	142	3.0	0.70	8.7	above 70s
H.B. 26-1-2	,,	30.2	1.19	142	3.6	0.74	7.3	43s
B.C. 68 × R. 9143. E. 30	,,	32.8	1.29	138	3.5	0.71	7.9	above 60s
B.C. × Maarad	,,	32.4	1.28	130	3.3	0.69	7.8	42s
I.S.C. 67 × Maarad	,,	33.7	1.33	126	3.2	0.69	7.8	40s
I.S.C. 67 × Y.S.	,,	31.4	1.24	126	3.2	0.69	8.4	above 60s
N.C. 14 × Maarad	,,	32.4	1.28	118	3.0	0.65	8.0	60s
Co-ano-8-3-2	Kholwad	30.4	1.20	150	3.8	0.75	8.3	53s
N.C. 14	,,	31.0	1.23	142	3.6	0.73	8.5	48s
Gujarat 67	,,	30.6	1.21	138	3.5	0.73	8.2	45s
Co-ano-8-3-2	Halwad	28.9	1.14	142	3.6	0.75	8.6	51s
N.C. 14	,,	29.0	1.14	110	2.8	0.62	7.9	53s
Gujarat 67	,,	32.4	1.28	118	3.0	0.64	7.3	53s
Gujarat 67-5B	Talod	29.5	1.16	157	4.0	0.74	8.7	53s
Gujarat 67-4A	,,	28.6	1.13	134	3.4	0.70	8.2	48s
Co-ano-7-3-7	,,	29.4	1.16	134	3.4	0.69	9.1	70s

1	2	3	4	5	6	7	8	9
Co-ano-8-3-2	talod	28.4	1.12	138	3.5	0.70	8.6	70s
T.C. 1-34	,,	30.0	1.18	126	3.2	0.65	8.8	39s
S.C. 8-126	,,	30.5	1.20	146	3.7	0.73	8.7	50s
H.B. 3	,,	27.5	1.08	126	3.2	0.67	8.7	48s
Gujarat 67	,,	30.8	1.21	118	3.0	0.64	8.5	45s
		1965-66 Season						
Punjab								
A. 218	Ferozepur	27.1	1.07	122	3.1	0.63	9.1	53s
		1966-67 Season						
Mysore								
G. 67	Arbhavi	29.8	1.17	138	3.5	0.73	7.8	37s
		1966-67 Season						
Madras								
E.L. 123	Srivilliputtur	27.4	1.08	146	3.7	0.75	8.4	above 70s
E.L. 192	,,	28.1	1.11	126	3.2	0.68	8.3	80s
E.L. 628	,,	28.0	1.10	142	3.6	0.73	9.3	above 70s
E.L. 815-3-1	,,	28.4	1.12	130	3.3	0.69	8.9	above 70s
E.L. 123	,,	28.8	1.13	146	3.7	0.74	8.8	above 70s
Co-Pusa-Egyptian	Coimbatore	30.8	1.21	154	3.9	0.74	9.2	above 80s
E.L. 815-3-1	,,	28.7	1.13	122	3.1	0.68	7.4	above 70s

(a) A mutant found in a cotton field growing L. 147 had been successfully grown in three successive years under careful supervision. A sample of this cotton grown in the Sircinna village of the Adilabad district had been received for tests. Its properties, which were very good, are given below.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C
	mm	in.	Millitex	Mic. value			
L. 147 mutant	25.6	1.01	150	3.8	0.73	8.6	38s

This cotton was grown as a rainfed crop and was multiplied from a single plant selection. The original plant was observed to possess many special characters, the bolls being bigger than that of L. 147 and was found to be completely resistant to jassids, bollworms and fungus and bacterial diseases. The yield of the plot growing the mutant was reported to be four times that obtained from neighbouring fields.

(b) Samples of the seven varieties, C.C. 1.1.3, C.C. 1.1.3 Bkl, C.C. 1.1-3-41, H. 4, Buri 147, Buri 1007 and C.J. 73, were received for tests from five centres, *viz.*

Jalgaon, Chalisgaon, Buldana, Somnathpur and Nagpur. Their average test results are given below.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
C.C. 1.1.3	23.4	0.92	179	4.5	0.81	8.8	35s
C.C. 1.1.3Bk1	24.1	0.95	185	4.7	0.82	8.8	36s
C.C. 1.1.3-41	24.0	0.94	183	4.8	0.83	8.7	37s
H.4	22.8	0.90	199	5.0	0.85	8.5	32s
Buri 147	25.2	0.99	180	4.5	0.80	8.7	42s
Buri 1007	26.7	1.05	171	4.3	0.79	8.7	47s
C.J. 73	22.2	0.88	196	5.0	0.81	8.6	32s

It will be seen that both Buri 147 and Buri 1007 have given better spinning performance than other varieties. Among the *desi* strains, C.C. 1.1.3 selections have performed better than the control C.J. 73.

(c) The eight varieties T.H. 87, D.Hy. 79, D. Hy. 82, D. Hy. 286, Hy 106, Hy. 172, Buri-147 and Buri-1007 had been raised at three different places, *viz.* Achalpur, Buldana and Nagpur. Their average test results are given below.

Variety	Mean Fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C
	mm	in.	Millitex	Mic. value			
T.H. 87	24.3	0.96	201	5.1	0.84	8.6	38s
D. Hy. 79	25.6	1.01	164	4.2	0.77	8.7	50s
D. Hy. 82	25.9	1.02	169	4.3	0.79	8.6	51s
D. Hy 286	24.9	0.98	170	4.3	0.78	9.0	43s
Hy. 106	25.9	1.02	172	4.4	0.79	9.3	44s
Hy. 172	25.4	1.00	186	4.7	0.81	9.5	44s
Buri 1007, (Control)	26.0	1.02	185	4.7	0.79	9.2	46s
Buri 147 (Control)	25.1	1.00	180	4.6	0.80	9.2	42s

It will be seen that both D. Hy. 79 and D. Hy. 82 have given very good spinning performance, and are superior to the controls.

(d) Samples of the varieties I.S.C. 77-1, Co-ano-8-3-2, N.C. 14, N.C. 38, I.S.C. 67 and Deviraj had been received for tests from Surat for the two seasons 1965-66 and 1966-67. Their average test results are given below.

It will be seen that Co-ano-8-3-2, N.C. 14, and N.C. 38 have all given spinning performance superior to I.S.C. 67 and Deviraj.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
I.S.C. 77-1	29.3	1.15	149	3.8	0.74	7.4	42s
Co-ano-8-3-2	28.8	1.13	142	3.6	0.71	7.9	52s
N.C. 14	29.1	1.15	120	3.1	0.64	7.9	above 60s
N.C. 38	28.9	1.15	145	3.7	0.72	7.6	49s
I.S.C. 67	30.7	1.21	124	3.1	0.68	7.1	42s
Deviraj	29.9	1.06	152	3.9	0.73	7.3	45s

(e) Samples of the varieties 3200, 2827, B.C.6-1, 11-1 and Digvijay from Broach and Khedbrahma had been received during the 1966-67 season. Their average test results are given below.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
3200	22.3	0.87	156	3.9	0.74	9.0	40s
2827	22.0	0.87	140	3.5	0.72	8.8	37s
B.C. 6-1	22.1	0.87	148	3.7	0.74	8.9	33s
11-1	22.5	0.89	163	4.1	0.76	8.8	35s
Digvijay	21.5	0.84	161	4.1	0.76	8.9	35s

It will be seen that the variety 3200 had given better spinning performance than Digvijay, while the others were practically equal to Digvijay.

(f) Among the many improved strains received from several stations in Gujarat during 1967, the following are noteworthy, being of high-spinning quality.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
Gujarat 67 × Y.S.2	28.8	1.13	126	3.2	0.67	8.9	above 70s
Gujarat 67 × Nectariless	30.1	1.19	201	5.1	0.83	8.2	above 60s
Gujarat 67 × Am. big boll	30.9	1.22	169	4.3	0.77	8.8	above 70s
B.C. 68 × Giza	34.5	1.36	134	3.4	0.68	7.8	below 60s
B.C. 68 × Moco	31.2	1.23	142	3.6	0.70	8.7	above 70s
Co-ano-7-3-9	29.4	1.16	134	3.4	0.69	9.1	70s
Co-ano-8-3-2	28.4	1.12	138	3.5	0.70	8.6	70s

(g) Among the improved strains received for tests from Badnawar (Madhya Pradesh), the following strains were promising, being adjudged suitable to spin 40s and above. Their test results are given below.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
B. 61-2098	25.4	1.00	165	4.2	0.76	9.1	43s
B. 59-1659	25.2	0.99	161	4.1	0.76	8.8	40s
B. 61-1865	24.9	0.98	173	4.4	0.75	9.0	44s
B. 59-1679	25.2	0.99	165	4.2	0.77	9.1	43s
Badnawar 1	24.8	0.98	161	4.1	0.78	9.0	44s
B. 59-684	24.3	0.96	150	3.8	0.76	8.8	40s
B. 61-2115	25.0	0.98	157	4.0	0.77	9.2	44s
B. 61-2050	25.2	0.99	161	4.1	0.79	9.5	41s
B. 59-1677	25.5	1.00	165	4.2	0.78	9.2	40s
B. 61-2058	25.8	1.02	154	3.9	0.76	9.1	40s
B. 58-1376	25.6	1.01	173	4.4	0.81	8.9	43s
B. 61-2038	25.8	1.02	169	4.3	0.79	9.2	42s
B. 59-1640	25.4	1.00	157	4.0	0.77	9.3	45s
B. 59-1685	25.6	1.01	165	4.2	0.76	8.9	43s
B. 61-2103	26.0	1.02	161	4.1	0.76	9.0	52s

(h) Samples of Suyodhar, 4287-1-4-1 and S.8-2-2 had been received for tests from Bagalkot, Nargund and Gokak. Their average test results are given below.

Variety	Mean fibre length		fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
Suyodhar	20.9	0.82	199	5.0	0.78	8.8	29s
4287-1-4-1	21.8	0.85	206	5.2	0.88	8.7	30s
S. 8-2-2	21.0	0.83	192	4.9	0.77	8.8	30s

All the three varieties had practically the same fibre properties and gave the similar spinning performance.

(i) Among the improved *G. hirsutum* strains received from Mysore State and tested at the Laboratory, the following are noteworthy, being adjudged suitable for spinning into 40s count and above.

Place	Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
		mm	in.	Millitex	Mic. value			
Mandya	Mysore 14	23.9	0.94	146	3.7	0.71	7.6	45s
,,	0192	25.0	0.98	142	3.6	0.69	7.9	41s
,,	86-10-1	24.4	0.96	144	3.9	0.72	8.0	42s
Bagalkot	98-41	21.9	0.86	177	4.5	0.77	8.8	42s
Gadag	(125-Co. 18 × 2196B85)-38	23.9	0.94	150	3.8	0.71	7.9	42s
,,	(Co.4.B. 40-21 × 2196B.5)-38	24.3	0.96	142	3.6	0.70	7.7	44s
,,	715 B-6-5-B	24.0	0.94	146	3.7	0.72	7.5	46s
,,	Laxmi	24.1	0.95	154	3.9	0.73	7.8	42s
,,	IHX-11-7-12	23.7	0.93	150	3.8	0.72	7.6	42s
Arbhavi	170-Co. 2	25.6	1.01	165	4.2	0.79	7.6	42s

(j) Among the improved strains received from Andhra Pradesh and tested at the Laboratory, the following showed good test results and had an H.S.C. of 50s and above.

Place	Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
		mm	in.	Millitex	Mic.value			
Mudhol	5135	23.7	0.93	138	3.5	0.68	8.9	56s
,,	5138	24.9	0.98	142	3.6	0.70	8.5	51s
,,	5988	24.5	0.96	138	3.5	0.67	8.5	55s
Gudivada	A.C. 122	24.8	0.98	154	3.9	0.73	8.6	56s
Tenali	A.C. 122	25.0	1.02	157	4.0	0.73	8.6	54s
,,	L.L. 54	24.0	0.94	154	3.9	0.73	8.4	53s
,,	V. 14	25.4	1.00	150	3.8	0.72	8.8	59s

(k) Among the improved strains received from Srivilliputtur in Madras State, and tested at this Laboratory, the following strains are noteworthy, being assessed as spinnable to counts 50s and above.

Variety	Mean fibre length		Fineness		M.C.	P.S.I. lb/mg	H.S.C.
	mm	in.	Millitex	Mic. value			
M.C.U. 2	24.9	0.98	130	3.3	0.69	8.6	51s
E.L. 123	27.4	1.08	146	3.7	0.75	8.4	above 70s
E.L. 156-E	25.0	0.98	138	3.5	0.71	8.2	58s
E.L. 192	28.1	1.11	126	3.2	0.68	8.3	80s
E.L. 467-1-1D	26.5	1.04	126	3.2	0.68	8.4	above 70s
E.L. 557-B-3-B	26.6	1.05	154	3.9	0.76	7.8	above 60s
E.L. 628	28.0	1.10	142	3.6	0.73	9.3	70s
E.L. 63-1	26.0	1.02	150	3.8	0.74	9.1	64s
E.L. 63-6	25.1	0.99	146	3.7	0.74	9.2	53s
E.L. 815-3-1	28.4	1.12	130	3.3	0.69	8.9	above 70s

(l) A samplé of a new improved strain 'Co-Pusa-Egyptian' had been received for tests from the I.A.R.I. Regional Research Centre, Coimbatore. This strain have very outstanding properties. Test results of this strain are shown below in comparison with two Egyptian cottons imported into India.

Variety	Mean fibre length		Irregularity, %	Fineness		M.C.	P.S.I. lb/mg	C.S.P. for 80s
	mm	in.		Millitex	Mic.value			
Co-Pusa-Egyptian	30.8	1.21	17.0	154	3.9	0.74	9.2	2070
Giza 45	31.4	1.24	21.2	134	3.4	0.68	10.0	2369
Menoufi	30.2	1.19	22.6	154	3.9	0.74	9.4	2126

It was observed that the Co-Pusa-Egyptian variety was practically on par with Menoufi, but slightly inferior to Giza 45. Samples of this cotton will be tested for a few more seasons.

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 1967 are given in Table 11.

TABLE 11. NUMBER OF COTTON SAMPLES TESTED AT OUTSTATIONS

Station	Mean fibre length	Fibre fineness	Fibre maturity	Fibre strength
Abohar	570	503	546	308
Coimbatore	860	877	877	883
Dharwar	1039	1049	621	406
Indore	538	538	556	538
Nanded	313	253	151	284
Nandyal	280	260	120	260
Sriganganagar	96	—	96	—
Surat	2877	2632	2733	2049

It may be mentioned that in Table 11 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.

III. Papers Published

A list of the various publications issued by this Laboratory during the year is attached (Appendix II). It will be seen that four research bulletins were published and five articles were sent to different journals for publication or read at various conferences. Thirty-nine technological circulars were issued on different major trade varieties of cotton for the information of the mills and the cotton trade. Further, a book entitled 'Handbook on 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, is under publication.

IV. Extension

The 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 imporved cotton strains evolved under various research projects are tested for their properties by the Laboratory at its headquarters as well as the outstations maintained under its charge. The Laboratory does not help the farmers directly but through the State Departments of Agriculture. Further, the technological circulars issued on trade varieties of cotton are useful to growers, trade and 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, the Laboratory continued to receive a number of samples of cotton fibre, 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 1967, together with the corresponding figures for 1966 and for the quinquennium 1960-65, are given in Table 12.

TABLE 12. NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium ending May 1965	1966	1967
Spinning	52	8	18
Fibre (E.I.C.A.)*	148	80	126
Fibre (Others)	155	40	72
Yarn	168	98	108
Cloth	158	97	75
Moisture	933	185	12
Miscellaneous tests	16	16	411
Total	1630	524	411

*These samples from the East India Cotton Association Limited, are tested free of charge as this Association reciprocates by supplying free of charge a number of samples (6 kg each) of trade varieties and the Grader's valuation reports on samples of improved strains from various agricultural stations sent to them by the Laboratory.

The total test fees realised during 1967 for carrying out tests on these samples amounted to Rs. 8,484, against Rs. 10,112 during 1966.

Training facilities

A revised training course in cotton technology and elements of statistics, of six months' duration, was conducted during the year for the benefit of persons employed in the cotton trade in the city. Four persons were selected for the course from among the candidates who had applied for the course and they successfully completed their training.

Supply of testing equipments

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

Laboratory Model Gin	1
Quartz Micro Balance	3
A.N. Stapling Apparatus	3
Halo Length Disc (small size)	72
Halo Length Disc (large size)	72

V. Conferences and Symposia

The Laboratory participated in the following scientific and technical conferences connected with this Laboratory's work and deputed the officers mentioned below for attending them and presenting their papers.

Date	*Meeting*	*Place*	*Attended by*
11-1-1967	25th Meeting of TDC 2 in Joint Session with 22nd Meeting of TDC 2 :1 and 5th Meeting of TDC 2 :3	Bombay	Dr. V.G. Munshi
12-1-1967 and 13-1-1967	Second SASMIRA'S Technological Conference	Bombay	Dr. V. Sundaram Dr. Jai Prakash Dr. S.M. Betrabet Dr. V.G. Munshi Dr. S.N. Pandey Shri P.G. Oka Shri G.S. Rajaraman [Dr. V. Sundaram presided over the Physics Session]
10-2-1967 and 11-2-1967	Liaison Advisory Committee of ATIRA	Ahmedabad	Dr. Jai Prakash.
25-3-1967 to 27-3-1967	24th All India Textile Conference	Kanpur	Dr. V. Sundaram Dr. V.G. Munshi [Dr. V. Sundaram presided over the Fibre Session]
27-3-1967	First Meeting of the Advisory Board of the I.C.A.R	New Delhi	Dr. V. Sundaram
4-4-1967 to 6-4-1967	First Workshop Meeting of Cotton Research Workers	Coimbatore	Dr. V. Sundaram Dr. Jai Prakash Dr. S.M. Betrabet
1-5-1967	Meeting of TDC	New Delhi	Dr. V. Sundaram

Date	*Meeting*	*Place*	*Attended by*
7-8-1967	Second Meeting of the Yarn Appearance Standards TDC 1 : 1 : 12 and TDC 1 : 1	Bombay	Dr. V. Sundaram (Convenor) Dr. Jai Prakash
17-8-1967 to 19-8-1967	Second Meeting of the Directors of Research Institutes	New Delhi	Dr. V. Sundaram
25-10-1967	26th Meeting of TDC 2 in Joint Sessions with 23rd Meeting of TDC 2:1 and TDC 2 :3	Bombay	Dr. V. Sundaram
27-10-1967	Meeting of TDC 5	Bombay	Dr. S.M. Betrabet
30-10-1967	Second Meeting of the Indian Cotton Development Council	Bombay	Dr. V. Sundaram

The Council had arranged at this Laboratory on the 18th September 1967, a meeting to finalise the programme for development of anhydrous ammonia applicators. Dr. J.S. Kanwar, Deputy Director-General, I.C.A.R., presided over the meeting. Dr. V. Sundaram, Director, Cotton Technological Research Laboratory, also attended the meeting.

VI. Summary of the Report

The research activities and the testing work progressed satisfactorily as in the past. A statement showing the Budget and Expenditure of this Laboratory during the financial year 1966-67 is attached (Appendix I). It may be seen that out of a sum of Rs. 17.10 lakhs sanctioned only a sum of Rs. 8.14 lakhs had been spent during the year. A sum of Rs. 8.34* lakhs provided under Capital Expenditure for modernisation and expansion of the Laboratory by the installation of the temperature and humidity control plant in the testing sections remained unutilized. The installation of this plant is in progress since September, 1967 when the sanction of the Government of India for the release of the necessary foreign exchange for this work was received. Further action for procurement of the machinery will be taken as soon as this work is completed.

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

The investigation on the effect of chemical treatments on the physical, chemical and structural properties of cotton fibres was continued. High crystallinity of cotton cellulose is responsible for high tensile strength and low extensibility, but is also the cause of undue stiffness as well as low dye and moisture absorption and chemical reactivity. With a view to overcoming these defects and bringing about changes in the elastic and various other properties of cotton fibres, the degree of crystallinity of two cottons, *viz.* Gaorani and 170-Co. 2, was reduced by treating them with anhydrous ethylamine, diethylamine, pyridine and aqueous solutions of sodium hydroxide (30%) and potassium hydroxide (40%) for varying periods of time, ranging from 15 minutes to 50 hours. The treated lint samples showed certain interesting changes in their properties which depended not only upon the chemical used but also upon the period of treatment and various other factors. Generally, it was observed that most of the swelling and changes in the physical, chemical, structural and optical properties had resulted within a quarter or half an hour of the treatments with the reagents.

It was observed from a study of the chemical analysis of seeds of 23 cotton strains that the seeds of *G. hirsutum* strains showed higher seed weight, protein content and oil content compared with seeds of *G. arboreum* strains. Further, the seeds of the glandless Badnawar strain contained 0.13 per cent of gossypol, while the per-

*This excludes the sum of Rs. 0.81 lakhs spent on technological schemes including P.L. 480 Projects.

centage of gossypol in other varieties ranged from 0.78 per cent (Garo Hills) to 1.86 per cent (Adonicum). Further work is in progress.

For adopting the Micronaire instrument for determination of fibre weight per unit length of very coarse *desi* cottons, over 70 samples of the coarse type of cottons were collected from various sources. The samples were tested for micronaire value after blending each of them with 216F, a fine cotton, in the ratio of 1 : 1. A regression equation connecting the theoretical harmonic mean of the micronaire values of the individual components with the experimental values of the blend has been obtained.

For comparing the fibre length as measured by different instruments, 25 samples of cotton (belonging to four different species) were selected and various length parameters determined using Balls Sorter, Baer Sorter, A.N. Stapling Apparatus, Fibrographs (Manual, Servo and Digital models) and Uster Stapling Apparatus. The data collected so far are being analysed.

In order to examine whether the application of α-naphthalene acetic acid (plant harmone) to the cotton plant had any effect on the quality of the fibres produced, samples from two experiments conducted at Faridkot (Punjab) and Srivilliputtur (Madras) were received for tests. Results obtained so far indicate that, in general, the fibre quality is not affected by this treatment.

The data of fibre tests on samples from two agronomic experiments were analysed. In one experiment conducted at Patiala with 320F cotton, it was found that lower quantities of irrigation proved beneficial to fibre length while the other fibre characters were unaffected by irrigation and nitrogen treatments. In the other experiment conducted at Faridkot with LL.54 cotton, the results showed that the values of mean fibre length, bundle strength and maturity coefficient were affected by irrigation treatments, while fibre length irregularity was affected by nitrogen application in a particular season. No conclusions could be drawn from this study.

Experimental work for the fabrication of an Extractor for improving the ginning of *kapas*, containing large quantities of immature locks and hulls, is in progress.

The experimental work on the investigation on the microbial decomposition of cellulose, financed out of P.L. 480 funds by the USDA, was practically completed during the year. From this study, it was noted that although the microbiological flora of air and soil were nearly the same in different parts of the world, there appeared to be important difference. Well-known cellulolytic fungi and myxobacteria reported by workers abroad were conspicuously absent, whereas *Streptomyces* and some *Aspergilli* seem to have important role in the degradation of cotton. *Streptomyces* were isolated for the first time in such a large number from raw cotton and fabric. Enzyme studies on *Streptomyces* have also been very interesting. The pH optima was of bimodal nature (pH 5.8 and pH 7.3) which was unique.

To measure the secondary cell-wall development of *G. herbaceum* and Indo-American cottons, 40 samples of Digvijay and 40 samples of Gujarat, 67 cottons were tested for degree of thickening for the growth period from 42 to 63 days. Full grown smaples of Digvijay were tested for length, fineness and maturity. Further work is in progress.

After determining the maturity of large number of Indian *hirsutum* and American Upland cottons, about 10 cottons representing each group, covering a wide range in maturity, were selected for further study of the structural peculiarities of these cottons. Methods of dyeing and propanol retention technique have been standardised to determine indirectly the interfibrillar void space in the cotton. Further work is in progress.

The effect of four amines, *viz.*, morpholine, piperidine, ethylenediamine and piperazine, on the swelling of cotton cellulose was studied by treatments at 20°C/1hr, 20°C/5 hr and 35°C/1 hr. The treated cottons were analysed for birefringence, density, moisture regain, accessibility to formylation and acid hydrolysis, infrared crystallinity index, strength and extent of swelling. Electron micrographs and X-ray diffractograms were also taken for samples treated at the most effective concentration of the swelling agents. The results were examined. The two monoamines, morpholine and piperidine induced only intercrystalline swelling, whereas the two diamines, ethylenediamine and piperazine, were effective as intracrystalline swelling agents.

Presence of certain specific groups, particularly aromatic ones, are known to offer substantial radio protection to the polymeric molecules. In order, therefore, to assess the protection offered to the cellulose molecule, the benzylated and benzoylated samples of increasing degree of substitution were prepared. In addition, acrylonitrile grafted samples and allylated samples were also prepared. All the chemically modified samples including acetylated samples prepared last year were subjected to the same dosages of gamma-ray irradiation. The benzylated and benzoylated samples having different degrees of substitution were irradiated at a constant dosage 1×10^7r. Physico-chemical properties were determined for all the samples and examined. Further work is in progress.

For undertaking studies on the changes in density of cotton and other textile fibres with temperature and relative humidity, necessary preliminary work was carried out. A density gradient tube has been fabricated and a large number of glass floats covering the wide range of density of textile fibres have been calibrated.

In order to study the effect of treatment of cotton fibres with caustic alkali of various concentrations at different temperatures on the change in lustre, 11 cottons were selected and were treated under slack conditions with sodium hydroxide and potassium hydroxide at 80°C for 15 minutes, using various concentrations of the alkali.

The study of the effect of swelling agents on the structural and the mechanical properties of cotton fibres was continued by using KOH as a swelling agent. It was noted that the changes in circularity were almost similar in both NaOH and KOH solutions. The changes in circularity were more pronounced when the treatment was carried out with NaOH than with KOH. It was also observed that the mature fibres attained more circularity than the immature fibres.

In order to make the textile fibres spinnable, it is necessary that they should hold together and be capable of transmitting tension along the whole length of the yarn. The adherence and transmission of tension are simultaneously achieved by

usually twisting the fibres around the central axis. From the point of view of productivity, however, it is desirable to obtain the maximum yarn strength with minimum of twist. The rate of development of cohesion and strength of rovings with twist was, therefore, investigated in relation to the fibre properties. Experiments were also undertaken to determine the dependence of cohesive property of slivers, rovings, etc., on the fibre configuration in the strand.

In connection with the project on the fabrication of a machine suitable for spinning small samples, some more parts for the building motion (of the plant) were designed and prepared in the Laboratory workshop. Some castings which could not be prepared in the Laboratory were ordered from outside and their supply is awaited. The work is in progress.

In order to examine the relationship between count and count-strength product (C.S.P.), seven more cottons, *viz.*, Deviraj, Devitej, Suyodhar, Laxmi (Adoni), M.C.U. 1, M.C.U. 3 and L.S.S. were spun to about 11 counts each (20s, 22s 24s and 40s) with a twist multiplier of 4.25, and these yarns were tested for lea strength.

To study the quality of yarns produced by the mixings as compared to the performance of the individual varieties, 40 cottons were selected. Out of these three cottons were taken at a time, mixed in equal proportions, spun to suitable counts, and the Highest Standard Count determined. During the year under report, 32 such mixings were spun as above and the yarns obtained were tested for lea strength.

For estimating the spinning value of cotton from its chief fibre properties in the cotton tracts of the Punjab, Uttar Pradesh, Rajasthan, Vidarbha and Middle Gujarat, necessary data were collected for the different tracts for the three seasons—1963-64, 1964-65 and 1965-66. The properties considered were: Mean fibre length, maturity coefficient, fibre-bundle strength and Highest Standard Count (H.S.C.) spinnable. Suitable regression equation for predicting the spinning value from the fibre properties was obtained for the Vidarbha tract.

When the strength and extensibility of single strands of yarn were determined using Uster Automatic Yarn Tester and Scotts Inclined Plane Tester, it had been observed that the strength values recorded on both the instruments were practically the same but the Uster instrument recorded higher values for extension than the Scotts Tester.

A large number of samples of improved varieties of cotton evolved in connection with various research projects on cotton breeding, agronomy, etc., were received at the Laboratory for various tests, from the State Departments of Agriculture. These samples were generally tested in the order of their receipt and the test results were sent to the officers concerned.

The Laboratory continued to receive samples for tests from the semi-Government organisations, Excise Department, cotton trade and industry, etc. These tests were carried out on payment of prescribed fees and the total amount collected during the year as 'Test fees' was Rs. 8,484.50.

During the year, four research bulletins were published and in addition,

five articles were either sent to different journals for publication or read at various conferences. Further, 39 technological circulars were issued on different trade varieties of cotton for the information of the cotton trade. A book entitled 'Handbook of Methods of Tests for Cotton Fibres, Yarns and Fabrics', containing a wide bibliography of relevant literature and useful to students of cotton technology and to those engaged in the cotton trade, industry and research, was under publication.

A revised training course of six-month duration in cotton technology and elements of statistics was conducted during the year for the benefit of persons employed in cotton trade and industry in the city and four persons underwent the course successfully.

The following instruments were fabricated and supplied to the parties who had asked for them:

Laboratory Model Gin	1
Quartz Micro Balance	3
Halo Length Disc (small size) ..	72
Halo Length Disc (large size) ..	72
A.N. Stapling Apparatus	3

VII. Personnel

During the year, Dr. V. Sundaram, Director was appointed as Principal Investigator, in the All-India Co-ordinated Research Project on Cotton with effect from the 13th December, 1967. Dr. R.L.N. Iyengar, ex-Director of this Laboratory was taken up as a retired scientist of the Indian Council of Agricultural Research and allowed to work in the Laboratory on a research project with effect from the 1st May, 1967. The post of Junior Accounts Officer in the grade of Rs. 270-575 was upgraded as Accounts Officer with a grade of Rs. 350—680 and Shri K. Ramaswami, who had been working as Junior Accounts Officer, was appointed to the upgraded post with effect from the 1st October, 1967. One post of Junior Scientific Officer (spinning) in the grade of Rs. 400—950 was sanctioned by the Indian Council of Agricultural Research up to the 29th February, 1968, in the first instance. The post could not be filled up during the year.

Three posts of Senior Research Assistants were filled up by promotion from among the Research Assistants. Further, 18 posts of Research Assistants, lying vacant at this Laboratory and outstations for some time, were filled up by open recruitment.

One post of Senior Research Assistant (spinning) and one post of Senior Research Assistant (testing) fell vacant, as the incumbents were transferred to other institutions under the Indian Council of Agricultural Research.

Consequent on the taking over of the staff-quarters by this Laboratory and their release for occupation by members of the staff, two posts of pump attendant-cum-watchman and one post of sweeper were created.

One Senior Research Assistant and four Research Assistants resigned from their posts during the year.

The following posts were sanctioned for technological work under the All-India Co-ordinated Research Project on Cotton.

Junior Physicist	1	(at Laboratory)
Senior Research Assistants	2	(one at Laboratory and one at Hissar)
Research Assistants	6	(all at field stations)
Laboratory Attendant	1	(at Laboratory)
Sliver makers	8	(all at field stations)
Stenotypist	1	(at Laboratory)

The sanctioned staff under this scheme have been posted at the main centres at Coimbatore, Nanded and Surat, while the full staff sanctioned at Hissar, Dharwar and Indore are yet to be appointed.

From the staff working under the P.L.480 Projects, one Microbiologist and one Research Assistant resigned.

Sarvashri V.G. Munshi and S.N. Pandey, Junior Scientific Officers at the Laboratory, were awarded Ph.D. degrees in Textile Physics during the year.

A list of technical and scientific staff of the Laboratory is attached (Appendix III).

VIII. Appendices

APPENDIX I

COTTON TECHNOLOGICAL RESEARCH LABORATORY

Budget estimates of expenditure of the Laboratory and outstations including the actual expenditure and receipts during 1966-67

A. Expenditure

I. **Technological Research**	Sanctioned Grant	Actual	Savings (—) Deficit (+)
	Rs.	Rs.	Rs.
(i) Technological Laboratory			
(a) Capital Expenditure—Expansion of Laboratory	8,42,100	7,700	(—) 8,34,400
(b) Working Expenses	7,70,000	7,35,100	(—) 34,900
(ii) Technological-Provincial	97,800	70,700	(—) 27,100
Total	17,09,900	8,13,500	(—) 8,96,400
II. Technological schemes including P.L. 480 Projects.	1,26,300*	80,700	(—) 45,600

*As per revised estimates for 1967-68

B. Receipts

	Rs.
(1) Sale of Products (Gins, etc.)	9,393
(2) Sale of Cotton Waste etc.	5,911
(3) Sale of Publications	2,600
(4) Fees for Tests	11,849
(5) Fees for Training, Application Fee, etc.	4,478
(6) Rent	2,343
(7) Interest on Loans and Advances	104
(8) Miscellaneous	13,259
Total	49,937

APPENDIX II.

LIST OF PUBLICATIONS

A. Technological Reports

1. Technological Reports on Trade Varieties of Indian Cottons—1966.
2. Technological Report on Standard Indian Cottons—1966.

B. Technological Bulletins

No. 1. "Estimation of spinning value of cotton from its chief fibre properties in different cotton tracts in India", by G.S. Rajaraman, V. Sundaram and R. L. N. Iyengar. (Reprinted from the "Indian Journal of Agricultural Science , Vol. 37, No. 1, Feb. 1967).

No. 2. "Circularity of cotton fibres and the effects of alkali concentration and tension on the changes brought about in it during mercerization", by P.G. Oka, Jai Prakash and R.L.N. Iyengar. (Reprinted from the Textile Research Journal, Vol. 37, No. 2. Feb. 1967).

No. 3. "Plant cell wall structure with special reference to cotton fibres", by S.M. Betrabet. (Reprinted from the Journal of Scientific and Industrial Research, 1967, Vol. 26, No 5).

No. 4. "Variation in structural and physical characteristics of fibres from different regions of cotton seeds", by V. Sundaram, Jai Prakash, V.G. Munshi, S.N. Pandey and R.L.N. Iyengar. (Reprinted from the Indian Journal of Technology, 1967, Vol. 5, No. 5).

C. Articles and Papers

(a) Sent for Publication

(1) "A study on the effect of alpha-naphthalene acetic acid on physical properties of 320F cotton," by V.G. Munshi and R.L.N. Iyengar.

(2) "Studies on lustre in textiles: Part III, Contribution of structural elements towards lustre behaviour of cotton fibres", by Jai Prakash, P.G. Oka and R.L.N. Iyengar.

(3) "Effect of irrigation and nitrogen treatments on: I. Physical properties and yield of 320F cotton, and II. Physical properties of LL. 54 cotton", by V.G. Munshi and R.L.N. Iyengar.

(b) Papers Presented at Conferences

(1) "Instrumental evaluation of lustre of textile materials—A Review", by P.G. Oka and Jai Prakash. (Contributed to SASMIRA'S 2nd Technological Conference held at Bombay on 12th and 13th January 1967).

(2) "Fibrilla orientation in relation to physical properties of cotton fibres" by V.G. Munshi, R.L.N. Iyengar and V. Sundaram. (Contributed to 24th All-India Textile Association Conference held at Kanpur on 26th, 27th and 28th March 1967).

D. Technological Circulars

1965-66 Season

1469 216F
1470 M.C.U. 2 (Summer)
1471 Gaorani 22
1472 216F (Rice-fallows: Madras State)

1966-67 Season

1473 Bengal Desi (Rajasthan)
1474 Bengal Desi (Punjab)
1475 H. 14
1476 Virnar (West Khandesh)
1477 Central Line
1478 Mwanza
1479 320F
1480 A.K. 277
1481 Gaorani 22
1482 Digvijay (Palej)
1483 Gujarat 67 (Kutch)
1484 Kalyan (Viramgam)
1485 Kalyan (Bavla)
1486 Deviraj (Manavadar)
1487 Gujarat 67 (Idar)
1488 Kalyan (Saurashtra)
1489 L. 147 (Ellichpur)
1490 Laxmi (Gadag)
1491 Deviraj (Nagar)
1492 Virnar (East Khandesh)
1493 Jayadhar (Hubli)
1494 Digvijay (Cambay/Petlad)
1495 Narmada
1496 Badnawar 1
1497 Adonicum
1498 Wagad (Saurashtra)
1499 Gaorani 22 (Mysore)
1500 Gaorani (Adilabad)
1501 C. Indore 1
1502 Virnar (Aurangabad)
1503 Maljari
1504 Westerns
1505 P. 216F (Madras)
1506 Karunganni 6
1507 M.C.U. 3

APPENDIX III

SCIENTIFIC AND TECHNICAL STAFF OF THE COTTON TECHNOLOGICAL RESEARCH LABORATORY

Director	Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C.
Senior Scientific Officers	Dr. Jai Prakash, M.Sc., Ph.D.
	Dr. S.M. Betrabet, M.Sc., Ph.D.
	Shri R.P. Neogi, B.Sc. (Tech.) (Manch.), A.M.C.T. (eng.).
Junior Scientific Officer (Spinning)	(one post vacant)
	(one post vacant)
Junior Scientific Officers	Dr. V.G. Munshi, M.Sc., Ph.D.
	Dr. S.N. Pandey, M.Sc., Ph.D.
	Shri G.S. Rajaraman, M.A.
	Shri P.G. Oka, M.Sc.
Senior Research Assistants (Testing)	Shri P.D. Vakil,
	Shri C.A.S. Aiyar, B.Sc.
	Shri S. Ramanathan,
	Shri P.N. Elayathu, B.Sc.
	Smt. S.B. Pai, B.Sc. (Hons.)
	Smt. K.L. Datar, B.Sc.
	Shri S.R. Ganatra, B.Sc.
	Shri S.G. Nayar, B.Sc.
	Shri A. Rajagopalan, B.Sc.
	Shri A.V. Ukidve, B.Sc.
	(one post vacant)
Senior Research Assistant (Ginning)	Shri D.G. Shete, L.M.E.
—do— (Engineering)	Shri H.V. Tamhankar, L.M.E., L.E.E.
—do—(Spinning)	Shri K.S. Bhyrappa, L.T.T.
—do— (Statistics)	Shri K. Venkateswaran, B.A.

Research Assistants (Testing)

Shri B.M. Petkar, B.Sc.
Shri K.R. Kamath, B.Sc.
Shri P.K. Jairam, B.Sc.
Shri V. Venugopalan, B.Sc.
Shri N. Thejappa, B.Sc.
Shri K.M. Vijayaraghavan
Shri T.K. Madusudana Das, B.Sc.
Shri V. Jose Joseph, B.Sc.
Shri Varghese Paul, B.Sc.
Shri C.P. Venugopalan, B.Sc.
Shri T.R. Lakshminarayanan, M.Sc.
Shri K. Vijayan, M.Sc.
Smt. Shaila P. Bhatawdekar, M.Sc.
Shri P.K. Chidambareswaran, M.Sc.
Shri P. Bhaskar, M.Sc.
Shri K.V. Babu, D.B.Sc.
Kum. I.K.P. Iyer, B.Sc.
Smt. S.D. Pai, B.Sc.
Kum. T.T. Annamma, B.Sc.
Shri A.K. Gupta, B.Sc., (Hons.)
Smt. J.K.S. Warrier, B.Sc.
Shri Y. Subrahmanyam, M.Sc.
Kum. M.K. Prema, M.Sc.
Shri S. Venkata Raman, B.Sc.
Shri C.R. Sthanu Subramoni Iyer, B.Sc.
Shri K.S. Shama Rao, B.Sc.
Shri K.V. Anantha Krishnan, B.Sc.
Shri S. Vasudevan, B.Sc., B. Tech.
(two posts vacant)

Research Assistants (Statistics)

Shri K. Chandran, B.A.
Shri Vijay Bahadur Singh, M.Sc.
(one post vacant)

—do— (Spinning)

Shri N.K. Haridas, D.T.T.
Shri H.R. Laxmi Venkatesh, D.T.T.

—do— (Workshop)

Shri R. Seetharaman, L.M.E., P.D.Au.E.

P.L. 480 Project Staff

Project No. FG-In-155

Biochemist	Kum. Usha I. Patel, M.Sc.
Mircrobiologist	Shri K. Kasturi, B.Sc. (Chemistry), B.Sc. (Microbiology).
Technical Assistant	(vacant)

Project No. FG/In/186

Junior Scientific Officer	(Textile Chemist)	Kum. I.G. Bhatt, M.Sc.
—do—	(Organic Chemist)	Shri N.S. Shah, M.Sc.
Senior Research Assistant	(Analytical Chemist)	Smt. Vatsala Iyer, M.Sc.
—do—	(Physicist) :	Shri A.W. Shringarpure, B.Sc.

Outstations

Station	Senior Research Assistant	Research Assistant
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.
		Shri S.N. Nagwekar, B.Sc.
Nandyal	Shri R. Dwarkanath, B.Sc.	
Nanded	Shri W.R. Sharma, B.Sc.	Shri S.P. Ingole, B.Sc.
Surat	Shri L.R. Jambunathan, B.Sc.	Shri R.C. Sankalia.
Sriganganagar		Shri Radha Ballabha, M.Sc. (Under training at CTRL, Bombay).
Abohar	Shri T.G. Shankarnarayanan, B.Sc.	Shri P.T. Ambujakshan, B.Sc. (one post vacant)
Indore	Shri N.C. Chiplonkar, M.Sc., D.C.T.	Shri G.S. Patel, B.Sc.

All-India Co-ordinated Research Project on Cotton

(a) **Laboratory**

Junior Physicist	(vacant)
Senior Reseach Assistant	(vacant)

(b) **Field stations**

Station	Senior Research Assistant	Research Assistant
Coimbatore	—	Kum. Santa Nayar, B.Sc.
Nandyal	—	Shri G. Varada Raj Rao, M.Sc.
Nanded	—	Shri V. Mohanan, B.Sc.
Surat	—	Shri S.S. Iyer, B.Sc. (Hon.).
		Shri M.C. Bhalodwala, B.Sc.
Hissar	(vacant)	(vacant)