COTTON TECHNOLOGICAL RESEARCH LABORATORY, BOMBAY

Annual Report 1969

(January 1, 1969 to December 31, 1969)

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI

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I. Introduction

This is the Forty-sixth Annual Report of the Laboratory and pertains to the calendar year 1969.

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

The chief functions of this Laboratory are :

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

(*ii*) to help the trade and the industry by furnishing true valuation of different *Trade Varieties* cultivated,

(*iii*) to carry out *basic research* on the physical and chemical properties of cotton in relation to quality and spinning performance,

(*iv*) to carry out investigations on the *ginning problems* of Indian cottons,

(*v*) to investigate the *greater and better utilization* of cotton, cotton wastes, linters, cottonseed, etc.,

(*vi*) to issue authoritative reports on the samples received for tests from the *trade and other sources*, and

(*vii*) to disseminate *technical information.*

This Laboratory is concerned with the testing and research on different aspects of cotton fibres, yarns and fabrics and these are dealt with in the Ginning, Fibre Testing, Spinning, Yarn Testing, Physics, Chemistry, Microscopy, X-ray and Statistics sections. This Laboratory maintains a good up-to-date library of books connected with cotton technology. The library contains 2,385 books, 122 of which were added during the year. The number of bound volumes was 2,181. The library also received regularly about 140 journals dealing with textiles and allied subjects, 62 of which were subscribed for and the others received on exchange or complimentary basis.

New Equipment Purchased

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

(*i*) Boiler—Reynolds Model ROF-1,
(*ii*) Milling Machine (Tapti),
(*iii*) Tool and Cutter Grinder (PRAGA),
(*iv*) Bench Type Drilling Machine (PRAGA),
(*v*) Buff Polishing Machine,
(*vi*) Warp Ring Frames (2), M-2 Model,
(*vii*) Simpson Multimeter, with Simpson Transistor Tester Adaptor,
(*viii*) Radart Transistor Power Supply,
(*ix*) Double Beam Oscilloscope,
(*x*) Gansons Vacuum Oven,
(*xi*) Thermohygrographs,
(*xii*) Oil Circuit Breaker,
(*xiii*) Water Distillation Still (capacity 2 litres per hour),
(*xiv*) R.C.L. Bridge (Philips—Type PR 9030), and
(*xv*) ATIRA Fibre Fineness Tester (Toshniwal).

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

Distinguished Visitors

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

Shri K. V. Ahmed Bavappa	—	Arecanut Specialist, Central Arecanut Research Station, Vittal (South Kanara).
Dr. Jett C. Arthur	—	Head, Radio-Chemistry Investigations, Southern Regional Utilization Research Laboratory, U.S. Department of Agriculture, New Orleans, U.S.A.
Shri Ranjit Singh	—	Chairman, Indian Cotton Development Council.
Shri K. G. Deshmukh, M.P.	—	Member, Indian Cotton Development Council.

In addition to the above, Dr. A. B. Joshi, Deputy Director General (Crop Sciences), Dr. J. S. Kanwar, Deputy Director General (S.A.E.), Shri K. P. A. Menon, Secretary, Shri N. K. Dutta, Under Secretary, Shri S. Natarajan, Director, Budget, Audit and Accounts, Shri R. B. Jain, Under Secretary of the Indian Council of Agricultural Research, and Dr. V. Santhanam, Project Co-ordinator (Cotton) and Head of the Regional Research

Centre, Indian Agricultural Research Institute, Coimbatore, visited the Laboratory on various occasions in connection with official work.

Staff Research Council

During the year under review, four meetings of the Staff Research Council were held. The first and the second meetings were held on the 25th February and 20th March, 1969, respectively, for considering and finalising the Research Programme of the Laboratory, for the year 1969. The third and the fourth meetings were held on the 26th April and 29th May, 1969, respectively, for finalising the arrangements in connection with the meeting of the South Zone-cum-All-India Workshop under the All-India Co-ordinated Research Project on Cotton, held in June, 1969.

Research Collaborations

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 eight field stations situated in the important cotton growing States, where specially trained staff have been posted. The South Zone-cum-All-India workshop meeting of the research workers in the All-India Co-ordinated Research Project on Cotton was held at this Laboratory in June, 1969.

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

(i) Secondary cell wall development of *G. herbaceum* and Indo-American cottons (in collaboration with Shri C. T. Patel, Cotton Specialist, Surat), and

(ii) Study of structural properties of chemically modified cotton by optical methods (in collaboration with Prof. E. H. Daruwalla, Department of Chemical Technology, Bombay University).

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

Membership on Other Organizations

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

(*i*) Indian Council of Agricultural Research Society,

(*ii*) Advisory Board of the Indian Council of Agricultural Research,

(*iii*) Agricultural Sciences Technology Panel of the Indian Council of Agricultural Research,

(*iv*) Board of Management of the Victoria Jubilee Technical Institute, Bombay, and

(*v*) (*a*) Senate, (*b*) Academic Council, (*c*) Faculty of Science, (*d*) Board of Studies in Physics, and (*e*) Board of University Teaching for subjects in the Faculties of Arts and Science, of the Bombay University.

He continued to be a member of the General Advisory Committee for Research and Liaison and also its Sub-Committee (Physics and Physical Testing) of the Bombay Textile Research Association.

During the year, Dr. V. Sundaram was appointed as a member of the Expert Committee to look into the question of starting a degree course in Textile Chemistry by the University of Baroda.

The Director and other Scientific Officers of this Laboratory continued to represent the Indian Council of Agricultural Research on the various Committees and Sub-Committees of the Indian Standards Institution dealing with Cotton Textiles. Dr. V. Sundaram has also been appointed as Vice-Chairman TDC: 1 (Physical Methods of Tests Sectional Committee), Chairman TDC: 2 (Cotton and Cotton Products Sectional Committee), and also as convenor TDC: 1:1 (Sub-Committee for Physical Methods of Test for Cotton) and TDC: 1:1:12 (Panel for Yarn Appearance Standards).

Post-graduate Training

The University of Bombay continued to recognize this Laboratory as a Post-Graduate Institution for guiding students for the M.Sc. and Ph.D. degrees in Textile Physics, during the year. Dr. V. Sundaram (Director) and Dr. R. L. N. Iyengar (Retired Scientist) continued to be teachers for guiding students for Ph.D. and M.Sc. degrees of the University of Bombay in Textile Physics (by research). During the year, eight members of the Research Staff were being guided for M.Sc. and one for Ph.D. degrees in Textile Physics (by research) of the Bombay University. In addition, this Laboratory has also been recognized for guiding students for the M.Sc. degree in Chemistry (by research) of the University of Bombay.

Expansion and Modernization

The expansion and modernization programme of this Laboratory is making steady progress. The conditioning plant has been installed and put into commission since October, 1969. This plant is required to be fitted with controls to be imported from the U.S.A. for maintaining standard atmospheric conditions. The import licence for procuring these controls has since been received from the Chief Controller of Imports, and orders have been placed for importing them through Messrs. Voltas Ltd., Bombay. In the meantime, the plant is being operated with manual controls. After the commission-

ing of this plant, the Yarn Testing Section was shifted to the new building and in the space vacated, the new blow-room machinery imported from the U.K. is being erected.

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

Staff Amenities

In addition to the 24 staff quarters already built and allotted to the members of the staff, 16 Type-I quarters are proposed to be constructed for allotment to the Class IV employees of the Laboratory. The Central Public Works Department has prepared lay-out plans and cost estimates for these quarters. These have been forwarded to the Indian Council of Agricultural Research, New Delhi, for according administrative approval and expenditure sanction.

Extension Services

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

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

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

Finance

A statement showing the sanctioned budget grant of the Laboratory and the actual expenditure during the financial year 1968-69 is furnished in Appendix I. It will be noticed that the actual expenditure is Rs. 12.25 lakhs as against the sanctioned grant of Rs. 11.99 lakhs. The net excess of expenditure amounting to Rs. 0.26 lakh arose out of an expenditure of

Rs. 2.27 lakhs under "working expenses" offset by a saving of Rs. 2.01 lakhs under "capital expenditure". The increase of expenditure under working expenses is mainly due to : (*i*) increase in the rates of dearness allowance and merger of part of dearness allowance with pay with consequent increase in other allowances payable to staff, (*ii*) increased expenditure on "other contingencies", and (*iii*) expenditure on Technological Outstations, the funds for which were not separately sanctioned by the Council although originally provided for in the budget estimates by the Laboratory. The savings under capital expenditure are mainly the result of non-release of foreign exchange for the purchase of certain items of equipment from abroad. Apart from this, an expenditure of Rs. 1.20 lakhs was incurred on Technological Schemes (including projects financed from P.L. 480 funds) against the sanctioned grant of Rs. 1.54 lakhs, leaving an amount of Rs. 0.34 lakh unutilized.

Outstanding Achievements

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

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

North Zone (Haryana, Punjab and Rajasthan)
A.218, H.138-13 and J.132.

Central Zone (Gujarat, Madhya Pradesh and Maharashtra)
A.56-347, B.59-1684, 66-BH.5/91, B.61-2098, I.A.N.560, I.A.N.10(199) and Hybrid 4.

South Zone (Andhra Pradesh, Mysore and Tamil Nadu)
Sujata, M.C.U.5, M.C.U.4, 33-III-1, E.L.156E, S.B.289E and 1085-6.

An analysis of the results has shown that the main factors which contributed to the superior performance of some of the strains (Sujata, M.C.U.5, A.218, B.59-1684) over the others are the greater fibre length uniformity and higher bundle strength of these strains. Hence, it is essential that these two characteristics are kept in view while breeding or selecting new strains.

(*ii*) An investigation was carried out on the use of various instruments for measuring cotton fibre length and it was concluded that although the concepts and the length measurements differed from instrument to instrument, any one of them was equally good for the purpose of comparison of cottons. Among the various instruments available, the Digital Fibrograph appeared to be the best on consideration of quickness, convenience and accuracy.

(*iii*) For the study of the preparation of radio-resistant and radio-

sensitive celluloses, the samples of cotton treated with different chemical reagents were tested for the effect of gamma-ray radiation.

(*a*) The allylated cellulose samples of three different degrees of substitution (D.S.), when irradiated to dosage of 1×10^7 roentgens, did not show much protective effect.

(*b*) On irradiating to different dosages of gamma-ray, the samples grafted with polyacrylonitrile showed progressive decrease in the tenacity retained values with dosage. The increase in graft pick-up did not show appreciable effect on the radio protection of cellulose.

(*c*) The protective effect of the acetylated samples of varying D.S. increased with D.S. up to a D.S. of 1.60, beyond which there appeared to be no change.

(*d*) The protective effect of aliphatic amines increased with the amount of amino group present while that of aromatic amines increased with the increase in phenyl group.

(*e*) The benzoylated sample irradiated in the presence of ethylene diamine appeared to show low protective action.

(*f*) The radio protection of benzoylated samples appeared to be due to energy transfer effects while in the case of allylated samples the substituted group appeared to protect the cellulose molecule by undergoing changes within itself.

(*iv*) An investigation on density measurements was taken up with a view to get information on the structural changes taking place inside the swollen and chemically modified cotton fibres and to study the effect of changes in relative humidity and temperature on these fibres. Some very interesting conclusions were arrived at, such as : (*a*) the crystallinity in chemically modified cotton fibres appeared to be related to porosity of these fibres ; (*b*) the dry density of fibres increased as the density in water decreased ; (*c*) the degree of swelling from direct experiment was not strictly comparable with swelling estimations from density studies ; and (*d*) chemically modified cottons showed no appreciable variation in density value in the temperature range 30°-55°C.

(*v*) A study was made on the shape of the cross-section of the cotton fibre. The cross-sections of 20 cottons (500 cross-sections of each) were examined for circularity and they were grouped into three categories, viz. circular, elliptical and flat. It was observed that the cottons from *G. arboreum* had higher percentage of fibres with circular cross-sections than cottons belonging to other species, the respective average percentages of fibres with circular cross-sections being :

G. arboreum	32.6%	*G. barbadense*	16.5%
G. herbaceum	22.8%	*G. hirsutum*	11.5%

(*vi*) A study of the effect of some chemical treatments and fibre length

parameters on yarn characteristics has been undertaken and the following interesting observations were obtained :

(*a*) There was practically no change due to mercerization on yarn evenness measured as variation in weight per unit length by the direct "cut and weigh" method, but there was a distinct improvement in yarn appearance; however, tests with Uster Evenness Tester indicated that the yarns had become apparently more irregular.

(*b*) The breaking load, mean turns per inch and the coefficient of variation in mean turns per inch increased slightly on mercerization.

(*c*) The correlation coefficient of all the length parameters with Uster mean deviation per cent values for 30s count was found to be more than those for 20s and 40s counts.

(*d*) The length parameters had good correspondence with yarn irregularity when the fibre fineness was eliminated.

(*e*) Floating fibre percentage influenced the evenness of yarn to considerable extent.

(*f*) Short fibre percentage did not affect much the irregularity of the yarn.

(*vii*) In a preliminary study of the characteristic curve connecting count and C.S.P. for eleven cottons, which had practically the same spinning value (viz. 40s H.S.C.), it was observed that the correlation coefficient between the count and the C.S.P. was as high as 0.98, and that the C.S.P. and count (C) were linearly related, the regression equation connecting the two values being C.S.P. = 19.4 (130—C).

(*viii*) From the yarn tests carried out on a number of samples at different levels of humidity, to study the variation observed in the yarn test results due to the humidity, the relationship between the test results at 65 per cent r.h. and those at other levels of relative humidity were arrived at, viz. :

$$Y_{65} = Y_H [1 + 0.0027(65—H)]$$
$$S_{65} = S_H [1 + 0.0028(65—H)]$$
$$T_{65} = T_H [1 + 0.000828(65—H)]$$

where Y, S, T and H stand, respectively, for the yarn strength index, the lea count strength product, the linear density of the yarn in tex units and the level of relative humidity.

(*ix*) During the year, two Technological Reports, seven research publications, one Annual Report and two articles were published. Six articles were sent to various journals for publication and three articles contributed at scientific conferences. Further, 65 Technological Circulars were issued on different Trade Varieties and Standard Indian Cottons for the benefit of the Trade, Industry, the Cotton Breeders, etc.

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

II. Progress of Research

During the year under review, considerable progress has been made in the various research investigations undertaken at this Laboratory. A few papers based on the research work completed were published in suitable scientific and technical journals. In the case of a few more investigations, the experimental work had been completed and the results are being analysed. The work on the P.L.480 Project dealing with the effect of gamma-ray irradiation on raw and chemically modified cottons was progressing satisfactorily. Some of the important results have been indicated under "Outstanding Achievements" in the previous section.

With regard to the Project on the evaluation of quality of new strains of cotton, it may be pointed out that nearly 1,400 samples were received from various trials under the All-India Co-ordinated Research Project on Cotton. In many cases, the tests had to be carried out urgently so as to have the results for discussion at the respective Zonal Workshop Meetings held in April, May and June, 1969. Consequently, there was a heavy pressure of testing work in the earlier part of the year, which caused some dislocation in the progress of other research investigations.

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

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

A number of samples are received at the Laboratory for various tests from the State Departments of Agriculture. Some samples are obtained in connection with various research investigations at the Laboratory. The number of samples received during the years 1967, 1968 and 1969 together with the corresponding average figures for the quinquennium 1960-65 are given in Table 1.

The samples received from the State Departments of Agriculture are generally tested in the order of their receipt and the test results are sent to the officers concerned as quickly as possible. The results of tests on each of the Trade Variety and Standard Indian Cotton samples are reported in the form of a Technological Circular immediately after tests are completed. Later, the test results are consolidated for the whole season and published as

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

Type of test	Average for the quinquennium ending May 1965	1967	1968	1969
Fibre and full spinning tests	857	649	632	587
Micro-spinning tests (with or without fibre tests)	2,064	1,874	2,536	2,408
Fibre tests alone	213	277	102	155
Mill tests	—	11	20	10
Standard cottons	22	17	27	23
Trade varieties (Lint)	90	42	23	20
Trade varieties (*kapas*)	—	24	52	57
Technological Research	634	213	39	16
Miscellaneous	40	78*	—	255*
Total	3,920	3,185	3,431	3,491

* Includes 63 samples and 255 samples for chemical tests during 1967 and 1969, respectively.

two Technological Reports, one on the Trade Varieties and another on the Standard Indian Cottons. The technological research samples are utilized for the Laboratory's research work ; test resports based on the results of tests on these samples are not usually issued as the results are included in the relevant research papers published by the Laboratory. Besides these, some samples are received for miscellaneous tests, such as determination of quality of ginning, neppiness, oil content in cottonseed, 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 1969, about 26 samples had been received as *kapas* and were ginned. Further, 53 samples of *kapas* of Trade Varieties were ginned for determining their ginning outturn.

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 1969, are given in Table 2.

The results are discussed below :

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

The Laboratory continued to be actively associated with the All-India Co-ordinated Research Project on Cotton initiated by the Indian Council of Agricultural Research with effect from the 1st April, 1967. The total number of samples received and tested at the Laboratory under this Project during 1969 was 1,401. Out of these, 277 samples were for fibre and full

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

State	Fibre and full spinning tests		Micro-spinning with or without fibre tests		Fibre tests alone		Number of reports
	C.P.	Ag.	C.P.	Ag.	C.P.	Ag.	
Maharashtra	—	167	63	413	—	29	77
Gujarat	103	132	127	446	21	—	108
Madhya Pradesh	57	10	122	105	—	—	18
Rajasthan	24	—	140	9	57	9	20
Punjab & Haryana	70	1	132	62	—	—	16
Uttar Pradesh	—	—	—	42	—	32	9
Mysore	—	55	169	97	8	40	48
Andhra Pradesh	5	36	35	89	—	2	26
Tamil Nadu	18	26	154	28	—	—	45
Others	—	2	96	—	—	6	7
Total	277	429	1,038	1,291	86	118	374

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

spinning tests and 1,124 samples for fibre and micro-spinning tests. In addition, 93 samples were tested for oil content. Some important test results observed, while testing the samples from the Project, are indicated briefly below :

NORTH ZONE

(*a*) *G. hirsutum trials*

The first few strains in Br.2(a), irrigated *G. hirsutum* co-ordinated varietal trial, according to spinning performance, were as follows :

Hissar	*Abohar*	*Jullundur*	*Sriganga-nagar*	*I.A.R.I., New Delhi*
A.218	A.218	H.139	A.218	J.132
V.2	H.138-13*	H.138-13*	R.A.18	H.138-1*
P.31	H.139	P.B.36	J.34	H.139
A.C.138*	—	A.218	P.31	P.B.31
J.127	—	A.231	A.II	R.A.18
J.132	—	P.B.30	J.132	A.218

* These refer to the same strain.

It will be seen that A.218 has given the best spinning performance at three out of five places. It has also shown satisfactory performance at the remaining two places, viz. Jullundur and New Delhi. The other promising strains which showed good performance at more than two places were H.139, J.152 and H.138-13. At Hissar, the results of the season were, in general, poorer as compared to the results of the previous season.

The promising strains belonging to Br.3 irrigated preliminary varietal trials from the various centres may be listed as follows :

Hissar	:	H.138, H.142 and P.1
Abohar	:	A.C.134, H.165 and H.142
I.A.R.I., New Delhi	:	P.B.48, R.A.20, A.C.134 and P.31

In the case of major varietal trials at Abohar, the strains A.245, A.218, A.247 and A.251 from trial No. 1 and the strains A.208, A.245 and A.248 from trial No. 2 were found to be promising.

Among the 17 promising *G. hirsutum* strains from Hissar, Culture 500 had shown good technological performance, while the strains H.S.B.1 and 512 had also good fibre properties.

The following strains from the various trials pertaining to the experiment "To breed extra-long staple American cotton" at Sriganganagar gave very good performance and therefore need special reference.

Trial No. 2 :	*Trial No. 4* :
(320F × AII)—G-16-44-3	C.166-134-Co.2-M-G.4
(320F × AII)—G-16-44-14	C.116-134-Co.2-M-G.6
(320F × AII)—G-16-44-9	J.122-G.2
(320F × AII)—G-42-6-5	K.3802-G.6

Trial No. 3 :	*Trial No. 6* :
A.C.134-G-15	C.116-134-Co.2-M
A.C.134-G-3	

Miscellaneous Trial :

Culture 500

Mention may be made of the following strains from preliminary strain trial (selections from A.218) of advance generation (irrigated) at Sriganganagar as they have given good spinning performance:

A.218-21, A.218-29, A.218-54, A.218-66 and A.218-22.

With regard to miscellaneous trial at the Indian Agricultural Research Institute, Regional Centre, Sirsa, the strains S.S.166-2, S.S.165, S.S.167 and S.S.166-3 recorded good spinning performance at 40s count.

(*b*) *G. barbadense trials*

In the case of *G. barbadense* trials at the Indian Agricultural Research Institute, New Delhi, the promising strains were Tadla, Pima S-2, 17-3, 2-S-3, 87-1, Barbados, V.155, Baksh 5250, K.2308 and B.C.9262.

(*c*) *Other trials*

The test results on samples from feeler trial showed that both Sujata and M.C.U.5 performed fairly well at Banswara.

CENTRAL ZONE

(*a*) *G. hirsutum trials*

In the case of co-ordinated varietal trials in Gujarat, the results have been obtained separately for the early and the late maturing groups. In the case of early maturing group, under Br.2(a) irrigated *G. hirsutum* trial, the first six strains according to spinning performance are as follows :

Surat	*Junagadh*	*Talod*
B.59-1684	B.147	B.59-1684
I.A.N.560	B.1007	B.1007
B.1007	B.59-1684	A.56-347
Narmada†	A.56-347	I.A.N.560
I.A.N.10(199)	I.A.N.560	I.A.N.10(199)
A.56-347	I.A.N.10(199)	Gujarat 67 and B.147

The strain B.59-1684 has given the best spinning performance at two places, namely Surat and Talod, while it recorded almost the same performance as B.147 and B.1007 at Junagadh. All these strains also figured amongst the best performers last season and have also recorded good yields at Surat this year. The other promising strains which fared well at all the places during this season were I.A.N.560 and A.56-347.

With regard to late maturity group, under Br.2(b) irrigated *G. hirsutum* trial, the first five strains according to the spinning performance are as follows :

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†Other names used for certain strains are given below :

Narmada	= A.51-9	Varalaxmi	= D.C.H.3
Khandwa 1	= A.56-347	,,	= Laxmi × S.B.289E
Hampi	= 5110	M.C.U.4	= E.L.123
Vijaya	= A.S.23	M.C.U.5	= 815-3-1
Krishna	= A.C.122	Sujata	= Co-Pusa-Egyptian

Surat	*Junagadh*	*Talod*
M.C.U.5	M.C.U.5	M.C.U.5
A.218	A.218	A.218
A.231	A.231	S.C.8-126
Hampi	Hampi	S.C.4-102
M.C.U.4	S.C.8-126	A.231 and Hampi.

It may be noted that M.C.U.5, A.218, A.231 and Hampi fared well at all the three centres. Of these, M.C.U.5 has given outstanding spinning performance, recording over 50s H.S.C. at all the three centres, closely followed by A.218.

In the case of Br.2(a), irrigated *G. hirsutum* co-ordinated varietal trial, the strains K.W.61-276, B.61-2098, I.A.N.560 and A.56-347 at Khandwa, and M.C.U.5, K.W.61-270, Vijaya, B.61-2098 and A.56-347 at Achalpur recorded good spinning performance.

Comparing the technological performance of the strains pertaining to Br.2(b), rainfed *G. hirsutum* co-ordinated varietal trial from various places, the first five strains from each centre may be listed as follows :

Badnawar	*Indore*	*Khandwa*
66-BH.5/91 (51s)	66-BH.5/91 (59s)	66-BH.5/91 (60s)
B.59-1684 (51s)	B.59-1684 (56s)	Badnawar 1 (51s)
B.1007 (51s)	B.61-2098 (50s)	B.59-1684 (50s)
B.61-2098 (50s)	Badnawar 1 (50s)	K.W.61-276 (45s)
A.218 (49s)	B.1007 (49s)	I.A.N.560 (43s)

Note : Figures in brackets, refer to the corresponding H.S.C. values.

It may be noted that the strain 66-BH.5/91 has given the best spinning performance at all the three centres, closely followed by B.59-1684.

With regard to Br.3, co-ordinated trial of advanced generation material belonging to *G. hirsutum* at Achalpur, the strains which gave good spinning performance for 50s count were 66-BH.5/39, B.61-2037, 4755, K.W.62-352 and 66-BH.5/73.

Summing up the data of the test results of other trials of *G. hirsutum* strains, it was observed that the following strains have recorded good technological performance at the places indicated :

Junagadh (Br.5 (a))	—	H.B.J.1-1479-1700
Junagadh (Br.6(b))	—	I.S.C.67 × Pima 4521
Junagadh (Br.7)	—	0692B × P.R.S.72
Junagadh (L.S.V.T.)	—	H.B.J.1-2-1479, G.C.1-456 and G.C.3
Indore (Br.5(a))	—	B.61-1947, B.61-1950 and B.61-2061
Indore (Br.5(b))	—	B.64-2474 and 66-BH.5/51

Badnawar (Br. 5(b))	—	66-BH.5/45, 66-BH.5/38, 66-BH.5/32, 66-BH.5/56 and 66-BH.5/58
Khandwa (rainfed varietal trial)	—	B.61-2034, K.W.66-2097, K.W.82-501, D.56-181, K.W.61-240 and K.W.61-276.

With regard to the trial of Physiology 1 at Surat, only two strains, viz. M.C.U.5 and B.59-1684, gave good performance. The strains 68-BH.25/7 and 68-BH.25/33 were found promising in the case of experiment "To breed *G. hirsutum* strain which has staple length more than Badnawar 1" at Badnawar.

(*b*) *G. barbadense trials*

Sujata and Giza 7 gave outstanding performance at Surat as they were spinnable to over 90s count. Sujata and Pima grown at Junagadh recorded C.S.P. over 2,100 at 60s count, whereas Andrews and Menoufi did not fare well.

(*c*) *G. arboreum trials*

In the case of *G. arboreum* trials, although the strains Sanjay, H.4, A.K.277 and C.C.1-1-3 ranked first four in the list, they did not attain the standard C.S.P. value for 30s count at Indore, while strain C.C.1-1-3 alone was found suitable for being spun to 30s count at Akola.

(*d*) *G. herbaceum trials*

Amongst the *G. herbaceum* trials in Gujarat, the following strains recorded good spinning performance :

Surat	:	3200, 2623 and Digvijay (Control)
Viramgam	:	62-2, 38-1, 2772, 11-7-2 and 11-7-1.

(*e*) *Other trials*

In the case of feeler trials at Khandwa and Achalpur, Hybrid 4 recorded C.S.P. value nearer to the standard required for 40s count. Sujata at both the places was adjudged as suitable for being spun to 60s count.

A number of *hirsutum-barbadense* crosses at Surat gave good spinning performance at 60s count.

SOUTH ZONE

(*a*) *G. hirsutum trials*

In the case of the samples from Br.2(a), irrigated *G. hirsutum* trial at Amaravati, none of the strains was adjudged suitable for spinning to 50s count. Vijaya and M.C.U.5 had given the best performance amongst the strains tested.

In the case of samples from Br.2(a) irrigated trial at Arabhavi, M.C.U.4, 33-III-1, Vijaya, M.C.U.5. and A.S.6 were the first five strains according to micro-spinning test and M.C.U.5, Mysore 14, Vijaya, 33-III-1 and 9092 in full spinning. The strain M.C.U.5 from Br.2(a) trial at Siruguppa had good combination of fibre properties and recorded standard C.S.P. for 40s count.

With regard to the samples from Br.2(a) irrigated trial at Coimbatore, M.C.U.5, M.C.U.4 and 33-III-1 gave good spinning performance. At Srivilliputhur, the promising strains were 86-1a-1, E.L.628, M.C.U.4, A.S.6 and P.R.H.30/2.

In the case of the samples from Br.2 (b) rainfed *G. hirsutum* trial at Dharwar, only M.C.U.5 was promising as it combined good fibre properties and had the required strength at 40s count. Strain M.C.U.5 from Br.2(b) trial at Ranibennur also possessed good fibre properties. However, all the strains recorded poor spinning performance.

With regard to the samples from Br.2(b) rainfed trial at Kovilpatti, strains Mysore 14, M.C.U.5, E.L.909-2 and 71-SB.6 gave good spinning performance.

In the case of the samples from Br.3(a) irrigated preliminary varietal trial at Arabhavi, E.L.S.150, A.H.010 and Vijaya gave satisfactory spinning performance.

Amongst the samples from Br.3(a) irrigated preliminary trial at Srivilliputhur, the best five strains according to spinning performance were 35-III-1, A.H.010, 63-1, A.H.004 and A.H.006.

Amongst the Br.3(b) rainfed preliminary varietal trial at Arabhavi, the strains Vijaya and I.C.1728 were found suitable for spinning to 40s count.

In the case of miscellaneous trials of *G. hirsutum* at Dharwar, two strains, namely Sujata and Laxmi × S.B.289E (D.C.H.3 or Varalaxmi) were found promising.

With regard to bulk yield trials at Tenali, all the samples except Krishna and P.216F were found suitable for being spun to 40s count. The first five strains in respect of spinning performance were S.82, H.S.38, H.S.6, V.1 and H.S.45, and H.S.10, 9/17, H.S.1, H.S.54 and H.139 in trials I and II, respectively.

In the case of main strain trial at Kovilpatti, E.L.156E and 909-BK.5, were more promising than the rest.

(*b*) *G. barbadense trials*

The samples of Sujata and S.B.289E from Coimbatore had given outstanding spinning performance as they were capable of being spun to 100s and 90s counts, respectively. A few samples of Sea Island types from Coimbatore had very high mean fibre length values combined with high bundle strength values. Another interesting result obtained with *G. barbadense* at

Coimbatore was with regard to the performance of the strain 1085-6. Further trials with this strain may be worthwhile.

(*c*) *G. arboreum trials*

In the case of the strains from this trial at Kovilpatti, none of the strains was better than K.7, as they were not spinnable to 30s count.

(*d*) *G. herbaceum trials*

In the case of the samples from Br.14(b) rainfed trial of *G. herbaceum* at Dharwar, none of the strains had satisfactory spinning performance at 30s count. The first five strains in the case of samples from Raichur pertaining to the same trial were B.C.6-1, 308-3, 1400, B.C.3200 and Digvijay when they were spun to 20s count.

Summarising, the following improved strains are very promising in the trials so far conducted:

The strain A.218 has given the best technological performance in the North Zone for the second year in succession and was found good in the Central Zone as well. The superiority of this strain is mainly due to its good fibre length associated with high bundle strength. The strain B.59-1684 originating from Badnawar has given very good performance at various centres like Indore, Surat, Talod and Badnawar. The strain A.56-347 has maintained its superiority over Narmada at Khandwa both under irrigated and rainfed conditions ; this has also fared well at Achalpur and Junagadh under irrigated conditions. The strain A.S.23 released under the name 'Vijaya' in 1968 by the Mysore State authorities has good length but low bundle strength. Similarly, the strain 909-2 grown in Tamil Nadu has good length but low strength. These need further improvement. The strain 33-III-1 which performed well in the South Zone last year, fared well this year at Srivilliputhur, having a length of 30.2 mm. and a bundle strength of 52.5 g/t.

Among the strains already approved for release, the strain M.C.U.5 (approved at the Bangalore meeting of the All-India Workshop) continued to give good performance this year also, at Surat, Junagadh, Talod, Achalpur, Coimbatore and Srivilliputhur, although its performance was not so good at various places in Mysore State. The strain Co-Pusa-Egyptian which was recommended for release in 1968, under the name 'Sujata', has maintained its spinning performance and proved suitable at many other places as well. Its yield also has been found to be fairly good this year.

At the All-India Workshop Meeting of Cotton Research Workers held in June 1969, the improved strains Sujata, A.56-347 (named as Khandwa 1) and G.27 were approved for release for large-scale cultivation, while pre-release seed multiplication of E.L.156E was recommended. Sujata is an extra-long staple cotton, having a *kapas* yield of 1,930 kg/ha. and being

capable of spinning up to 100s count. This variety is proposed to be developed in Coimbatore, Yemmiganur and Shimoga tracts of Tamil Nadu, Andhra Pradesh and Mysore State, respectively. A.56-347 has recorded higher yield than Narmada, the local variety, and is capable of spinning to higher counts (up to 43s). G.27 is a *desi* strain giving a very high yield, much superior to the existing variety 231R.

The strain E.L.156E gives nearly double the yield of the existing variety K.7 under rainfed conditions and is practically of the same spinning capacity as K.7. This variety is proposed to be developed to replace K.7 in the Karunganni tract of Tamil Nadu.

(ii) Improved Varieties Evolved Under Other State Schemes

Although the results of the tests on samples received from the State Departments of Agriculture are mainly intended for the particular Cotton Breeder or research worker who had sent the 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. The test results are given in Table 3 and some of the interesting observations are indicated below :

MAHARASHTRA

The eight strains, viz. T.H.87, D.Hy.79, D.Hy.82, D.Hy.286, D.Hy.172, Hy.106, B.147 and B.1007, had been tried at a number of places in the State. The samples of these received from Achalpur, Kutaki and Yeotmal had been tested during 1969. Their average test results indicate that D.Hy.79, D.Hy.82, D.Hy.286 and Hy.106 are on par with B.1007 in spinning performance. Similarly, the strains C.C.1-1-3, C.C.1-1-3-Bk.1, C.C.1-1-3-41, H.4, B.147, B.1007 and Sanjay were raised at a number of places in the State. From their average test results, it is observed that B.1007 gave the best spinning performance ; amongst the *desi* strains, however, C.C.1-1-3-Bk.1 was better than the rest.

GUJARAT

The strains 3943 and Digvijay were raised at a number of places and sent to the Laboratory for tests by the Cotton Specialist, Surat. Their average test results show that both the strains have similar fibre properties and practically the same spinning capacity.

MYSORE

Among the many strains, samples of which were received and tested at the Laboratory during the year, the strain Vijaya was the most promising and was adjudged suitable for spinning to 41s count.

Andhra Pradesh

A large number of samples of new strains had been received from several stations. The test results of those samples which had been adjudged suitable for spinning to 40s count and above are indicated in Table 3. The promising strains are S.82, S.88, A.C.122 (already released as Krishna), V.13, V.14 and P.216F at Tenali, B.1007 and P.A.1 at Adilabad, and Laxmi at Adoni.

Tamil Nadu

A large number of improved strains were received from Tamil Nadu for tests during 1969. Among these, the varieties S.B.289E, L.1143E, E.L.156E and P.R.S.72 were observed to be very promising.

Table 3. Test Results of Promising Improved Varieties

Variety	Mean fibre length		Fineness		Maturity coefficient	Bundle strength		H.S.C.
	mm	in.	Millitex	Micronaire value		g/t	lb/mg	
Achalpur, Kutaki and Yeotmal (Maharashtra)								
T.H.87	24·3	0·96	169	4·3	0·78	46·8	8·7	40s
D.Hy.79	25·8	1·02	150	3·8	0·73	45·0	8·4	47s
D.Hy.82	25·5	1·00	150	3·9	0·73	46·4	8·7	48s
D.Hy.286	25·0	0·99	152	3·9	0·72	48·5	9·0	49s
D.Hy.172	24·4	0·96	162	4·1	0·76	49·2	9·2	42s
Hy.106	25·2	0·99	154	3·9	0·75	49·9	9·3	46s
B.147	24·5	0·96	159	4·1	0·76	47·2	8·8	41s
B.1007	26·3	1·04	151	3·9	0·72	48·2	8·7	47s
Somnathpur, Dhulia, Washim, Nanded, Badnapur and Jalgaon (Maharashtra)								
C.C.1-1-3	23·4	0·92	175	4·5	0·88	48·2	9·0	35s
C.C.1-1-3-Bk.1 ..	23·4	0·91	185	4·4	0·87	47·0	8·8	38s
C.C.1-1-3-41	23·4	0·92	175	4·4	0·88	48·1	9·0	35s
H.4	22·8	0·90	193	4·9	0·79	46·2	8·6	31s
B.147	25·5	1·00	165	4·2	0·86	46·5	8·7	39s
B.1007	25·7	1·00	162	4·0	0·74	47·0	8·7	44s
Sanjay	22·7	0·90	190	4·8	0·79	47·9	8·9	30s
Surat, Kathor, Asunder, Nandida, Vankla, Shera, Bedoli and Khadsupa (Gujarat)								
3943	22·8	0·90	157	4·0	0·76	47·7	8·9	31s
Digvijay	21·9	0·86	141	3·6	0·74	48·6	9·1	31s

TABLE 3 (*Contd.*)

Variety	Mean fibre length		Fineness		Maturity coefficient	Bundle strength		H.S.C.
			Millitex	Micronaire value				
	mm	in.				g/t	lb/mg	
Arabhavi (*Mysore State*)								
Vijaya	24·4	0·96	130	3·3	0·62	44·0	8·2	41s
Tenali (*Andhra Pradesh*)								
S.82	26·2	1·03	173	4·4	0·79	52·0	9·7	46s
V.13	25·9	1·02	169	4·3	0·78	51·5	9·6	47s
Krishna	25·1	0·99	154	3·9	0·74	47·2	8·8	40s
Krishna (Max.)	24·4	0·96	169	4·3	0·78	48·8	9·1	43s
V.14*	25·9	1·02	173	4·4	0·77	50·9	9·5	43s
S.88*	25·1	0·99	157	4·0	0·74	49·3	9·2	43s
P.216F*	23·1	0·91	181	4·6	0·80	50·4	9·4	42s
V.14	26·4	1·04	169	4·3	0·76	52·5	9·8	47s
S.88	24·4	0·96	169	4·3	0·78	51·5	9·6	42s
Adilabad (*Andhra Pradesh*)								
B.1007	26·2	1·03	157	4·0	0·76	47·2	8·8	42s
P.A.1	24·4	0·96	150	3·8	0·76	46·1	8·6	41s
Adoni (*Andhra Pradesh*)								
Laxmi (N)	24·3	0·96	150	3·8	0·73	42·3	7·9	45s
Laxmi (F)	25·0	0·98	165	4·2	0·74	40·7	7·6	40s
Coimbatore (*Tamil Nadu*)								
S.B.289E*	31·4	1·24	169	4·3	0·75	49·5	9·2	Above 80s
S.B.289E	29·4	1·16	150	3·8	0·69	49·8	9·3	,,
L.1143E	23·2	0·91	126	3·2	0·66	39·7	7·4	42s
Kovilpatti (*Tamil Nadu*)								
E.L.156E	25·0	0·98	130	3·3	0·69	45·6	8·5	40s
Tanjore (*Tamil Nadu*)								
P.R.S.72	24·5	0·96	197	5·0	0·84	47·7	8·9	40s

*These samples belong to 1966-67 season.

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

The results of full scale spinning tests carried out on extra-long staple cotton samples received and tested at the Laboratory during 1969 are shown in Table 4. This would be of help to the Cotton Breeders to draw on the material for use in their research programme.

TABLE 4. RESULTS OF EXTRA-LONG STAPLE (27 MM AND ABOVE) COTTONS TESTED IN 1969

Variety	Place	Mean fibre length		Irregularity, %	Fineness		Maturity coefficient	Bundle strength		H.S.C.
		mm	in.		Millitex	Micronaire value		g/t zero gauge	P.S.I. lb/mg	
Maharashtra					1967-68 Season					
D.Hy.82	Kutaki	27·4	1·08	19·9	154	3·9	0·76	46·6	8·7	49s
Buri 1007	Parbhani	28·2	1·11	23·1	150	3·8	0·73	44·5	8·3	43s
Buri 1007	Badnapur	27·2	1·07	21·2	150	3·8	0·73	46·6	8·7	51s
Buri 1007	,,	27·4	1·08	20·0	138	3·5	0·68	46·1	8·6	51s
					1968-69 Season					
A.P. Buri	Kopargaon	30·2	1·19	21·6	165	4·2	0·78	40·7	7·6	45s
Buri 147	,,	28·2	1·11	21·6	177	4·5	0·78	42·9	8·0	49s
Buri 1007	,,	27·7	1·09	25·9	165	4·2	0·76	40·2	7·5	47s
1371	,,	28·4	1·12	20·8	165	4·2	0·80	39·1	7·3	45s
107/221	,,	29·5	1·16	18·8	157	4·0	0·74	39·7	7·4	47s
4-42 Acala	,,	28·5	1·12	15·0	173	4·4	0·79	41·3	7·7	46s
56/23	,,	28·7	1·13	19·2	173	4·4	0·74	40·2	7·5	47s
Nimbkar 1	,,	28·7	1·13	19·9	181	4·6	0·78	35·9	6·7	34s
Nimbkar 3	,,	27·7	1·09	23·5	181	4·6	0·81	33·8	6·3	31s
Laxmi	,,	28·2	1·11	19·9	150	3·8	0·72	38·6	7·2	45s
Buri 1007	Jalgaon	27·8	1·09	22·1	169	4·3	0·78	46·1	8·6	50s
Buri 1007 (Nucleus) ..	Amaravati	27·2	1·07	24·4	150	3·8	0·74	47·2	8·8	41s

Table 4 (*Contd.*)

Variety	Place	Mean fibre length		Irregularity, %	Fineness		Maturity coefficient	Bundle strength		H.S.C.
		mm	in.		Millitex	Micronaire value		g/t zero gauge	P.S.I. lb/mg	
Gujarat				1967-68 Season						
I.S.C.67 × Giza	Surat	31·0	1·22	26·6	126	3·2	0·65	39·1	7·3	38s
I.S.C.67 × 133-FK.3622	,,	27·3	1·07	27·4	142	3·6	0·72	39·7	7·4	32s
I.S.C.67 × Marrad	,,	28·4	1·12	30·6	118	3·0	0·63	39·1	7·3	36s
I.S.C.67 × R.9/43E-30	,,	27·5	1·08	26·8	126	3·2	0·67	39·7	7·4	38s
I.S.C.67 × Meade-1930	,,	27·5	1·08	28·6	138	3·5	0·70	38·6	7·2	41s
B.C.68 × Giza	,,	27·1	1·07	27·6	114	2·9	0·61	38·6	7·2	33s
B.C.68 × Marrad	,,	32·9	1·30	26·4	122	3·1	0·64	38·6	7·2	39s
Tamil Nadu				1967-68 Season						
S.B.289E	Coimbatore	29·4	1·16	24·2	150	3·8	0·69	49·9	9·3	Above 80s
				1968-69 Season						
Co-Pusa-Egyptian	,,	29·4	1·16	18·0	150	3·8	0·70	49·8	9·3	100s

(iv) Mill Tests

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

During the year, mill tests were carried out on 11 samples. The comparative test results at the mill and the Laboratory are given in Table 5.

TABLE 5. COMPARATIVE MILL AND LABORATORY TEST RESULTS ON 1968-69 SEASON SAMPLES

Spinning Test Results

Place	Variety	Laboratory test results				Mill test results				
		Waste, %	Count	Strength, lb	t.m.	Waste, %	Yarn recovery, %	Count	Strength, lb	t.m.
Tamil Nadu										
Coimbatore	S.B.289E	8·8	60s	38·2	3·75	22·7*	—	60s	41·1	3·91
			80s	26·8	3·75		—	80s	27·2	3·91
Coimbatore	Sujata	9·0	80s	30·0	3·75	20·4*	—	80s	30·9	3·91
			100s	21·2	3·75	23·0*	—	100s	25·8	—
Kovilpatti	E.L.156E	9·9	40s	41·9	4·0	7·1	—	40s	44·0	4·0
	Laxmi	9·2	40s	38·2	4·0	7·5	—	40s	44·8	4·0
Mysore										
Arabhavi	Vijaya	9·2	40s	38·0	4·0	8·4	—	40s	37·0	4·0
	Deviraj	9·4	40s	37·8	4·0	8·3	—	40s	34·5	4·0
Hagari	3870-S.B.	13·7	24s	65·5	4·25	15·9	82·0	24s	58·6	4·45
	3870-IV/1	13·7	24s	60·0	4·25	16·1	81·0	24s	55·2	4·45
	Westerns 1	17·2	24s	57·5	4·25	14·5	82·0	24s	50·7	4·45
Andhra Pradesh										
Nandyal	1301-D.D	13·7	30s	55·3	4·0	13·7	82·5	30s	56·3	4·4
	Laxmi	11·6	30s	56·6	4·0	16·3	78·7	30s	55·0	4·45

* Combed.

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

It will be seen that the new variety Sujata, evolved at Coimbatore, gave outstanding performance and was considered suitable for spinning 100s count, while another new variety S.B.289E, possessing nearly similar fibre properties, was found suitable for spinning to 80s count. The variety E.L.156E is a high yielding variety and its spinning performance being equal to that of Laxmi, which is locally grown, will be of immense benefit to the farmers. At Arabhavi in Mysore State, the high yielding variety Vijaya gave slightly better spinning performance than Deviraj, which is locally grown at present. Among the two new varieties, 3870-S.B. and 3870-IV/1, the former was better than the latter, both being better than the locally grown Westerns variety. At Nandyal in Andhra Pradesh, the high yielding variety 1301-D.D. gave nearly the same spinning performance as Laxmi.

(*v*) *Extension of Improved Varieties*

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

(*vi*) *Standard Indian Cottons*

In order to assess the seasonal fluctuations in the characters of Indian cottons and with a view to judging the comparative superiority or otherwise of the newly evolved strains, a number of selected varieties of Indian cottons called Standard Indian Cottons are tested at the Laboratory every year. These are grown under identical conditions from year to year in the Government Farms under departmental supervision. Extensive fibre and spinning tests are regularly carried out on such samples. The results obtained on 24 samples received from the 1967-68 season were published as Technological Circulars for the information of the Cotton Breeders and other research workers as early in the season as possible. The results of all the samples pertaining to the 1967-68 season were consolidated and published at the end of the season as Technological Report No. 6 entitled, "Technological Report on Standard Indian Cottons—1967-68 Season". Most of the samples of the Standard Indian Cottons of the 1968-69 season have been received and tested.

(*vii*) *Trade Varieties*

Lint samples of fair average quality of the major Trade Varieties of Indian Cottons are being obtained through the East India Cotton Associa-

tion Ltd., Bombay, each season. Representative *kapas* samples of the varieties are procured from the State Departments of Agriculture for determination of ginning percentage. The fibre and spinning test results, ginning percentage and other tests results on each variety of cotton were published as Technological Circulars as early in the season as possible, for the information of the cotton trade and industry. Such circulars were issued during 1969 on 47 Trade Varieties. The test results on all the Trade Varieties of the 1967-68 season were compiled and published as Technological Report No. 5 entitled, "Technological Report on Trade Varieties of Indian Cottons—1967-68 Season". Most of the samples of the 1968-69 season have also been received and tested.

(viii) Testing Work Done at Field Stations

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 for each fibre property at the various field stations during 1969 is given in Table 6.

TABLE 6. NUMBER OF COTTON SAMPLES TESTED AT FIELD STATIONS

Station	Fibre properties tested			
	Mean fibre length	Fibre fineness	Fibre maturity	Fibre strength
Coimbatore	1,589	1,483	1,483	1,423
Dharwar	997	997	823	823
Hissar	291	754	657	16
Indore	676	595	577	496
Nanded	667	667	502	506
Nandyal	332	339	137	187
Sriganganagar	120	54	210	120
Surat	3,661*	3,560	3,602	4,185

* 3,566 tested on Digital Fibrograph and 35 on Balls Sorter.

It may be mentioned that at the field stations, the samples are tested for specified fibre properties only, while at the Laboratory, all the chief fibre properties are generally determined on all the samples.

2. Evaluation of linter, oil and gossypol contents of various genetic stocks for evolving varieties with higher oil content and low gossypol content

During the year under report, 153 cottonseed samples were tested for moisture content, seed weight and oil content. Oil content values of these samples ranged from 12.92 per cent (D.46-2-1 Garo Hill) to 23.29 per cent (Co-Pusa-Egyptian). These included 28 seed samples from Arabhavi from Br.2(a) and Br.3 trials of All-India Co-ordinated Research Project on Cotton (A.I.C.R.P.). Oil content values of these samples varied from 16.42 per cent (0892-B) to 20.84 per cent (E.L.123). Twelve cottonseed samples each from Coimbatore and Siruguppa, pertaining to the A.I.C.R.P. trials (1968-69 season), were tested for oil content. Laxmi and Hampi varieties showed almost the same percentage of oil in seeds at both the places while other samples from Coimbatore showed higher oil content (about 2 to 5%) than the corresponding samples from Siruguppa.

Further study was also made on oil, linter and kernel per cent of cottonseeds of 33 Trade Varieties and it was observed that oil content varied from 15.05 per cent (Jayadhar) to 21.27 per cent (320F), linter content from 2.60 per cent (N.R.5) to 15.48 per cent (Pramukh) and kernel from 50.0 per cent (K.7) to 60.3 per cent (Deviraj).

Kernels of 11 cottonseed samples were studied for free gossypol and the values ranged from 0.50 per cent (Red arboreum) to 1.81 per cent (Laxmi). Protein content was determined for seven seed samples and the values ranged from 19.9 per cent (Gujarat 67) to 23.6 per cent (N.R.5). Kernel powder was analysed for protein content on 10 cottonseed samples and the values ranged from 29.5 per cent (Sanguineum) to 40.7 per cent (G.135-49). Hulls of two varieties of cottonseeds were also tested for protein content and the values were 5.8 per cent (N.R.5) and 5.3 per cent (Red arboreum).

3. Physico-chemical characteristics of cotton treated with decrystallizing and swelling reagents

During the year under report, M.C.U.3 cotton was treated with zinc chloride solutions under varying conditions. Treated and control samples were studied for degree of polymerization (D.P.), crystallinity, moisture regain, dye absorption and barium activity number. Treatments with higher concentrations (60% and above) of zinc chloride showed appreciable decrease in crystallinity and D.P. and increase in the other three properties, with a few exceptions. Some of the selected samples were also studied for fine structural changes by employing infra-red spectroscopic technique. Changes observed in spectra are being examined in detail. Preliminary treatments on lint samples of M.C.U.3 cotton were also carried out with urea solutions (0 to 55%) and treated samples were tested for crystallinity and sorption behaviour. Treated samples showed appreciable decrease in crystallinity and increase in moisture regain values compared to the un-

treated sample. The effect of this treatment is being studied in more detail with respect to concentration, time and temperature.

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

The results of Micronaire tests on *desi* cottons, carried out after blending them with P.216F cotton, were given in the last Annual Report. During the year under report, another cotton, namely Laxmi, having about the same Micronaire value as P.216F, was taken as standard and Micronaire tests were carried out on *desi* cottons after blending them with Laxmi, adopting the same procedure as with P.216F. The Micronaire value of the blended sample, when compared with the harmonic mean of the individual fibre fineness values, showed the same type of regression equation and correlation as was observed in the case of blends with P.216F. The theoretical harmonic mean (y) plotted against the experimental Micronaire value (x) of the blend gave the regression equation $y = 0.91x + 0.485$.

Further work is in progress.

5. Comparison of fibre length as measured by different instruments

The analysis of the data relating to fibre length and length uniformity parameters determined by various instruments was continued and completed. The analysis led to the following important conclusions :

The mean length determined by the Balls Sorter was found to be significantly lower than that by the Baer Sorter. The mean lengths obtained by Baer Sorter and A.N. Stapling Apparatus did not differ from each other significantly, though the latter showed a trend for higher values. However, in general, the mean lengths determined by these three methods lie very close to one another, the differences between them varying from 0.11 mm to 0.44 mm.

Though the values of mean lengths obtained by Fibrographs (both Manual and Digital) and Uster Stapling Instrument might be theoretically expected to be the average length of fibres in a sample, practically all of them were very much lower than the average length obtained by conventional sorting methods like Balls Sorter or Baer Sorter. This discrepancy might be mainly due to the imperfections and incorrectness in the postulates and assumptions made in each case.

The effective length from Baer Sorter diagram due to Clegg's construction was considerably higher than the values of upper-half mean lengths from Uster and Manual Fibrograph, 2.5% span length from Digital Fibrograph and effective length from Uster diagram, all of which were akin to American Grader's estimation.

The Fibrosampler technique of specimen preparation for tests on Digital Fibrograph was not found to improve either the quality or the speed of the specimen preparation as compared with hand-combing technique.

High values of correlation coefficients were obtained between the various parameters of length by different methods. This indicated that for the purpose of comparing and ranking the cotton samples according to their length, any one method could be used in place of another without much risk of error.

The Balls Sorter could be taken as a standard instrument for length measurement, though it is very slow. The Baer Sorter, on the other hand, takes more time for testing, is more strenuous and is less accurate, being subject to considerable personal error of measurement. The A.N. Stapling Apparatus is comparatively quicker but is also subject to considerable personal error.

The Uster Stapling Instrument is quicker but it gives a lower mean value than that by the conventional diagram obtained with the Baer Sorter.

The Manual and Servo models of the Fibrograph are quicker and the upper-half mean lengths obtained by them closely agree with the American Grader's value. The Digital Fibrograph is extremely rapid and is the quickest and most convenient for testing, the 2.5 % span length value, determined with this instrument, closely agreeing with the American Grader's value of the staple length. Added to this, the coefficient of variation (C.V.) from Balls Sorter distribution (weight) is highly correlated with digital ratio from which it follows that Digital Fibrograph can assess also the uniformity of cotton samples with a fair degree of accuracy.

6. Effect of pests and diseases on the quality of cotton

With a view to assess the extent of deterioration of the quality of cotton as a result of attack by pests and diseases and to assess the effect of various insecticidal 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, nine samples of Laxmi from Adoni and 14 samples of G.46 from Nanded (Maharashtra) pertaining to 1966-67 season were tested for ginning percentage, mean fibre length, Micronaire fineness, maturity coefficient and bundle strength at zero and 3 mm gauge lengths. The results will be analysed after tests are completed on all the samples.

7. Determination of Balls Sorter equivalent values of mean fibre length of cotton for different values of 2.5% span length and uniformity ratio of the Digital Fibrograph

Extensive tests were carried out on the Digital Fibrograph on about 2,000 cotton samples. A preliminary analysis was done on the data relating to the cotton samples having mean length between 21.6 mm (0.85 in.) and 26.7 mm (1.05 in.). It was observed that the 2.5% span length values and Balls Sorter mean length values were highly correlated. The multiple correlation coefficient was higher when the uniformity ratio also

was taken into account. The relationship between the 2.5% span length and Balls Sorter mean length values is proposed to be studied in more detail separately for different staple length groups. Statistical analysis of the data will be carried out.

8. Fabrication of an Extractor for improving the ginning of *kapas*

During the period under report, damaged parts, such as steel wire brush and steel wire grid, were replaced and repaired, respectively, and their positions were adjusted. Trials on old *kapas* samples were conducted to study the performance of the Extractor. It was observed that the speed of rollers was varying with the change of feed rate of *kapas*. This was mainly due to defective pulley locking arrangements and slackening of belts when the machine was in operation.

Arrangements for the removal of the above defects are in progress. Regular tests will be carried out thereafter.

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

During the period under report, study on degree of cell wall thickening of the cotton fibres extracted from bolls of different ages (7 to 56 days), at intervals of seven days, was completed on 40 samples of Digvijay cotton. It was observed that the degree of thickening gradually increased with the advancement of age. Further work is in progress.

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

During the period, 12 samples of *G. herbaceum* cottons were screened by propanol retention technique. Determinations of convolution angle and reversals were carried out on 32 samples (10 samples of *G. hirsutum* grown in India, 10 samples of *G. hirsutum* grown in the U.S.A. and 12 samples of *G. herbaceum*). Fibre bundle strength values at zero and 3 mm gauge test lengths were also determined for all the 32 samples under study. All samples have been dyed with Carbolan Violet 2 R.S. and the determination of dye absorption values is in progress.

11. Investigation of the microbial decomposition of cellulose in Indian environments with special reference to cellulolytic enzymes produced by streptomyces and fungi isolated from cotton and cotton products

Screening of samples received : Twelve different cotton, yarn and fabric samples were screened for viable count and for the presence of cellulolytic organisms. Eight cultures of fungi and two of actinomycetes showed prominent cellulolytic activity. Further studies are in progress.

Degradation of canvas pads in sea : Ten canvas pads (12″ × 4″) were kept about 10 feet deep in break water in the sea. After every week, one

pad was removed and was screened for the presence of cellulolytic micro-organisms. It was found that the fabric strength decreased from about 518 kg to 11 kg after four weeks. Two fungi and two actinomycete cultures isolated from deteriorated canvas and showing prominent cellulose activity are being studied further.

Enzyme studies : Four prominent cellulose producing cultures—two of fungi and two of actinomycetes—and three standard cultures were grown in different media for varying period. Effects of pH and temperatures on enzyme production were also studied.

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

The sample of cotton grafted with polyacrylonitrile was analysed for the effect of radiation dosage. The tenacity retained in the grafted sample of pick up, 63.57 per cent, increased slightly at the initial dosage of 1×10^5r and then systematically decreased with dosage. The results of the number-average molecular weight determination on the irradiated grafted samples indicated that the degradation of polyacrylonitrile (PAN) side chains in grafted samples of pick ups, 63.57 per cent and 27.53 per cent, was comparatively much less than that in cellulose backbone. The tenacity retained values of the grafted samples of the increasing pick ups, viz., 27.53, 63.57, 97.00 and 125.00 per cent, indicated that there was not much effect of increasing graft chains on the radio-protection of cellulose.

The acetylated samples of varying D.S. were assessed for the effect of acetyl group of the radio-resistance of cellulose. The tenacity, elongation and D.P. retained values of the acetylated samples of increasing D.S. indicated that the protective effect increased with D.S. up to a D.S. of 1.60, beyond which there appeared to be no change. The acetylated samples of D.S. 1.02 and 2.34, irradiated to the dosage of 1×10^8 roentgens, showed reduction in copper number and change in viscosity values after $NaBH_4$ treatment. The uronic acid carboxyl groups in the case of acetylated samples, irradiated to 1×10^8 roentgens, were low as compared to those in raw sample. The above observations indicated that the substituent acetyl group appeared to enter predominantly on C_6 Carbon atom.

The acetylated sample of D.S. 0.74 was analysed for the degradation products. The analysis indicated that the nature of degradation products were similar to that in the case of acetylated sample with D.S. 1.02. The percentage of degradation products and the oxidative breakdown were comparatively more than those in raw sample.

Physico-chemical tests were performed on cellulose irradiated in presence of amines. The results appeared to show that the protective effect of aliphatic amines increased with the amount of amino-group present, capable

of forming the intermediate product NH_3, while the protective effect in the case of aromatic amines increased with an increase in the phenyl group.

The tenacity retained values of the benzoylated sample, D.S. 1.0, irradiated in presence of EDA and Indole, appeared to show that there was decrease in protective action with EDA, while Indole did not have much effect.

Allyl cellulose of three different D.S., prepared by modified procedure, were assessed for their radio-protective effect. The samples did not show much protective effect when irradiated at 1×10^7 roentgens. E.S.R. analysis showed that the benzoylated samples yielded lower radical concentration compared to raw samples, while allylated samples yielded higher radical concentration. It appeared that the radio-protection of benzoylated samples might be due to the energy transfer effects resulting in a lowering of localization energy on cellulose. In the case of the allylated samples the substituted allyl group appeared to protect the cellulose molecule by undergoing changes to itself. The dose response curves of the allylated samples showed that the spin concentration of the allylated samples was greater than that of the control in the range of doses employed, the concentrations in the substituted samples tend to level off at higher doses compared to that in control, and, with higher D.S., the radical concentration at any particular dose increased. The warming up studies on the same samples showed significant and interesting changes at temperature of —95°C and —23°C (178°K and 250°K).

The following two papers were read at the 11th Joint Technological Conference held at SITRA, Coimbatore, from the 11th to the 13th December, 1969, under the joint auspices of ATIRA, BTRA and SITRA.

Effect of gamma-ray radiation on the acetylated cellulose samples :
Part I. Changes in physico-chemical properties.
Part II. Analysis of degradation products.

A paper entitled, "ESR investigations on radiation induced free radicals in natural and chemically modified cotton cellulose" was presented at the Convention of Chemists held at Kharagpur, from the 27th to the 31st December, 1969.

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

The investigation was taken up with a view to get information on the structural changes taking place inside the swollen and chemically modified cotton fibres and to study the effect of changes in relative humidity and temperature on these fibres. Studies on the variations in density of chemically treated cotton fibres (covering a wide range of crystallinities) with variations in relative humidity conditions and some auxilliary experiments like moisture regain, swelling value by propanol-2 retention method and density in water

of these fibres, which had been carried out only partially last year, were completed during the year under report. Experiments on the effect of variation of temperature on some of the chemically modified cotton fibres were carried out during the year. The results of density tests on chemically modified cotton fibres were analysed and relationships were worked out connecting density and degree of substitution. The final combined analysis of the data from various experiments is being carried out. Some of the main conclusions are :

(*a*) The crystallinity in chemically modified cotton fibres appeared to be related to porosity of these fibres.

(*b*) The dry density of fibres increased as the density in water decreased.

(*c*) The degree of swelling from direct experiment was strictly comparable with swelling estimations from density studies.

(*d*) None of the chemically modified cotton fibres tested for studies on the effect of changes in temperature on the density of these fibres, showed any appreciable variation in density value in the temperature range of 30°C to 55°C.

(*e*) The density of viscose and cotton fibres (untreated and chemically treated) decreased with increase in the level of moisture in these fibres. In the case of some of the fibres, a peak density was prominently observed during the early stages of moisture absorption and the humidity level at which this took place depended on the particular fibre.

(*f*) Wax content, cellulose content and micronaire fineness of cotton fibres belonging to various stages of growth did not have any significant correlation with density. Crystallinity from iodine absorption method showed a significant correlation with density.

(*g*) It was observed from a study of the variations in density of unpurified and purified cotton fibres, belonging to different stages of growth, that the changes in density of fibres during their growth period were not only due to the influence of varying amounts of non-cellulosic constituents in them but also due to changes in the crystallinity.

14. Effect of swelling and/or decrystallizing treatment on the strength-length gradient of cotton in relation to its structural parameters

The data collected from the strength tests at 1, 2, 3, 4 and 6 mm gauge lengths on raw and mercerized samples were graphically plotted. It was observed that mercerization improved the strength uniformity of all cottons. The crystalline-amorphous ratio of the mercerized samples was determined employing moisture sorption technique. Crystallinity of the mercerized samples was found to be about 40 per cent. Ten samples were hydrolysed, using 2.5 N HCl at boil, for measuring the average crystallite length adopt-

ing the levelling off D.P. measurement. In addition, ten samples were treated with ethylene diamine (98%) at room temperature to prepare samples with low degree of crystallinity. Further experimental work is in progress.

15. Physico-chemical and structural properties of gamma-ray irradiated cellulose in relation to some other oxycelluloses

Purified cellulose in the form of yarn (20s count) was subjected to six increasing dosages of gamma-ray irradiation from a Cobalt-60 source. Various physico-chemical and structural properties, viz. strength, copper number, carboxyl content, D.P., alkali solubility, moisture regain, etc., of the oxycellulose produced, both before and after (*i*) oxidation with chlorous acid and (*ii*) reduction with sodium borohydride, were studied.

With the increase in dosage, the values of tenacity retained and D.P. decreased, while the values of copper number and alkali solubility increased. The oxycellulose produced by gamma-ray irradiation of cotton after chlorous acid and sodium borohydride treatments showed a continuous fall in tenacity, although the D.P. values remained unchanged. They had a copper equivalence of 11.45.

Preliminary trials were undertaken for the preparation of oxycellulose by the action of the specific oxidizing agent, viz. $K_2Cr_2O_7$ + oxalic acid, which is known to oxidize cellulose molecule at C_6 position.

16. Fabrication of Torsion Balance

During the period under report, almost all the parts required for the above balance were either fabricated or purchased locally. They were assembled to study the performance and the effect on actual scale reading with standard fractional weights. It was observed that conical pivots at the axle end caused friction and the sensitivity of the balance was reduced. Hence, the balance gave erratic values. It is, therefore, felt that the conical pivot system should be changed to jewelled bearing system. Arrangements for fixing jewelled bearings and making a new axle to suit jewelled bearings is in progress.

17. Investigations on the untwisting/twisting behaviour of cotton fibres in water

Purified ramie and a few cottons of different botanical species were selected for this study. It was observed that all fibres of a given cotton did not rotate in the same direction while being immersed in water. However, one cotton characterized by a high linear density (about 250 millitex), appeared to be an exception, as about 90-95 per cent of its fibres rotated in the anti-clockwise direction (as seen from above) when immersed in water. More coarse cottons will be studied to verify this observation. In contrast to cotton, ramie fibres always rotated in one direction (namely, clockwise direc-

tion as seen from above) when immersed in water. Further study is in progress using swollen and stretched fibres. Besides, data on gross morphological features, such as fibre maturity, linear density and number of convolutions and structural reversals per unit length, are being collected with a view to examine the contributory factors giving rise to this phenomenon.

18. Preparation of colour charts for different grades of Indian cottons

These investigations were taken up to study the range of reflectance (Rd) and the degree of yellowness (+b) for the commercial varieties of cotton grown in India. For this, a large number of samples of various grades are required to be examined. During the period under report, about 600 samples pertaining to 1966-67 season were tested on Nickerson-Hunter Colorimeter. Details regarding staple, class, grade, etc. (i.e. Grader's report), for the above samples were collected from the E.I.C.A. Ltd., Bombay. Analysis of the data for the earlier seasons were also in progress during the period under report. As most of the samples tested were from the higher grades, viz. extra superfine, superfine, etc., attempts were made to procure the samples from the lower grades, such as fair, fully good, etc.

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

It had been discussed earlier that the maximum changes in circularity due to treatment with NaOH and KOH of various concentrations occured at 10 mol. concentration of the alkali. As this work was done on one cotton only, two more samples of cotton, Auburn (maturity 66% and 33%), were treated with the same concentrations employed earlier, namely 5, 10, 20, 30 and 40 per cent of NaOH and KOH during the period under report. The circularity of these samples was determined. It was noted that the changes in circularity were similar to those observed for the samples of cotton N.C.14.

These studies were further extended by treating all the four samples (two each of N.C.14 and Auburn) with various concentrations of zinc chloride, namely 35, 50, 60, 70 and 80 per cent. The data on the changes in circularity indicated that the maximum change occurred at 70 per cent zinc chloride. It was also observed that the circularity value for the next higher concentration, viz. 80 per cent was considerably lower than that for 70 per cent.

It was mentioned in the last year's report, that the cross-sections of 20 cottons (each having about 60% mature fibres) were grouped into three categories, viz. circular, elliptical and flat. Analysis of these data showed that the cottons from *G. arboreum* had higher percentage of fibres with circular cross-section than the cottons belonging to the other species, the respective average values of fibres with circular cross-section being :

G. arboreum	32.6%	*G. barbadense*	16.5%
G. herbeceum	22.8%	*G. hirsutum*	11.5%

20. Studies on the effect of various chemical treatments on yarn evenness

As reported last year, yarn samples of various counts had been mercerized with and without tension, and the yarn evenness, yarn strength and twist in yarn determined before and after treatment. The yarn evenness had been determined employing three different methods, namely Uster Evenness Test method, Visual observation method and cut and weigh method. The data were analysed during the year. It was observed that there was practically no change due to mercerization in yarn evenness measured as variation in weight per unit length by the cut and weigh method. However, an increase in U% value was observed which might be due to change in factors, such as shape, dielectric constant, etc. Visual assessment of yarns indicated that the yarn became somewhat regular after the mercerizing treatment. The breaking load was observed to have increased on mercerization. As regards changes in coefficient of variation in strength, no definite trend was observed, while percentage strength irregularity was observed to remain practically unchanged. It was also observed that mean turns per inch and coefficient of variation in turns per inch increased slightly on mercerization.

In addition, with a view to investigate the influence of various fibre length parameters on yarn irregularity, 30 cottons were spun to three counts, namely 20s, 30s and 40s. Most of these cottons had H.S.C. between 30s and 40s. The length parameters were determined with Digital Fibrograph and Balls Sorter and the mean deviation percentage values for all the samples were determined with Uster Evenness Tester. The data were analysed and the following conclusions were drawn :

(*a*) Correlation coefficients between the length parameters and the Uster irregularity values were higher for 30s count than those for 20s and 40s counts.

(*b*) Uniformity ratio as determined with Digital Fibrograph showed a highly significant but negative correlation with Uster values indicating that cottons with more regular fibres can be spun into yarns of greater evenness.

(*c*) Short fibre percentage did not show considerable influence on yarn irregularity.

(*d*) Floating fibre percentage of Digital Fibrograph showed significant correlation with Uster values.

(*e*) Amongst the Balls Sorter parameters, only fibre length irregularity percentage showed highly significant correlation with yarn irregularity.

(*f*) Coefficient of variation in fibre length showed poor correlation with Uster values.

(*g*) Mean length values showed significant correlation with Uster Evenness values, but this effect is possibly due to the close association of length with length irregularity and fineness.

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

Eleven samples of cottons having H.S.C. about 40s, viz. Digvijay, Laxmi, Deviraj, Devitej, Suyodhar, Laxmi (Adoni), M.C.U.1, M.C.U.2, M.C.U.3, L.S.S. and Buri 147, had been spun into about ten counts ranging from 20s to 50s with a twist multiplier of 4.25 and their yarns tested for lea strength. The relationship between the corrected C.S.P. values and the counts was examined. For individual cottons, the C.S.P. showed a regular fall for higher counts and the rate of fall was more or less uniform for M.C.U.1, M.C.U.2 and M.C.U.3, but irregular for others. Taking all the cottons together, it was observed that the average C.S.P. of all the cottons showed an uniform downward trend as the count increased. The correlation coefficient between the count and the average C.S.P. was as high as 0.98. The C.S.P. and the count were linearly related, the regression equation connecting the two values being C.S.P. = 19.4 (130—C). Obviously, this equation is applicable only in respect of cottons whose H.S.C. is about 40s.

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

A suitable creel to feed Drawing Frame Silver to the fabricated plant for super high-drafting purpose is under preparation.

23. Study of spinning of mixings of different cottons

Four more mixings suitable for 40s count were spun during the year. The chief fibre properties and spinning performance of the individual cottons used are given below :

	Store No.	Cotton	Staple length, mm	Micro-naire value	Maturity co-fficient	H.S.C.
(a)	680062	Buri 1007	24·8	3·4	0·72	36s
	691887	Laxmi	22·5	3·4	0·70	37s
	692589	A.K.235	21·8	5·2	0·85	30s
(b)	680062	Buri 1007	24·8	3·4	0·72	36s
	692693	M.C.U.1	23·2	3·2	0·71	36s
	691602	Narmada	23·0	4·3	0·76	31s
(c)	680062	Buri 1007	24·8	3·4	0·72	36s
	691887	Laxmi	22·5	3·4	0·70	37s
	692693	M.C.U.1	23·2	3·2	0·71	36s
(d)	680062	Buri 1007	24·8	3·4	0·72	36s
	690967	Badnawar 1	26·0	3·3	0·73	45s
	691887	Laxmi (Gadag)	22·5	3·4	0·70	37s

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

Suitable prediction formulae for estimating the Highest Standard Count from the chief fibre properties have already been determined for the Vidarbha and Middle Gujarat tracts. For the tracts of Uttar Pradesh, Rajasthan and Punjab, the data available were too meagre to be used for obtaining satisfactory results.

In order to examine the feasibility of predicting the yarn strength at different counts from fibre properties, some preliminary studies were undertaken to find out the extent of association between the yarn strength at 20s and 30s counts and the fibre properties. The analysis of the data from a few samples showed that the correlation coefficients between the yarn strength and the fibre properties were practically of the same order for 30s and 20s counts and that the correlation coefficients were not significant except between yarn strength and fibre strength. Further, the rate of fall in C.S.P. from 20s to 30s was not correlated with the fibre properties to the significant level. However, the rate of fall of C.S.P. near about the H.S.C. values for all cottons appears to follow a regular trend. For this study, data on 106 samples, each spun into three counts, were analysed. The cottons were divided into six groups on the basis of the ranges of counts to which they were spun, the middle count being that which is nearest to the H.S.C. (C) of the sample. The equation connecting the rate of fall (k) in each group with the average H.S.C. of the group was found to be :

$$k = 56.6 - 0.864\ C.$$

25. Comparison of the results of single strand tests made in the 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, yarn samples of various counts are being tested for single yarn strength and percentage breaking elongation by these instruments.

During the period under review, experimental work was continued; four samples of 60s count were tested on the Uster Automatic Tester and one sample of 60s count on both the Scott Inclined Plane Tester and the Uster Automatic Tester. Test results on all the yarn samples of 60s count showed that the values of single yarn strength determined by the two instruments were not different; however, the per cent breaking elongation recorded by the Uster Automatic Tester was slightly higher than that measured by the Scott Inclined Plane Tester. This is in conformity with the results obtained earlier with the yarn samples of 20s, 30s and 40s counts.

26. Variation of yarn strength with relative humidity

Further analysis of the results of tests on skein strength at different levels of relative humidity (r.h.) was carried out after pooling the data on all the samples of different counts. The following regression equation was worked out to calculate the skein strength of yarn at the standard atmospheric condition of 65 per cent r.h., from tests carried out at other levels of r.h. :

$$Y_{65} = Y_H [1 + 0.0027(65—H)] \quad \ldots\ldots(1)$$

where Y_{65} = Yarn Strength Index (Y.S.I.) in metric units at 65 per cent r.h. and Y_H = Yarn Strength Index (Y.S.I.) in metric units at a r.h. of H per cent.

The above relation was found to be satisfactory for the range of r.h. from 35 per cent to 85 per cent. In the range from 35 per cent to 75 per cent r.h. the mean difference between calculated and experimentally observed values was about 1.5 per cent, while the mean difference was about 2.6 per cent at 85 per cent r.h. Hence, it is felt that, as far as possible, the yarn strength tests should not be carried out at relative humidity levels above 75 per cent r.h.

After converting the Y.S.I. values into C.S.P. values, the general correction factor for obtaining C.S.P. at standard atmosphere of 65 per cent r.h. was calculated as :

$$S_{65} = S_H [1 + 0.0028(65—H)] \quad \ldots\ldots(2)$$

From the same experimental work, the analysis of variance for linear density of the yarn in tex units and relative humidity was worked out. The following correction factors were obtained for conversion of tex values (T_H) at other levels of r.h. to that (T_{65}) at 65 per cent r.h. :

$T_{65} = 0.9872\ T_H + 0.7046$ for conversion from 35% to 65% r.h....(3)
$T_{65} = 0.9954\ T_H + 0.4339$ „ „ „ 45% to 65% r.h....(4)
$T_{65} = 1.0032\ T_H + 0.1739$ „ „ „ 55% to 65% r.h....(5)
$T_{65} = 0.9880\ T_H + 0.1262$ „ „ „ 75% to 65% r.h....(6)
$T_{65} = 0.9630\ T_H + 0.3503$ „ „ „ 85% to 65% r.h....(7)

The general correction factor for conversion to tex at 65 per cent r.h. from any level of r.h. between 35 per cent and 85 per cent works out as under :

$$T_{65} = T_H [1 + 0.000828(65—H)] \quad \ldots\ldots(8)$$

Where T_{65} and T_H are the tex values of the sample at 65 per cent r.h. and at the r.h. of H per cent at which tests have been carried out.

The broken skeins after testing at different levels of r.h. were conditioned at 65 per cent r.h. and weighed to find the tex values. The regression equation based on these values worked out as under :

$$T_{65} = T_H [1 + 0.0008451(65—H)] \quad \ldots\ldots(9)$$

The values for sorption of water by cellulose taken from the tables of Jeffries (*J. Textile Inst.*, **51,** 9, T.339-374) gave the following equation for tex :

$$T_{65} = T_H [1 + 0.0010984(65—H)] \quad \ldots\ldots (10)$$

It may be seen that equations (8), (9) and (10) are almost similar.

The values of tex determined at various humidity levels were corrected to the standard level of 65 per cent r.h. using equation (8). The corrected values were compared with the actual test values at 65 per cent r.h. and the mean percentage differences are given below :

For test carried out at relative humidity	35%	45%	55%	75%	85%
Mean percentage difference between corrected values and those observed at 65 per cent r.h.	0.75	0.88	0.82	0.80	1.11

III. Publications

During the year, two Technological Reports, seven research publications, two articles and one Annual Report were published, and 65 Technological Circulars were issued. Further, six articles were sent for publication and three articles contributed at various conferences. The details are given below :

A. Technological Reports

No. 5. Technological Report on Trade Varieties of Indian Cottons, 1967-68 Season.

No. 6. Technological Report on Standard Indian Cottons, 1967-68 Season.

B. Research Publications (*C.T.R.L. Publications—New Series*)

No. 13. Studies on Chemically Modified Cotton. Part I: Effect of chemical treatments for varying periods on crystallinity and certain other properties of cotton— by S. N. Pandey and R. L. N. Iyengar.

No. 14. Studies on Chemically Modified Cotton. Part II: Effect of different concentrations of chemicals on crystallinity and certain other properties of cotton — by S. N. Pandey and R. L. N. Iyengar.

No. 15. Studies in Effect of Gamma-radiation on Synthetic Fibres— by S. P. Potnis, S. M. Shetty, K. N. Rao and Jai Prakash.

No. 16. Effect of Gamma-radiation on Synthetic Fibres. II : Irradiation in the presence of chemicals—by S. P. Potnis, S. M. Shetty and Jai Prakash.

No. 17. Studies on Cellulolytic Micro-organisms. Part II : Cellulolytic enzymes of *Streptomyces* sp. and *Aspergillus terreus*—by S. M. Betrabet and Usha I. Patel.

No. 18. Studies on Chemically Modified Cotton. Part III : Chemical treatments at different temperatures and their effect on crystallinity and various other properties—by S. N. Pandey and R. L. N. Iyengar.

No. 19. Studies on Chemically Modified Cotton. Part IV: Studies on relationship between the properties of untreated and chemically modified cotton fibre—by S. N. Pandey and R. L. N. Iyengar.

C. Articles and Papers

(a) Published

1. Cotton Technological Research Laboratory—Its role in the improvement of cotton production in India—by V. Sundaram. Published in Cotton and Textile Annual, 1968.
2. The Cotton Technological Research Laboratory, Matunga, Bombay-19, and its help to the Indian Textile Industry—by V. Sundaram. Published in the "Textile Digest", Vol. XXX, No. 1.

(b) Sent for Publication

1. A study on the effect of agronomic treatments on the seed weight and oil content of cottonseed—by S. N. Pandey and R. L. N. Iyengar.
2. Studies in Swelling of Cellulose. Part I: Intra-crystalline swelling and decrystallization in zinc chloride treated cotton cellulose—by S. M. Betrabet, E. H. Daruwalla, H. T. Lokhande and M. R. Padhye.
3. Cotton Technological Research Laboratory, Matunga, Bombay—45 years of active service to the nation—by V. Sundaram.
4. Microscope in the service of cotton—by S. M. Betrabet.
5. Colour and lustre of cotton—by P. G. Oka and V. Sundaram.
6. Status and developments in cotton quality testing—by V. G. Munshi.

(c) Contributed at Conferences

1. Effect of Gamma-ray Radiation on the Acetylated Cellulose Samples. Part I: Changes in physico-chemical properties —by I. G. Bhatt, V. Iyer, A. W. Shringarpure, V. Sundaram and Jai Prakash.
2. Effect of Gamma-ray Radiation on the Acetylated Cellulose Samples. Part II: Analysis of degradation products—by N. S. Shah, V. Sundaram and Jai Prakash.
3. ESR investigations on radiation-induced free radicals in natural and chemically modified cotton cellulose—by P. K. Chidambareswaran, V. Sundaram, Jai Prakash, N. C. Verma and B. B. Singh.

D. Annual Report

Annual Report of the Cotton Technological Research Laboratory for the Calendar Year 1967 (issued through the Indian Council of Agricultural Research).

E. Technological Circulars

Standard Indian Cottons—1967-68 Season

17 320F
18 L.S.S.
19 M.C.U.1 (Winter)
20 Laxmi (Mysore)
21 K.6 (Pandyan)
22 Laxmi (Madras)
23 H.14
24 Westerns (Guntakkal)

1968-69 Season

25 M.C.U.2 (Summer)
26 A.K.277
27 Digvijay
28 V.797
29 Sanjay
30 A.K.235
31 Deviraj (Gujarat)
32 Gujarat 67
33 M.C.U.1 (Winter)
34 Deviraj (Mysore)

Trade Varieties—1967-68 Season

1563 M.C.U.1 (Coimbatore)
1564 Deviraj (Manavadar)

1968-69 Season

1565 Gaorani 22
1566 Gaorani 46
1567 U.P. Desi (Shyamali)
1568 Sanjay (Maharashtra)
1569 Bengal Desi (Punjab)
1570 Sanjay (Botad)
1571 A.K.235
1572 Y.1
1573 Gaorani 6 (Bhainsa)
1574 H.14
1575 Buri 147 (Vidarbha)
1576 Laxmi (Maharashtra)
1577 C. Indore 1
1578 Sea Island Andrews (A.P.)
1579 M.C.U.1 (Irrigated)
1580 Gaorani 22 (Mysore)
1581 Adonicum
1582 Comillas
1583 Westerns
1584 Kalyan (Bavla)
1585 Jayadhar (Hubli)
1586 Digvijay (Palej)
1587 320F (Punjab)
1588 Virnar (Khandesh)
1589 Deviraj (Manavadar)
1590 Gujarat 67 (Idar)
1591 Digvijay (Dabhoi)
1592 Deviraj (Nagar)
1593 Wagad (Saurashtra)
1594 Jayadhar (Bagalkot)
1595 Deviraj (Mysore)
1596 Digvijay (Kapadvanj)
1597 Maljari
1598 Gujarat 67
1599 Laxmi (Adoni)
1600 A.K.277
1601 320F (Rajasthan)
1602 L.147 (Adilabad)
1603 Badnawar 1
1604 Digvijay (Cambay)
1605 V.797
1606 Narmada
1607 Laxmi (Raichur)
1608 Laxmi (Gadag)
1609 Ganganagar 1 (Desi)

IV. Extension

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

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

Testing Work

Apart from the research samples received from various agricultural stations, this Laboratory continued to receive a number of samples of cotton, yarn and cloth for special tests, from commercial firms and Government and Semi-Government organizations. Such samples are tested on payment of the prescribed fees. The number of such samples received for various tests during the year 1969, together with the corresponding figures for 1968 and for the quinquennium 1960-65 are given in Table 7.

TABLE 7. NUMBER OF SAMPLES RECEIVED FOR PAID TESTS

Type of test	Average for the quinquennium ending May, 1965	1968	1969
Spinning	52	22	2
Fibre (E.I.C.A.)*	148	46	27
,, (Others)	155	81	166
Yarn	168	147	119
Cloth	158	97	90
Moisture	933	34	68
Miscellaneous tests	16	11	32
Total	1,630	438	504

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

The total tests fees realised during 1969, for carrying out tests on these samples, amounted to Rs. 10,279.50 against Rs. 11,058.50 during 1968.

Training Facilities

The Laboratory is conducting two training courses of two months duration each for persons employed in the cotton trade and co-operative marketing societies, one for those coming from the Bombay City and other for those coming from mofussil centres. During the year, the following nine students were selected and given training in fibres tests and elements of statistics :

1.	Shri N. R. Subramaniam,	M/s. Janakiram Mills Ltd., RAJAPALAYAM (Tamil Nadu).
2.	Shri R. L. Patil,	Vidarbha Co-operative Marketing Society Ginning & Pressing Factory, ACHALPUR (Maharashtra).
3.	Shri V. V. Velinker,	Patel Volkart Ltd., BOMBAY.
4.	Shri M. S. Patel,	Manilal Patel & Company, BOMBAY.
5.	Shri I. B. Shah,	M/s. Bhaidas Cursondas & Company, BOMBAY.
6.	Shri A. N. Choksi,	The East India Cotton Association Ltd., BOMBAY.
7.	Shri S. Sundararaman,	The Gomathy Mills, VIRAVANALLUR (Tamil Nadu).
8.	Shri P. G. Dambal,	The Dharwar District Co-operative Marketing Federation Ltd., HUBLI (Mysore State).
9.	Shri S. M. Patel,	Shri Daxin Gujarat Sahakari Cotton Marketing Union Ltd., SURAT (Gujarat).

Supply of Equipments

The following instruments were fabricated and supplied :

Laboratory Model Gins	8
Ginning Percentage Balances	7
Halo Length Discs (Small size)	10
,, ,, ,, (Large size)	15
Plush Boards	2
Steel Combs	36

V. Conferences and Symposia

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

Date	*Meeting*	*Place*	*Attended by*
7-1-1969	18th Meeting of Textile Division Council, TDC.	New Delhi	Dr. V. Sundaram
6-2-1969 to 8-2-1969	Third Meeting of the Directors of Research Institutes.	Izatnagar	Dr. V. Sundaram
21-2-1969 and 22-2-1969	SASMIRA'S Fourth Technological Conference.	Bombay	Dr. V. Sundaram Dr. V. G. Munshi Dr. S. N. Pandey Shri P. G. Oka Kum. I. G. Bhatt Shri N. S. Shah
26-3-1969	Annual General Meeting of the ICAR.	New Delhi	Dr. V. Sundaram
28-3-1969	Advisory Board meeting of the ICAR.	New Delhi	Dr. V. Sunradam
1-4-1969 to 3-4-1969	Workshop Meeting of Cotton Research Workers for the Northern Zone.	Hissar	Dr. V. Sundaram Dr. V. G. Munshi
16-4-1969	Seminar of Textile Technologists arranged by the Indian Cotton Mills Federation	Bombay	Dr. V. Sundaram Dr. S. N. Pandey Kum. I. G. Bhatt Shri N. S. Shah
24-4-1969	28th Meeting of the Cotton and Cotton Products Sectional Committee, TDC-2.	Bombay	Dr. V. Sundaram
6-5-1969 to 8-5-1969	Workshop Meeting of Cotton Research Workers for the Central Zone.	Indore	Dr. V. Sundaram
12-5-1969	Panel for Yarn Appearance Standards, TDC 1:1:12.	Bombay	Dr. V. Sundaram Shri P. G. Oka
13-5-1969	36th Meeting of the Physical Methods of Test Sectional Committee, TDC-1.	Bombay	Dr. V. Sundaram

Date	*Meeting*	*Place*	*Attended by*
4-6-1969 to 7-6-1969	3rd All-India Workshop Meeting of the Cotton Research Workers (Including South Zonal Meeting).	Bombay	Dr. V. Sundaram Shri R. P. Neogi Dr. V. G. Munshi Dr. S. N. Pandey Shri G.S.Rajaraman Shri P. G. Oka Kum. I. G. Bhatt Shri N. S. Shah Shri D. G. Shete Shri C. A. S. Aiyar Shri P. D. Vakil Shri H.V.Tamhankar
18-7-1969	Scientific Panel for Agricultural Sciences Technology of the ICAR.	New Delhi	Dr. V. Sundaram
18-9-1969	4th Meeting of the Indian Cotton Development Council.	Bombay	Dr. V. Sundaram
14-10-1969	37th Meeting of TDC-1 in joint session with TDC 1:1	Bombay	Dr. V. G. Munshi
5-12-1969	29th Meeting of the Cotton and Cotton Products Sectional Committee, TDC-2.	Bombay	Dr. V. Sundaram Dr. V. G. Munshi
7-12-1969 to 12-12-1969	3rd International Conference of Global Impacts of Applied Microbiology.	Bombay	Dr. S. N. Pandey Dr. A. J. Desai
11-12-1969 to 13-12-1969	11th Joint Technological Conference held at SITRA under the joint auspices of ATIRA, BTRA and SITRA	Coimbatore	Kum. I. G. Bhatt Shri N. S. Shah Shri A. W. Shringarpure
22-12-1969 to 24-12-1969	23rd Annual Conference of the Indian Society of Agricultural Statistics.	Bombay	Dr. V. Sundaram Shri G.S. Rajaraman Shri K. Venkateswaran
27-12-1969 to 31-12-1969	Convention of Chemists organized by the Indian Chemical Society, C.S.I.R., National Institute of Sciences, Society of Biological Chemists, etc.	Kharagpur	Dr. V. Sundaram Shri P. K. Chidambareswaran
29-12-1969	19th Meeting of Textile Division Council.	New Delhi	Dr. V. G. Munshi

VI. Summary of the Report

This is the Forty-sixth Annual Report of the Laboratory and pertains to the year 1969.

The research activities and the testing work progressed satisfactorily as in the past. During the financial year 1968-69, a sum of Rs. 12.29 lakhs had been spent against a sum of Rs. 11.99 lakhs only sanctioned. The details of the budget and expenditure are shown in Appendix I. The savings of Rs. 2.01 lakhs under capital was mainly due to certain purchases, including import of equipment from abroad, not having materialised, contrary to anticipation, on account of delay in the receipt of the import licences, etc. The increase of expenditure amounting to Rs. 2.27 lakhs under working expenses was mainly due to : (*i*) increase in the rates of dearness allowance and consequent increase in other allowances (Rs. 0.8 lakh) ; (*ii*) increased expenditure on other contingencies (Rs. 0.5 lakh); and (*iii*) the funds for the expenditure on Technological Outstations (Rs. 0.96 lakh) not having been separately sanctioned by the Indian Council of Agricultural Research. In addition, an expenditure of Rs. 1.20 lakhs was incurred on technological schemes, including P.L. 480 Projects, against the sanctioned grant of Rs. 1.54 lakhs, leaving an unutilised amount of Rs. 0.34 lakh.

The expansion and modernization programme of this Laboratory is making steady progress. The conditioning plant has been installed and put into commission since October, 1969. This plant is required to be fitted with controls, to be imported from the U.S.A., for maintaining standard atmospheric conditions. The import licence for procuring these controls has since been received from the Chief Controller of Imports and orders have been placed for importing them through M/s. Voltas Ltd., Bombay. In the meantime, the plant is being operated with manual controls. After commissioning of this plant, the Yarn Testing Section was shifted to the new building and in the space vacated, the new blow-room machinery, imported from the U.K., is being erected.

1. (*i*) During the year, about 1,400 samples pertaining to the trials under the All-India Co-ordinated Research Project on Cotton were received and tested at the Laboratory. Among these, 277 samples were for fibre tests and full spinning, 1,038 for micro-spinning (with or without fibre tests) and 86 for fibre tests only. In addition, fibre tests were carried out on about

6,000 samples at the eight outstations of the Laboratory. The All-India-cum-South Zone Workshop Meeting under the Co-ordinated Research Project on Cotton was held at the Laboratory during June 1969. Arrangements were also made by the Laboratory to have some of the newly evolved strains, such as Sujata, S.B.289E, Vijaya, E.L.156E, 1301-D.D., etc., tested in a few leading textile mills.

In the North Zone (Haryana, Punjab and Rajasthan), the strain A.218 was found to have maintained its technological superiority over the other strains. This strain also gave good technological performance at Surat, Junagadh and Badnawar, in the Central Zone. However, its yield level has to be improved. The strains J.34 and J.127 from Jullundur gave very high yield but did not show good technological performance.

The strain B.59-1684 from Badnawar maintained its good technological performance in the Central Zone (Gujarat, Madhya Pradesh and Maharashtra) during this season also. Other new strains from Central Zone which gave good performance were A.56-347, B.61-2098, 66-BH.5/91, I.A.N.560, I.A.N.10(199) and Hybrid 4. Of these, Hybrid 4 has a high yield potential and matures earlier than Gujarat 67, the current variety under cultivation, in many parts of Gujarat.

The most interesting results observed were that the strain M.C.U.5 from the South Zone and strain A.218 from the North Zone have given very good technological performance when grown at several centres in the Central Zone ; of these, M.C.U.5 has given yields as high as the local controls in some of the places. In addition, both these strains were observed to be early in maturing compared to the local strains. The two *G. barbadense* strains, Sujata and Giza 7, raised at Surat, gave very good technological performance, being capable of spinning to 90s count.

In the South Zone (Andhra Pradesh, Mysore and Tamil Nadu), the strain 815-3-1, which was released for general cultivation under the name of M.C.U.5 at the Workshop Meeting held at Bangalore, in June 1968, has shown good performance at most of the centres, except in Mysore State. As already pointed out, M.C.U.5 has fared very well at several centres in the Central Zone as well. The technological performance of this strain from the feeler trial conducted at Banswara in Rajasthan, was also satisfactory. The strain Vijaya, released by the Mysore State Authorities in 1968, maintained good fibre length at Amaravati (Andhra Pradesh) and Coimbatore (Tamil Nadu) but not at Arabhavi and Siruguppa in Mysore State. This strain has low fibre strength which needs to be improved. Another important result observed was that the *G. hirsutum* strain E.L.156E gave not only better technological performance but also higher yield than the *G. arboreum* strain K.7, in rainfed trials in the Karunganni tract of Tamil Nadu ; this indicates the possibility of replacing *desi* strains by the *hirsutum* types, which have generally a higher yield potential.

The *G. barbadense* strain Co-Pusa-Egyptian, which was recommended for pre-release multiplication last year under the new name "Sujata", maintained its good performance at Coimbatore, as the sample could be spun into 100s count. This strain has also fared very well in mill tests and has been found suitable by the mills for spinning into yarns of 80s to 100s counts. Sujata gave good performance at Surat, as already indicated, and also at Phaltan (Maharashtra) and Banswara (Rajasthan). Other *barbadense* strains which gave good performance were S.B.289E and 1085-6.

An analysis of the results has shown that the main factors which contributed to the superior performance of some of the strains (Sujata, M.C.U.5, A.218, B.59-1684) over the others are the greater fibre length uniformity and higher bundle strength of these strains. Hence, it is essential that these two characteristics are kept in view while breeding or selecting new strains.

(*ii*) During the year, in addition to samples received from trials under the All-India Co-ordinated Research Project on Cotton, a large number of samples of improved varieties belonging to other State research projects, etc., were received and tested. In all, 248 reports were issued during the year on 1,838 samples, out of which 429 were for fibre and full spinning tests, 1,291 for micro-spinning (with or without fibre tests) and 118 for fibre tests only. Besides these, 47 samples of important Trade Varieties and 18 samples of Standard Indian Cottons were tested. A number of samples specially requisitioned for technological investigations were also tested for specific properties. The Laboratory continued to undertake tests on samples received from Government Organizations, Excise Department, the Cotton Trade and Industry, etc. These tests were carried out on payment of the prescribed fees, the total amount thus collected being Rs. 10,279.50.

2. During 1969, 153 cottonseed samples were tested for seed weight and oil content. Further, 18 seed samples were tested for nitrogen and protein content, 11 for free gossypol, 30 for linter percentage and 33 for hull and kernel percentage. The method for determination of total gossypol content was also standardized during the year.

3. For studying the physico-chemical characteristics of cotton, when treated with decrystallising and swelling reagents, M.C.U.3 cotton was treated with zinc chloride and urea solutions of various concentrations. Treated samples showed appreciable decrease in crystallinity.

4. As very coarse *desi* cottons cannot be tested directly on the Micronaire instrument, trials were carried out, last year, by testing them after blending them with a finer cotton, viz. P.216F. During the year, similar trials were conducted by blending the *desi* cottons with another finer cotton, viz. Laxmi, and the results were in agreement with the observations made last year.

5. A number of instruments are commercially available for determining the length parameters of cotton fibres but all the instruments do not measure the same characteristics, as the principle used in one instrument differs from

that used in another. Hence, an investigation was conducted during the last two years by testing 25 samples of cotton by various instruments, such as Balls Sorter, Baer Sorter, A.N. Stapling Apparatus, Uster Stapler and Manual and Digital Fibrographs. The results were examined with regard to their accuracy, speed of testing, convenience, etc., and it was concluded that the Digital Fibrograph was the quickest and the most convenient for testing ; the 2.5% span length determined on it closely agrees with the American Grader's value of the staple length and the uniformity ratio recorded is highly correlated with the coefficient of variation of fibre length as observed from the Balls Sorter distribution (by weight).

6. In order to study the microbial organisms which attack cotton and cellulose materials under marine conditions, 10 canvas pads (12″ × 4″) were kept about 10 feet deep in break water in the sea. The samples were removed one by one at weekly intervals and screened for the presence of cellulolytic micro-organisms and also for the decrease in the tensile strength of the fabric. It was found that the fabric strength decreased from 518 kg to 11 kg after four weeks. After this period, the fabric strength was negligible. Two cultures of fungi and two of actinomycetes isolated from the deteriorated canvas have shown prominent cellulolytic activity and are being studied further.

7. The effect of irradiation with gamma-rays on raw as well as chemically modified cotton cellulose is being investigated under a project financed out of P.L. 480 funds. Some of the interesting results observed during the year are : (*i*) when cotton is grafted with polyacrylonitrile, the tenacity retained after irradiation increased slightly at the initial dosage of 1×10^5 roentgens and then decreased progressively. The effect of increasing graft chains on the radio-protection of cellulose was not appreciable ; (*ii*) in the case of acetylated samples, the protective effect increased with D.S. but only up to a D.S. of 1.60. The substituent acetyl group appeared to enter predominantly on C_6 carbon atom. Further, the percentages of degradation products and oxidation breakdown of the acetylated samples were found to be more than those in the raw samples ; (*iii*) the protective effect of aliphatic amines increased with the amount of amino group present, while in case of aromatic amines it increased with the phenyl group ; (*iv*) in the case of benzoylated samples, irradiated in the presence of EDA and Indole, the protective effect decreased with EDA while there was not much effect with Indole ; (*v*) the allylated samples of different D.S. did not show much radio-protection ; and (*vi*) it appeared from studies on the electron spin resonance spectra that the radio-protection of the benzoylated samples might be due to the energy transfer effects, while in the case of the allylated samples the substituted allyl group appeared to protect the cellulose molecule by undergoing changes within itself. When irradiated at a dosage of 1×10^7 roentgens, allylated samples yielded greater radical concentration than their control (mercerized sample) ; the spin concentration was also higher. These

samples showed significant and interesting changes at temperatures of —95°C and —23°C (178°K and 250°K).

8. The data relating to changes in density of fibres during different stages of growth were analysed to find out whether these were associated with changes in the chemical and physical properties of the fibres. The correlation coefficients obtained between density values and crystallinity values from iodine absorption method, and those between density values and D.P. values were significant. Wax content, cellulose content and micronaire fineness had a high correlation with density (correlation coefficient ranging from 0.735 to 0.794) but not statistically significant. Crystallinity showed a high significant correlation (0.821) with density.

9. To study the effect of swelling and decrystallising treatments on the strength-length gradient of cottons in relation to changes in structural properties, bundle strength tests on selected samples were carried out at different gauge lengths after mercerizing them in the slack state and the values plotted in a graph, for all the samples. It was observed that mercerization improved the strength uniformity of all cottons.

10. In the investigation dealing with the study of the effect of some chemical treatments on yarn evenness, it was observed that : (*i*) there was practically no change due to mercerization on yarn evenness measured as variation in weight per unit length ; (*ii*) the breaking load, mean turns per inch and the coefficient of variation in mean turns per inch increased slightly on mercerization ; (*iii*) length parameters have good correspondence with yarn irregularity when the effect of fibre fineness was eliminated; (*iv*) the mean length of cotton fibres did not appear to have much influence on yarn irregularity; and (*v*) floating fibre percentage had greater influence than the short fibre percentage on the evenness of the yarn.

11. Studies on the changes in shape of cotton fibres due to different chemical treatments were continued by treating samples of N.C.14 and Auburn with various concentrations of zinc chloride, namely 35, 50, 60, 70 and 80 per cent and it was observed that the maximum change occurred at 70 per cent concentration. The cross-sections of 20 cottons (500 cross-sections for each) were examined for circularity and they were grouped into the three categories, viz. circular, elliptical and flat. It was observed that the cottons from *G. arboreum* had higher percentage of fibres with circular cross-sections than cottons belonging to other species, the respective values of fibres with circular cross-sections being :

G. arboreum	32.6%	*G. barbadense*	16.5%
G. herbaceum	22.8%	*G. hirsutum*	11.5%

12. To study the characteristic curve connecting count and C.S.P., eleven samples of cotton having about 40s H.S.C. had been spun into about ten counts ranging from 20s to 50s with a twist multiplier of 4.25. The yarn samples of different counts were tested for lea strength for studying the relationship of the C.S.P. values with the counts. It was observed that the

average C.S.P. of all cottons showed a uniform downward trend as the count increased. The C.S.P. and the count (C) were linearly related, the regression equation connecting the two values being C.S.P. $=19.4\ (130—C)$.

13. The results of tests on skein strength at different levels of relative humidity (r.h.) on all the samples of different counts were pooled and the following regression equation was worked out therefrom to calculate the skein strength of yarn at the standard atmospheric condition of 65 per cent r.h. from tests carried out at other levels of r.h. :

$$Y_{65} = Y_H\ [1 + 0.0027\ (65—H)]$$

where Y_{65} = Yarn skein strength in Y.S.I. units at 65 per cent r.h., and Y_H = Yarn skein strength in Y.S.I. units at a r.h. of H per cent.

After converting the Y.S.I. values into C.S.P. (lea count strength product) values, the general correction factor for obtaining C.S.P. at standard atmosphere of 65 per cent r.h. was calculated as :

$$S_{65} = S_H\ [1 + 0.0028\ (65—H)]$$

where S_{65} and S_H are the C.S.P. values at 65 per cent and H per cent r.h.

The general correction factor for conversion of tex values from any level of r.h. between 35 and 85 per cent, to that at 65 per cent r.h., works out to :

$$T_{65} = T_H\ [1 + 0.000828\ (65—H)]$$

where T_{65} and T_H are the tex values of the sample at 65 per cent and H per cent r.h. at which tests were carried out.

The above relations were found to be satisfactory for the range of r.h. from 35 to 85 per cent. However, it is felt that, as far as possible, the yarn strength tests should not be carried out at relative humidity levels above 75 per cent as the differences between calculated and observed values exceed 1.5 per cent.

Publications

During the year, two Technological Reports, seven research publications, one Annual Report and two articles were published. Besides, 65 Technological Circulars on selected Standard Indian Cottons and major Trade Varieties were issued. Further, six articles were sent for publication in various journals and three articles contributed at scientific conferences.

Training

During the year, training courses for persons employed in the Cotton Trade and Co-operative Marketing Societies, etc., were conducted and nine persons completed the course successfully.

Fabrication and Supply of Instruments

There was continued demand for the instruments fabricated at the Laboratory. During the year, 8 Laboratory Gins, 7 Ginning Percentage Balances, 10 halo length discs (small size), 15 halo length discs (large size), 2 plush boards and 36 steel combs were fabricated and supplied to those who had asked for them.

VII. Personnel

The term of Dr. S. M. Betrabet, Senior Scientific Officer, who had proceeded to the U.S.A. on the 26th August, 1968, on foreign assignment to take up the Post-Doctoral Associateship of the National Academy of Sciences was extended for a further period up to the 26th August, 1970, by the Council. Dr. S. N. Pandey, Junior Scientific Officer, has been appointed as Senior Scientific Officer, on an *ad hoc* basis to officiate in place of Dr. S. M. Betrabet with effect from the 28th June, 1969. Dr. V. G. Munshi, Junior Physicist under the All-India Co-ordinated Research Project on Cotton, was appointed as Senior Scientific Officer from the 25th April, 1969. Dr. N. B. Patil was appointed as Senior Scientific Officer from the 4th August, 1969.

Shri B. Srinathan was appointed as Junior Scientific Officer (Spg.) from the 25th June, 1969, and Shri P. G. Oka, Junior Scientific Officer, as Junior Physicist under the All-India Co-ordinated Research Project on Cotton from the 21st July, 1969. Dr. K. R. Krishna Iyer was appointed as Junior Scientific Officer from the 1st December, 1969.

During the year under report, the Outstation at Abohar was closed due to the termination of the scheme for breeding extra-long staple cotton at Abohar, to which the said Outstation was attached. Shri S. N. Nagwekar, Senior Reserach Assistant working thereunder, was accordingly transferred in the same capacity to the Main Centre at Hissar, under the All-India Co-ordinated Research Project on Cotton from the 1st April, 1969.

Shri A. K. Anthony, Research Assistant at Coimbatore, was promoted as Senior Research Assistant at the Main Centre at Sriganganagar under the All-India Co-ordinated Research Project from the 1st September, 1969. The post of Senior Research Assistant (Bio-chemistry) was filled in by Dr. A. J. Desai from the 1st July, 1969, on an *ad hoc* basis.

Six Research Assistants were recruited during the year under report, viz. Kum. Suman R. Jage, and Sarvashri G. Viswanathan and Ram Parkash at the Laboratory, Shri I. H. Hunsikatti at Dharwar, Shri V. A. Shukla at Sriganganagar and Shri V. B. Suryanarayanan at Nanded, under the All-India Co-ordinated Research Project. All of them joined on the 11th September, 1969, at the respective places.

Shri C. P. Venugopalan, Research Assistant at the Laboratory, was transferred from the 7th September, 1969, to the Main Centre at Coimbatore

vice Smt. Santa V. Nayar who was transferred from the complement of the Co-ordinated Project to the regular complement of the Outstation, at the same place. Shri G. Varadraj Rao, Research Assistant at Nandyal, under the Co-ordinated Project was transferred to the Laboratory from the 20th January, 1969 and Shri Y. Subramanyam, Research Assistant at this Laboratory, was transferred in his place from the said date.

Shri Varghese Paul, Research Assistant in the Laboratory, was relieved of his duties at this Laboratory from the afternoon of the 7th June, 1969, to take up the appointment of Research Assistant under the Central Institute of Fisheries Technology, Ernakulam.

Kum. R. D. Jayalakshmi, Senior Research Assistant (Microbiology), resigned her post from the 17th August, 1969. The resignations of Kum. T. K. Girija and Sarvashri S. Venkataraman and K. V. Babu, Research Assistants at the Laboratory, were accepted with effect from the 8th March, the 1st August, and the 1st September, 1969, respectively. Shri Vijaya Bahadur Singh, Research Assistant (Statistics), also resigned from the 17th August, 1969.

The death of Shri Keshav Pacha, a spinning operative, on the 18th October, 1969, is deeply regretted.

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

V. SUNDARAM
Director

VIII. Appendices

APPENDIX I

FINANCIAL STATEMENT

Expenditure and Receipts of the Laboratory During 1968-69

A. Expenditure

	Sanctioned Grant (Rs.)	Actual Expenditure (Rs.)	Savings (—) Deficit (+) (Rs.)
I. Technological Research			
Technological Research Laboratory including outstations			
(*a*) Capital expenditure including expansion of Laboratory	4,51,000	2,49,899	(—) 2,01,101
(*b*) Working Expenses	7,48,100	9,75,056	(+) 2,26,956
	11,99,100	12,24,955	(+) 25,855
II. Technological Schemes including P.L. 480 Projects	1,54,400	1,20,559	(—) 33,841

B. Receipts

	(Rs.)
Sale of Products (gins, etc.)	36,236
Sale Proceeds of Fruits, Vegetables, etc.	150
Analytic and Testing Fees	12,237
Rents	16,255
Fees for Training, Application Fees, etc.	2,079
Sale of Publications	3,628
Interest on Loans and Advances	130
Miscellaneous (including sale of waste cotton)	9,375
Foreign Service Contribution	947
Total	81,037

APPENDIX II

Scientific and Technical Staff Working at the Cotton Technological Research Laboratory as on the 31st December, 1969

Director	Dr. V. Sundaram, M.Sc., Ph.D., A.R.I.C.
Senior Scientific Officers	Dr. S. M. Betrabet, M.Sc., Ph.D. (on foreign assignment)
	Shri R. P. Neogi, B.Sc., B.Sc. (Tech.)(Manch.), A.M.C.T. (Eng.)
	Dr. V. G. Munshi, M.Sc., Ph.D.
	Dr. N. B. Patil, M.Sc., Ph.D.
Junior Scientific Officer (Spinning)	Shri B. Srinathan
Junior Scientific Officers	Dr. S. N. Pandey, M.Sc., Ph.D. (Officiating as Senior Scientific Officer vice Dr. S. M. Betrabet on foreign assignment)
	Shri G. S. Rajaraman, M.A.
	Dr. K. R. Krishna Iyer, M.Sc., Ph.D.
	(One post vacant)

Senior Research Assistants (Testing)

Shri P. D. Vakil	Shri S. R. Ganatra, B.Sc.
Shri C. A. S. Aiyar, B.Sc.	Shri S. G. Nayar, B.Sc., L.L.B.
Shri S. Ramanathan	Shri A. Rajagopalan, B.Sc.
Shri P. N. Elayathu, B.Sc.	Shri A. V. Ukidve, B.Sc.
Smt. S. B. Pai, B.Sc. (Hons.)	Shri B. M. Petkar, B.Sc.
Smt. K. L. Datar, B.Sc.	

Senior Research Assistant (Ginning)	Shri D. G. Shete, L.M.E.
,, ,, ,, *(Electrical)*	Shri H. V. Tamhankar, L.M.E., L.E.E.
,, ,, ,, *(Spinning)*	Shri K. S. Bhyrappa, L.T.T.
	Shri S. Raghupathi, D.T.T.
,, ,, ,, *(Statistics)*	Shri K. Venkateswaran, B.A.
,, ,, ,, *(Microbiology)*	(Post vacant)
,, ,, ,, *(Bio-chemistry)*	Dr. A. J. Desai, M.Sc., Ph.D.

Research Assistants (Testing)

Shri K. R. Kamath, B.Sc.	Smt. S. D. Pai, B.Sc.
Shri P. K. Jairam, B.Sc.	Kum. T. T. Annamma, B.Sc.
Shri V. Venugopalan, B.Sc.	Shri A. K. Gupta, B.Sc. (Hons.)
Shri N. Thejappa, B.Sc.	Smt. J. K. S. Warrier, B.Sc.
Kum. Indira K. P. Iyer, B.Sc.	Shri T. K. Madusudan Das, B.Sc.

Research Assistants (Testing)—Contd.	
Shri V. Jose Joseph	Shri K. S. Shama Rao, B.Sc.
Shri K. Vijayan, M.Sc.	Shri K. V. Ananatha Krishnan, B.Sc.
Smt. Shaila P. Bhatawdekar, M.Sc.	Shri S. Vasudevan, B.Sc., B.Tech.
Shri P. K. Chidambareswaran, M.Sc.	Kum. Radhika R. Nayak, B.Sc.
Shri P. Bhaskar, M.Sc.	Kum. Suman R. Jage, B.Sc.
Shri G. Varadaraj Rao, M.Sc.	Shri G. Viswanathan, B.Sc.
Smt. Prema Nair, M.Sc.	Shri Ram Prakash, B.Sc.
Shri C. R. Sthanu Subramoni Iyer, B.Sc.	(Four posts vacant)
Research Assistants (Statistics)	Shri K. Chandran, B.A.
	(Two posts vacant)
Research Assistants (Spinning)	Shri N. K. Haridas, D.T.T.
	Shri H. R. Lakshmi Venkatesh, D.T.T.
Research Assistant (Workshop)	(Post vacant)

Outstations

Station	*Senior Research Assistant*	*Research Assistant*
Coimbatore	Shri S. K. Iyer, B.A.	Smt. Santha V. Nayar, B.Sc.
Dharwar	Shri M. S. Sitaram, B.Sc.	Shri E. S. Abraham, B.Sc.
		Shri I. H. Hunsikatti, B.Sc.
Indore	Shri N. C. Chiplonkar, M.Sc., D.C.T.	Shri G. S. Patel, B.S.
Nanded	Shri W. R. Sharma, B.Sc.	Shri S. P. Ingole, M.Sc.
Nandyal	Shri R. Dwarkanath, B.Sc.	—
Sriganganagar	—	Shri V. A. Shukla, B.Sc.
Surat	Shri L. R. Jambunathan, B.Sc. A.M.I.E.T.	Shri R. C. Sankalia

P.L. 480 Project (Grant No. FG-IN-186)

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

ALL-INDIA CO-ORDINATED RESEARCH PROJECT ON COTTON

(*a*) *Laboratory*

Junior Physicist	Shri P. G. Oka, M.Sc.
Senior Research Assistant	Shri Radha Ballabha, M.Sc.

(*b*) *Outstations*

Station	*Senior Research Assistant*	*Research Assistant*
Coimbatore	—	Shri C. P. Venugopalan, B.Sc.
Hissar	Shri S. N. Nagwekar, B.Sc.	(Post vacant)
Nanded	—	Shri V. B. Suryanarayanan, B.Sc.
Nandyal	—	Shri Y. Subramanyam, M.Sc.
Sriganganagar	Shri A. K. Anthony, B.Sc.	—
Surat	—	Shri S. S. Iyer, B.Sc.
		Shri M. C. Bhalod, B.Sc.