FAO COFFEE MISSION TO ETHIOPIA

1964-65

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1968

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F.G. Meyer
L.M. Fernie
R.L. Narasimhaswamy
L.C. Monaco
D.J. Greathead

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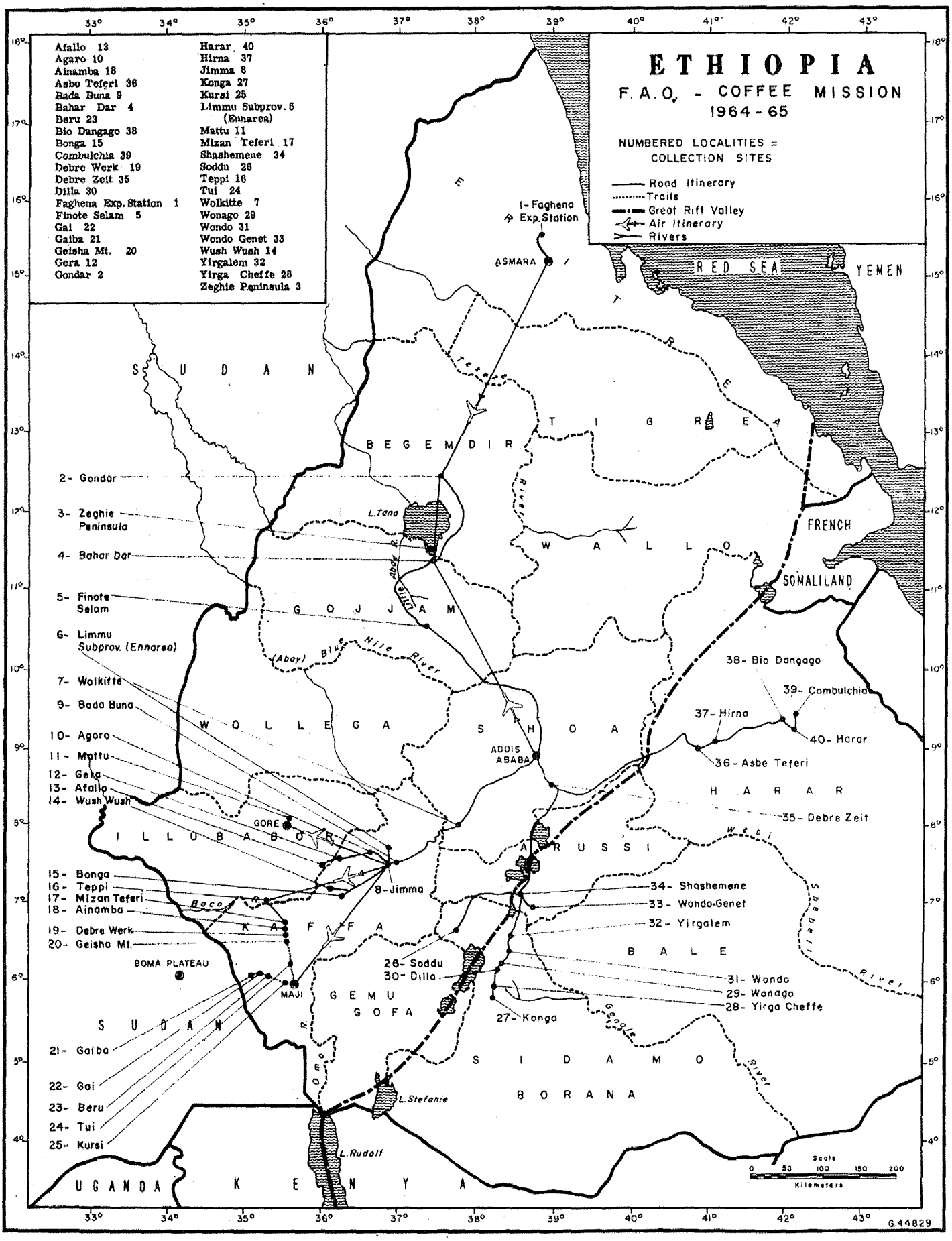
PREFACE

The principal aim of the FAO Coffee Mission to Ethiopia was to gather botanical, entomological, genetical and horticultural data for the increase of knowledge and understanding of the Arabica coffee plant, particularly concerning its origin, variability and distribution in Ethiopia. These data in no way complete the task of documentation. In fact, an even more urgent need is now felt to return to the field for the purpose of covering areas still unexplored. In the limited time available on this first coffee mission expedition, a number of important areas, of necessity, were left untouched.

The official members of the mission, each with separate objectives, have submitted separate chapters in fulfillment of commitments made when the mission was organised by FAO. While some duplication in coverage was unavoidable, this does not seriously detract from the main content of the Report.

On behalf of the members of the Coffee Mission, this report is respectfully submitted.

Frederick G. Meyer
Leader


ETHIOPIA
F.A.O. - COFFEE MISSION
1964 - 65
NUMBERED LOCALITIES = COLLECTION SITES
Road Itinerary
Trails
Great Rift Valley
Air Itinerary
Rivers
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Agaro 10
Ainamba 18
Asbe Teferi 36
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Beru 23
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Combulchia 39
Debre Werk 19
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RED SEA
YEMEN
SUDAN
ERITREA
TIGRE
BEGEMDIR
WALLO
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GOJJAM
L. Tana
Blue Nile River
(Abay)
WOLLEGA
SHOA
ADDIS ABABA
HARAR
ILLUBABOR
GORE
ARUSSI
Wabi Shebelli River
KAFFA
BALE
BOMA PLATEAU
MAJI
GEMU GOFA
SIDAMO
BORANA
Ganale River
Omo River
L. Stefanie
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2- Gondar
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7- Wolkitte
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21- Gaiba
22- Gai
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Scale
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Kilometers
G.44829

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INTRODUCTION

The first coffee mission to Ethiopia organised by the Food and Agriculture Organization of the United Nations (FAO) resulted from a proposal introduced by Mr. C.A. Krug (FAO) and fellow delegates at the First FAO Conference on Coffee Production and Protection held in Abidjan, Ivory Coast, in October 1960. Under the item "suggestions for the establishment of a mechanism to promote international cooperation on technical coffee problems", ways and means were discussed for exploration of native coffee species, and establishment of world collections and taxonomic study of the species of coffee.

Ethiopia was chosen as the site of the FAO Mission chiefly to collect germ plasm material, pathogens and pests of Arabica coffee (Coffea arabica L.) for botanical, breeding, rust screening and related purposes. Aims and objectives are enumerated below.

The Arabica coffee plant, as the principal economic species, contributes 75 percent of the world's commercial coffee. According to FAO (1961) "the value of world coffee exports ... in the fifties was the most valuable single commodity in world trade, just ahead of raw cotton, raw wool and wheat". Quite understandably, the Arabica coffee plant has been the subject of extensive research during the present century, mostly horticultural and genetical. The 5227 references listed by Martínez and James (1960), mostly on C. arabica, attest to this. References on the botany and distribution of C. arabica, however, are another story. Chevalier's (1947) monograph of Coffea listed 66 species and numerous varieties, C. arabica among them, but nothing fundamentally new was added on the botany and distribution of Arabica coffee. This was reasonable, since Chevalier never visited Ethiopia and his few specimens were all of cultivated material collected in northern Ethiopia where the plant is not indigenous. Chevalier's remark, for example, that the Arabica coffee plant is wild in the arid savanna country adjacent to the Atbara River in the northwestern part of Ethiopia is misleading and incorrect.

The history of Arabica coffee, as an economic plant of importance, goes back to about 1500 when the world supply came from the Yemen. Shortly after that the plant is purported to have been taken to Ceylon, then to India and Java. By 1720, the coffee plant had reached the New World, first French Guiana and Surinam in South America and a few years later Martinique in the West Indies, as seedlings from a single plant had been received in the Botanic Garden in Amsterdam in Holland from Java, in 1706.

The Yemen was almost the sole source of coffee germ plasm over most of the recorded history of C. arabica. Yet, there is no reason to suggest that Arabica coffee is indigenous of the Yemen. The Yemen, as part of old Arabia Felix, is largely a desert area with high mountains in the centre of the country where coffee is grown on terraces and watered from wells (Sylvain, 1956). The Arabica coffee plant is really a rain forest species with a tolerance to grow in a wide range of climatic and ecologic conditions. The date coffee was introduced into the Yemen from Ethiopia is unknown. No other country of Africa seems to be associated with the history of the Arabica coffee plant, although the closest relatives of C. arabica are quite definitely tropical African. Among the various species of the section

EUCOFFEA, C. arabica is wholly confined to Ethiopia and possibly to one or two contiguous areas in the Sudan and Kenya. Related species occur in Central and West Africa.

Already seven-eighths of the forest cover of Ethiopia has vanished, leaving only a fragment in the southern and southwestern provinces still in a semi-pristine condition. As the remaining forest areas are newly opened by roads, the present more or less undistrubed areas will be threatened by expanding agriculture and timber interests, thus complicating the picture of origin and distribution of the coffee plant still further. Collections of germ plasm material of C. arabica were thus a matter of some urgency to recover valuable information now before the advance of the axe and bulldozer made further ruinous inroads in the most important areas.

Aims and objectives

The aim of FAO was to send a team of experts to Ethiopia, consisting of botanist, breeder, geneticist, and entomologist for field study of the Arabica coffee plant and to collect (1) material to document the plant botanically; (2) seeds for follow-up studies in breeding and selection work; (3) insect pests; (4) seed material for screening against the coffee leaf rust (Hemileia vastatrix), and (5) coffee leaf rust spores for identification of rust races. A mission of this scope had never before been attempted by a coordinated scientific team. Earlier germ plasm material was collected by individual workers : W.A. Archer (1951); P.G. Sylvain (1952-54); J.B. Lejeune (1954-56); C.A. Krug (1957); E. Anderson (1959); A. Bechtel (1957-60); and F.G. Meyer (1961-62).

1. Botanical collections

Herbarium specimens were prepared of C. arabica for further study on the distribution and variation of the plant. Also, herbarium specimens were prepared of trees, shrubs and herbs associated with the coffee plant in rain forest areas. A complete set of herbarium material is on deposit at the Royal Botanic Gardens, Kew where determinations were made on plants other than C. arabica; also a set of specimens are deposited in the herbarium of the U.S. National Arboretum, Washington, D.C.; duplicates will be deposited in some other herbaria.

2. Seed collections

Members of the mission obtained 621 collections of C. arabica seeds from all areas visited. Two collections of seedlings from Eritrea were sent to the U.S.A. after the mission ended. All seed collections are listed in Appendix VIII. Material will be grown for experimental purposes in India at the Central Coffee Research Institute (Balehonnur, Mysore State), 81 collections; in Tanzania at the Coffee Research Station, Lyamungu, 196 collections; in Ethiopia at the Agricultural Technical School, Jimma, 433 collections; in Latin America, 490 collections divided between Costa Rica at the Instituto Interamericano de Ciencias Agrícolas de la OEA, Turrialba; and Peru at the Research Station, Tingo Maria. A complete set of seed collections were given to Dr. Branquinho d'Oliveira at the Estaçao Agronômica Nacional, Oeiras, Portugal for his research in coffee leaf rust screening, and for identification of physiologic races of the rust organism. A partial report of this screening by A.J. Bettencourt and J. Lopes appears as Appendix V.

3. Pests

Collections of pests on the coffee plant were made by Dr. Greathead (Appendix VI). Five major groups of insects were found on coffee plants in areas visited: berry boring caterpillar, leaf miner (three sorts), stem borers, Antestia bug and scale (Coccidae). Less important pests included ants and snails.

4. Pathogens

Spore material of over 50 collections of Hemileia vastatrix, the coffee leaf rust, were sent to Dr. d'Oliveira in Portugal. Some other parasitic fungi found on leaves of C. arabica were collected. Collections of fungi are listed in Appendix VII. Of a total of 23 known rust races of H. vastatrix in the world, only four are known from Ethiopia.

Observations by members of the Mission clearly show that coffee leaf rust is more common at lower altitudes (1,300 m at Teppi in Illubabor Prov.) than at 1,750 m at Jimma in Kaffa Province. Yet, H. vastatrix was found in nearly all stations visited, except in Gojjam Province, in Eritrea, and one place in Kaffa Province (Wush Wush Plantation). Elsewhere in Kaffa and Illubabor Provinces and in parts of Harar Province where collections were made, the coffee leaf rust was observed. In most areas the coffee leaf rust fungus was parasitized by Verticillium hemileiae.

5. Breeding and selection

Value of the seed collections will be for follow-up work in breeding and selection work. The industry is now threatened with disease and other related problems. The coffee leaf rust exists throughout the Old World in many places where the Arabica coffee plant is grown, but not in the New World. The highest producing and at the same time fully rust susceptible coffee plants in Brazil, for example, are products of a relatively depauperate genetic stock. Available germ plasm reserves for combating coffee leaf rust are wholly inadequate. With the centre of genetic variability for C. arabica located in Ethiopia, collections from this area are of considerable potential value to coffee breeding programs.

Personnel

The expedition by FAO to Ethiopia covered the period 15 October 1964 to 15 January 1965, with seven countries participating. The official team consisted of L.M. Fernie, breeder, representing Tanzania, Kenya and Uganda; D.J. Greathead, entomologist, Uganda; L.C. Monaco, geneticist, Brazil; F.G. Meyer, botanist, USA; and R.L. Narasimhaswamy, breeder, India. Ethiopia sent five observers: Ato Worku Makonnen, Ethiopian Coffee Board, Dr. Dagnatchew Yirgou, pathologist; Ato Abebe Abaye, Ministry of Agriculture; Mr. Floyd E. Bolton who has since returned to USA, and Ato Yilma Yomano-Barhan, Jimma Agricultural Technical School.

Itinerary

The itinerary of the team is given in Appendix I. Appendix II presents an alphabetical list of the coffee collecting localities, while Appendix III shows the condition of coffee plants in flower and fruit during the mission expedition.

Spelling of place names

Considerable variation exists in the spelling of place names, e.g. Gimma (Italian), Jimma (English), Jima (Ethiopian). In this report phonetic spelling has been used according to English usage in transliterating out of the Amharic. No official list of Anglicized place names exists for the country.

ACKNOWLEDGMENTS

Without the full cooperation of the Government of His Imperial Majesty, Haile Selassi I, the mission would have been impossible. Officials in the Ethiopian Ministry of Agriculture and the National Coffee Board of Ethiopia provided both moral support and guidance, as well as logistic help on numerous occasions. Thanks are extended to Ato Zegeye Abberu, Director-General, Ministry of Agriculture, and his immediate representatives, in particular Ato Werqu Makasha, Director-General for Agricultural Research, for receiving the FAO delegation and for guidance rendered.

Various members of the National Coffee Board assisted in the field activities; special thanks are due to Ato Lemma Frewhywot, Executive Secretary, who on several occasions accompanied members of the mission personally into the field; and Ato Worku Makonnen for his friendly cooperation and intelligent handling of many details in the field.

The many courtesies received from the Agricultural Technical School at Jimma, especially facilities for preparing and drying coffee collections and herbarium specimens are gratefully acknowledged. In particular, thanks are extended to Ato Yilma Yomano-Barhan, Director, and Mr. Floyd E. Bolton, instructor, for their willing assistance. Mr. Bolton also helped to arrange for a trip to Maji with Mr. Fernie, specifically for coffee material. Mr. Harold Kurtz and members of the American Mission at Maji were particularly helpful and kind and they are to be thanked for hospitality extended to Mr. Bolton and Mr. Fernie during their brief stay.

Several other Ethiopian contacts kindly offered hospitality to members of the mission during visits to various parts of the country. The following persons in particular are thanked for permitting members of the Coffee Mission to collect coffee material on their properties : Ato Getahoun Birke in Limu, Ato Teke Egano at Doyo and Gera, Dejazmatch Johannes Girma at Sedecha, Ato Mahari Endale at Kossa on the Limu Road, Ato Shone Seda at Sapa Dildye, Ato Shibeshi at Mizan Teferi, Mr. F. Buckholz at Wush-Wush, Dr. Vittorio Nastasi and Dr. Gaetano La Barbera, both of the Ethiopian Department of Agricluture, Asmara, Eritrea.

Grateful acknowledgment is made to Sir George Taylor, the Director of the Royal Botanic Gardens, Kew and members of his staff for kindly making identifications on specimens associated with the coffee plant collected by the botanist during the Coffee Mission.

Mr. J.L. Greig, FAO Representative in Ethiopia and his administrative assistant, Ato Solomon, handled many details of the mission with dispatch. Dr. A.B. Fagundes, at that time Chief of the Industrial Crops Branch, saw to many difficult matters of organization from Headquarters in Rome.

The Food and Agriculture Organization of the United Nations wishes to extend its thanks to the following governments and bodies, for releasing their officers for the duration of the Ethiopia Coffee Mission, and for financial assistance : the Governments of Tanzania, Kenya and Uganda and their Coffee Boards for the services of Mr. Fernie and of Dr. Greathead; the Government of the United States of America and the U.S. National Arboretum for the release of Dr. Meyer; the Government of Brazil and the Instituto Agronômico, Campinas, São Paulo, for the services of Mr. Monaco; and the Government of India and the Coffee Board Research Department, Mysore, for the release of Mr. Narasimhaswamy.

1. FURTHER OBSERVATIONS ON THE HISTORY AND BOTANY OF THE ARABICA COFFEE PLANT, COFFEA ARABICA L., IN ETHIOPIA

by
F.G. Meyer
Research Botanist, U.S. National Arboretum
Crops Research Division, Agricultural Research Service
U.S. Department of Agriculture, Washington D.C., U.S.A.

The present author reported some observations on the history and botany of the Arabica coffee plant, made during an earlier trip to Ethiopia in 1961-62 for the purpose of documenting the coffee plant botanically (Meyer, 1965a).

The following notes, made during the FAO Coffee Mission expedition, 1964-65, are offered as additional information toward a better understanding of C. arabica as an indigenous plant of the montane rain forests of southwestern Ethiopia.

1.1 HISTORICAL

Briefly, the documented history of the Arabica coffee plant is tied almost entirely to cultivated plants grown for centuries on terraces in the otherwise barren mountain highlands of the Yemen, at elevations of 1,300 - 2,250 m. The Yemen was the principal source of C. arabica germ plasm until explorations began in Ethiopia a few years ago. Yet, after a more careful study of the biology of this rain forest plant there is little to convince a careful observer that desert mountains of the Yemen should in any way be considered to be the native habitat of C. arabica.

Early travellers and writers long ago advocated that the Arabica coffee plant originated in Ethiopia. Yet, only since the Second World War has authentic material become available for the study of this age-old question, mainly through FAO and US/AID coffee experts who visited Ethiopia. Sylvain (1955,1958), Anderson (1961) and (Meyer 1965a) presented data in support of an Ethiopian genetic centre of C. arabica. The present report is submitted as additional evidence in support of an Ethiopian origin of Arabica coffee, although much more collecting is still required in many areas of the country, especially in remote areas of southern Kaffa, western Illubabor and Gama Gofa. Areas east of the Rift Valley have never been adequately investigated, either.

1.2 TAXONOMY AND DISTRIBUTION

The rain forest species of Coffea in the section EUCOFFEA consist of 17 taxa in Chevalier's treatment (1947), all diploids with known karyotypes, except C. arabica, which is a tetraploid. The diploid taxa occur mostly in rain forest areas of Uganda, Kenya, the Congo and West Africa to Sierra Leone with two or three species in East Africa. Geographically, C. arabica is disjunct from all other coffee species and is confined to the Ethiopian plateau. The putative parentage has been suggested by Narasimhaswamy (1962), but the origin of C. arabica, as the only polyploid taxon of the genus, still remains unknown. Field observations show a wide range in plant to plant variability in Arabica coffee found in rain forest areas visited by the mission, but not so great as to detect putative parentage, at least visually. Careful progeny testing and character evaluation on many collections of Ethiopian origin might, however, help to resolve the matter of origin of C. arabica.

The Arabica coffee plant is cultivated in numerous localities listed below of northern, western and eastern Ethiopia : in many parts of Sidamo province, on the Zeghie peninsula, Lake Tana in Gojjam province, on the Red Sea escarpment at 5,000 ft. (1,700 m) in Eritrea, in Wollega province, especially around Lechemti, Ghembi and Dembidollo* and in some other areas. In fact, the Arabica coffee plant is cultivated in all provinces of Ethiopia at elevations of 4,000 to 7,000 ft. (1,300 to 2,000 m) altitude. Limited natural regeneration may be expected locally where coffee is planted in gallery forest, as, for example, around Ghembi in Wollega province. Further exploration is necessary in areas east of the Rift Valley, e.g. in Sidamo, Bale, particularly, to determine whether wild coffee really exists in these areas. Chevalier (1947) regards C. arabica var. abyssinica Chev. from northern Ethiopia as representing the wild phase of the plant. Actually, the specimens seen by Chevalier represent cultivated plants of unknown origin.

Observations by members of the FAO Coffee Mission support the view that the Arabica coffee plant is not wild at present; nor is it likely to have existed as wild in the recent past in the arid savanna country of northwestern Ethiopia or in any other northern area of the country.

The distribution of C. arabica in Ethiopia is complicated by the long history of man in this land of ancient agriculture. Shifting cultivation has so altered the genesis of forest succession over wide areas of Kaffa and Illubabor provinces, for example, that it is hardly possible to pinpoint, with any degree of accuracy, the distribution of truly wild coffee plants. Yet, the coffee plant is common and spreads naturally into many forest areas visited by the Coffee Mission in sites now sparsely inhabited.

Strenge (1956) and others have shown that in Kaffa province around old village sites now heavily forested, the remains of half buried grinding tools and other artifacts are not uncommon along with hedges of a giant native Euphorbia, possibly E. obovalifolia Rich., 50 ft. tall, a succulent plant which appears to be out of character in a rain forest environment. The human population of Kaffa province apparently was much greater a hundred years ago, with a sharp decrease following the wars that brought Menelik II to power in 1889.

1.3 RAIN FOREST HABITAT AND DISTRIBUTION OF COFFEA ARABICA

The Arabica coffee plant is manifestly a rain forest species whose closest relatives, e.g. C. canephora, C. eugenioides, C. congensis, C. excelsa, C. liberica in the section EUCOFFEA, are distributed primarily in rain forest areas of tropical Africa.

Observations show that semi-wild or spontaneous and naturalized plants of C. arabica are most abundant in evergreen forest areas of southwestern Ethiopia with an average yearly precipitation of 60 to 80 in. (1,500 to 2,000 m). Rainfall is spread over the year, with no month rainless; December and January are the driest months, but heavy rains of brief duration are not uncommon even during this period.

In areas of Kaffa and Illubabor provinces visited by the mission, the Arabica coffee plant, in addition to being genuinely cultivated, spreads spontaneously, and naturalizes in forest areas over an altitudinal gradient between 3,000 ft. to slightly over 6,000 ft. (910-1,830 m). The plant is reported to grow in forests of Gamu Gofa, but time did not permit a visit to this province. The distribution of the coffee plant east of the Great Rift Valley in Shoa, Bale and Sidamo provinces is confusing, because of extensive cultivation with far more forest disturbance in

* and also in the Chercher Hills of Harar Province.

some areas in Sidamo. In one place near Shashemene in Shoa province, coffee plants were found growing spontaneously in a limited rain forest area. In view of nearby coffee plantations, the origin of such material is open to question. Furthermore, we know that monkeys and rodants relish the sweet pulp of ripe coffee fruit and these animals certainly are responsible for the spread of the coffee plant in forest districts of Ethiopia.

The Arabica coffee plant is reported to occur in a semi-wild condition in two known areas outside of Ethiopia, namely the Boma Plateau located about 6°10' N, 34°40' E, in the Sudan adjacent to Kaffa province (Thomas, 1942), and Mt. Marsabit in the northern province of Kenya. Marsabit is an isolated mountain with an evergreen forest near the summit. In 1965, Dr. D.J. Greathead, entomologist on the FAO Coffee Mission, visited Mt. Marsabit and photographed spontaneous coffee near the summit of this mountain, but the origin of the plants is unknown.

1.4 OBSERVATIONS ON SEEDLINGS OF COFFEA ARABICA

Seedlings of FAO collections raised in the greenhouse at the Plant Introduction Station, Glenn Dale, Maryland, showed interesting variation in cotyledon number and in some other respects. Details are given below. Seeds planted about 1 February 1965 were ready to send to Costa Rica and Peru shortly after 1 June 1965. Germination was well above 90 percent in most collections and 100 percent in some collections.

Number of collections	488	
Seedlings reported	11,003	
Seedlings with 3 cotyledons	385	3.49%
Seedlings with 4 cotyledons	62	0.56%
Seedlings with white variegated leaves	8	
Multiple seedlings (2 or 3) produced from a single seed (polyspermy?)	41	0.37%
Seedlings with leaves resembling C. arabica "Nana"	4	
Seedlings with 2 lead shoots above cotyledons	5	
Seedlings with white variegated cotyledons	18 out of 20 in a single collection	

Leaves a whorl of 3 on lead stem, opposite on the lateral branches.

Polycotyledony was relatively high among the seedlings. Extra cotyledons usually resulted in one (not both) of the cotyledons splitting to the base or nearly so. The following figures show the incidence of polycotyledony in 11,003 seedlings.

Coll. No.	Seedlings	2-Cot	3-Cot	4-Cot
E-5	70	55	13	2
E-16	46	34	12	
E-36	78	59	15	4
E-524	94	81	11	2
E-562	40	30	9	1
E-579	71	52	15	4

An analysis of colour genes bronze vs. green in 11,003 seedlings would have been interesting, since the bronze allele (Br) is known to be incompletely dominant over green in the young leaves of the Arabica coffee plant. A statistical analysis was not possible before the seedling populations were distributed; however, seedlings with bronze young leaves were in the majority. A few green-leaved seedlings were noted.

SUMMARY

1. Various travellers and some scientific observers previously have reported that Arabica coffee grows wild in the forests of Kaffa and adjacent provinces of southwestern Ethiopia. However, all early reports were undocumented. Explorations since the second war, particularly since 1961, have changed the picture significantly.

2. Botanists and coffee research workers have always known C. arabica as a cultivated plant from domesticated material long grown in the Yemen. From this source, coffee spread to other parts of the tropics, beginning shortly after 1500, first to Ceylon and then to India and Java. Until recently, material of Arabica coffee from the primary germ plasm centre of the plant in southwestern Ethiopia had never reached the hands of scientists for serious study.

3. Proof of nativity of C. arabica is not easy to establish. Yet some material collected in Kaffa and Illubabor provinces of Ethiopia by the mission come closest to truly wild Arabica coffee of anything known heretofore.

4. The history of the Arabica coffee plant, since 1500, is fairly well documented. Before that the story is almost purely legendary. No evidence exists, for example, for cultivation of the Arabica coffee plant in areas of Africa outside of Ethiopia prior to the spread of European influence in tropical Africa, e.g. before the middle of the 19th century. The Arabica coffee plant does not turn up in any of the early 19th century plant collections made in Africa in areas outside of Ethiopia.

5. Ethiopia is the primary centre of genetic diversity of the Arabica coffee plant. No other country of Africa is involved and the Yemen must be discounted, except as a secondary dispersal centre. The plant was wholly introduced in the New World from material that originated from the Yemen via Java and Holland. Those who question the existence of truly wild coffee in Ethiopia are satisfied that incipient domestication has been involved in all Ethiopian coffee plants. This cannot be denied categorically. Perhaps the term "wild", as applied to C. arabica, should relate as a quantitative measure to represent stages in domestication, if, in fact, this is possible to determine by experimental or other means.

6. The Arabica coffee plant is not a sophisticated domesticate as compared with some other domesticated agricultural crop plants of Ethiopian origin. Traditionally, the coffee plant is little more than a gathered crop in many forest areas. A current trend exists to domesticate the plant, as a result of a demand for commercial coffee as the primary export product of Ethiopia. Domestication of C. arabica is most evident in Sidamo, parts of Kaffa, Wollega, Zeghie Peninsula and in Harar province where selections (some named) are sometimes grown. Coffee plants in Harar and Zeghie Peninsula were domesticated over a long period of time and seem to conform to more or less one major but different cultivars in each area.

7. The Arabica coffee plant exhibits weedy tendencies as indicated by the rapid spread of the plant along trails, under isolated trees in abandoned fields, and in clearings in forest areas near village sites. Humans, mules, monkeys and other animals are factors in the dissemination of coffee seeds. Large birds, such as hornbills, may also disseminate the plant.

8. Observations support the view that the Arabica coffee plant is neither wild now nor in the recent past in the arid savanna country of northwestern Ethiopia or in any other northern areas of the country. This is contrary to reports in the literature by some other authors.

9. 621 collections of Arabica coffee seeds were prepared during the course of the Coffee Mission for use in follow up research. Seedling material is now growing at experiment stations in Ethiopia, Tanzania, India, Costa Rica and Peru. Voucher herbarium specimens were also prepared in the field for botanical study.

10. Other collections included 63 samples of parasitic leaf fungi, including 58 collections of coffee leaf rust (Hemileia vastatrix) and 5 on other Rubiaceae.

11. The coffee leaf rust (H. vastatrix) and the parasitic fungus Verticillium hemileiae coexist on C. arabica in most areas visited, with little evidence of leaf drop often associated with coffee leaf rust disease. As observed in the Chercher Hills of Harar province, leaf drop may, in part, have been due to Hemileia. Coffee leaf rust was not observed in some places visited, notably on the Zeghie Peninsula, the Wush-Wush plantation in Kaffa province and at Soddu-Walamo in Sidamo province.

12. The entomologist with the mission collected 37 kinds of pests on Arabica coffee plants. Pests of C. arabica were not abundant in forest areas visited, but under plantation conditions in open areas, pests often caused damage sufficient to justify measures of control. The low incidence of Antestiopsis, Antestia bug, was more difficult to interpret, due perhaps to the season during which the expedition took place. In other areas of Africa, Antestia bugs are among the most important pests of C. arabica.

13. Coffea arabica is the only species of coffee indigenous of Ethiopia. No evidence was found on the present expedition to explain the origin of this self-fertile tetraploid species. The putative parents were not observed.

2. FAO COFFEE SURVEY IN ETHIOPIA

by

L.M. Fernie
Horticulturist
Coffee Research Station, Lyamungu, Tanzania
(Representative of Tanzania, Kenya and Uganda on
the Coffee Expedition)

2.1 INTRODUCTION

In view of the doubts regarding the truly indigenous nature of "wild" coffee, coupled with the particular requirements of East Africa, the policy was to collect seed samples of apparently representative types from as many areas as possible, regardless of whether the coffee was indigenous, spontaneous, exploited or obviously planted. Whatever its category, it was almost certainly derived locally, that is not introduced from another country, and only thus would Ethiopia's coffee be truly sampled. In addition, if any particular tree should be found exhibiting uniformly unusual characteristics of fruit, leaf or habit, it would simply be sampled as an individual tree, thus eventually giving an indication of variability from individual trees as well as the opportunity to test the particular characteristics as they appeared in the progeny. The desirability and practicalities of making immediate selections in the field and taking vegetative material as cuttings for the build-up of clones were dismissed at an early stage, and it was decided that all selections would be carried out on the progenies from seeds to be raised under reasonably uniform conditions in East Africa. The main objectives for East Africa were :

- Resistance to Coffee Berry Disease (Colletotrichum coffeanum Noack);
- Resistance to Leaf Rust (Hemileia vastatrix Berk. & Br.);
- High quality;
- High yields.

Unfortunately, it is possible to screen for only one of these factors, namely, rust resistance in the seedling stage.

In addition, a brief study was made of the conditions under which the coffee was growing in the different localities, and a note was made of the plants in association with it, both as shade trees and as competing weeds.

Samples of leaf rust on coffee and on other plants of the Rubiaceae were collected for forwarding to Dr. Branquinho d'Oliveira at the Coffee Rust Research Centre, Oeiras, Portugal for identification and grouping.

2.2 NOTES ON AREAS VISITED

2.2.1 Gojjam Province

2.2.1.1 Finote Selam, elev. 5,750 ft. (25 October)

This was the first coffee seen in Ethiopia. The majority was growing under fairly dense shade of Albizzia sp., and had been planted at a very close irregular spacing. As a result of the shade and close planting there were few weeds. There

was apparently some selection of self-sown progeny for further planting. There were also odd plantings at the fringes of the main area, where the shade was sparse and weed competition occurred, grouped around individual trees such as Cordia africana. There was evidence of nitrogen deficiency, over-bearing, and die-back.

The original seed was said to have been brought from the Zeghie Peninsula, but unfortunately this area was not sampled, as it was decided to sample the immediate surroundings of Zeghie instead. However no ripe fruit was found there.

The fruit, which was ripening, was mostly longish and flattish, and the number of malformed beans appeared to be numerous.

Here, as throughout Ethiopia, there was considerable divergence of leaf shape on any one tree, apparently according to the season in which it developed. The young leaves were green-tipped.

No leaf rust was seen, but there was occasional occurrence of "weak-spot".

The presence of a leaf skeletonizer, a leaf-miner and a snail was noted.

2.2.1.2 Zeghie Peninsula, elev. 6,280 ft. (26 October)

Zeghie was reached after one hour's journey by launch from Bahar Dar. The narrow neck of the peninsula was traversed, but not one ripe fruit of coffee was found.

The whole area was fairly heavily shaded with Albizzia sp., probably A. schimperiana as the dominant tree giving a nice high feathery shade. Other conspicuous shade trees were Cordia africana and occasional Ficus spp. Most of the shrubby undergrowth was cleared but specimens of two genera of the Rubiaceae, Randia urcelliformis and Pavetta aff. oliverana were found.

The ground cover was predominantly plants of Acanthaceae. "Weeding" was apparently confined to post-rains pre-harvest slashing in order to facilitate the collection of the dried fruits by stripping.

The coffee was irregularly distributed (probably planted), but approximated to a spacing of from 6 ft. x 6 ft. to 6 ft. x 8 ft. Most trees were tall with a number of bare stems and an overhead canopy of leaves and fruiting branches. Stems were usually bent and this had probably been induced during harvest where some breakages had obviously occurred. This was the only form of "pruning" carried out.

Growth had the appearance of being slow; there was no evidence of stem-pitting. The bark was smooth. The oldest trees were said to be 80-100 years old, but Sylvain (1958) suggests that the plant was known in this district at the end of the 17th century.

It was interesting to note that complete callussing of many of the wounds had occurred, contrary to general experience in Tanganyika.

The young leaves were green. The unripe fruit was longish and slightly flattened; there were no persistent calyces. Yields appear to be very low, the majority of the fruit being borne at the extremities of small branches.

There was no sign of leaf rust, nor was there any positive "weak-spot". There was evidence of a leaf-miner, a leaf skeletonizer, and berry moth.

Land tenure was apparently according to family, and sales were only permitted to a brother. It was understood that no coffee from this area was exported.

The trees are too old and unthrifty and they require rejuvenating. Urgent requirements for the area are :

- Pruning, preferably rejuvenating the trees by stumping at the beginning of the rainy season;
- Some reduction of shade by branch lopping;
- Careful harvesting of ripe fruit only;
- Wet processing, with particular attention to cleanliness, adequate fermentation and careful drying.

2.2.2 Begemedir Province

2.2.2.1 Azoza (nr. Gondar), elev. 6,700 ft. (27 October)

Some plantations had been established here in the past. The trees were growing on a form of multiple stem free growth; there was obviously no pruning as such. Irrigation was apparently practised, but trees were not thrifty, probably due to weed competition.

The trees were predominantly copper-tipped, and therefore were presumably not derived from Zeghie, where the young leaves were exclusively green. Both fruit and bean were roundish in appearance. No sample was collected.

2.2.3 Harar Province

2.2.3.1 Harar, elev. 6,000 ft. (5 November)

Around Harar city in particular, the growing of coffee was being neglected in favour of growing Chat or Khat (Catha edulis), the young shoots of which are exported to Aden as well as being widely used locally as a narcotic stimulant.

In Harar, coffee leaves were being sun-dried and used for making tea.

The type of coffee known in East Africa as Harar has a ragged bean giving an undesirable quality, whilst the plants themselves are known to be particularly susceptible to the brown eye-spot leaf fungus (Cercospora coffeicola). Certainly the latter was widespread in the area, but in Ethiopia Harar coffee has a reputation for quality.

2.2.3.2 Combolchia, elev. 6,300 ft. (5 November)

Trees were planted in small plots, which were mostly unshaded. The young leaves were copper coloured; no pruning was carried out.

No leaf rust was seen, but the cherries were badly affected by sun scorch, possibly associated with brown blight (Colletotrichum coffeanum), which was unconfirmed. No sample was collected.

2.2.3.3 Road Harar to Dire Dawa (5 November)

Here also smallholdings were seen where growth was better than at Harar. Terracing and some irrigation were practised. The sun scorch/brown blight condition was also observed, but no leaf rust. The tip leaves were copper coloured. No sample was collected.

2.2.3.4 Hirna (Chercher Hills), elev. 5,090 ft. (6 November)

Here the first evidence of the presence of leaf rust in Ethiopia was noted. Certain trees only in one plot were infected, whilst a nearby plot was apparently free from the disease. The brown eye-spot was also seen, as might be expected on Harar coffee and, as elsewhere in the parts of Harar Province which were visited, the sun scorch and/or brown blight complex occurred. Some die-back, possibly due to drought, was noticed, and iron deficiency symptoms were present.

The coffee was planted in rows on terraces, more or less regularly at a spacing of approximately 6 ft. - 7 ft. apart in the row with 10 ft. - 12 ft. between the terraces. Most of the coffee was unshaded, but an occasional Cordia africana tree occurred. There was no pruning.

The young leaves were copper coloured; occasional persistent calyces were noticed on the fruit. A seed sample was collected.

2.2.3.5 Asbe Teferi, elev. 5,200 ft. (6 November)

Here, at a much lower altitude, leaf rust infection was heavy and widespread, and there was evidence of considerable leaf-fall. Other maladies noticed included brown eye-spot, brown blight and/or sun scorch, iron deficiency, and die-back.

There was no pruning, and the trees were obviously subject to biennial or irregular bearing with over-bearing in the "on" year. There was a cooperative irrigation system, but the water supply was very limited and it is doubtful whether the trees could really benefit from such an application.

The trees, which were again copper-tipped, were planted at a regular spacing, and clean weeding was practised. It was interesting to note the presence of such common East African weeds as Galinsoga parviflora (McDonaldii), Bidens pilosa (Black Jack), Ageratum conyzoides, and Cyperus sp. (water grass; nut-grass; ndago). Whilst most plots were unshaded, some coffee was being grown under shade. No seed sample was collected.

2.2.3.6 General impressions and recommendations

Most of the area around Harar itself and much of the Eastern Chercher Hills appeared to be marginal for coffee.

Where the available soil moisture is adequate, the use of shade trees is recommended.

It would be interesting to know how much of the neglect of the coffee is due to the rival attractions of Khat or Chat (Catha edulis), both as an export crop and for home consumption as a narcotic stimulant.

Pruning is again the most urgent requirement, especially in those plots where deterioration due to neglect of this operation has not yet set in.

The presence of brown blight on the sun-scorched or hail-damaged fruits should be investigated.

A response to copper-spraying, and possibly nitrogen fertilizer, could be expected in the Asbe Teferi area.

2.2.4 Shoa Province

2.2.4.1 Shashemene - Wondo-Genet, elev. 5,900 ft. (10 November)

The area lies in a valley with dominant natural shade trees of Albizzia sp., Cordia africana and Ficus spp. The coffee was planted as smallholdings near the owners' houses, and as plantations on a larger scale with regular spacing. Most of the coffee was unshaded, but some plantings under trees were seen.

The crop was only starting to ripen, but there were signs of over-bearing and a biennial bearing rhythm. There was evidence of bad planting at too great a depth and of twisted tap-roots. There was a complete lack of pruning. Both green and copper-tipped trees were seen.

Pests included Antestia , a leaf-miner and a serpentine miner; leaf rust, brown blight and/or sun scorch, and weak spot were the observed diseases.

2.2.4.2 Shashemene - Wondo-Genet (Mitchell Cotts), elev. 5,900 ft. (10 November)

In this plantation of 170 acres the oldest blocks had been planted in 1943-44. Seed was said to have been obtained from Harar, and therefore the brown eye-spot was prevalent, and the beans are unlikely to be acceptable in the world's quality markets. Leaf rust was also present, while pests included Antestia, leaf-miner, serpentine miner and a leaf skeletonizer. Some die-back was noted on unshaded trees.

There was mixed shade, including Jaracanda sp., which is notoriously bad for coffee and should be uprooted, Millettia ferruginea and Cordia africana. As in East Africa the coffee seems to thrive under C. africana, which together with Albizzia sp., could well be used more extensively in this area which would seem to demand shade. Apart from other advantages, these trees would greatly assist in the suppression of Couch grass (Digitaria scalarum), which was widespread and together with other grasses urgently needs removal by hand digging or by chemical treatment with Dalapon. Greater attention to weeding is necessary throughout this estate.

2.3.4.3 Recommendations for Wondo-Genet

There is urgent need for a regular pruning system.

The use of better seed is recommended.

Cultivation needs improving and in particular couch and other grasses must be eradicated.

The planting of shade trees would greatly assist in the suppression of grasses, a reduction of fertilizer costs, and the control of crop and die-back.

A copper spray program should be introduced to control leaf rust and brown eye-spot and to improve leaf retention.

Before incorporating insecticides, attempts should be made to improve the growing conditions, and to open up the coffee plants by pruning.

2.2.4.4 Welkite, elev. 6,400 ft. (16 november)

Here on the road from Addis Ababa to Jimma, there were a number of smallholdings, some having coffee interplanted with Chat (Catha edulis) and with the false banana (Ensete ventricosum). Conditions were generally bleak and exposed. The trees were of varying ages with light copper-tipped leaves; the crop was only starting to ripen.

Only one tree was found with severe leaf rust, whilst susceptibility to brown blight and/or sun scorch was variable.

The area has however produced a unique bean. The shape is the most roundish seen whilst the size is variable but often large. The centre cut is usually bent, and most if not all the beans are malformed and therefore undesirable commercially for a quality market.

2.2.5 Sidamo Province

2.2.5.1 Alama, elev. 6,200 ft. (11 November)

A small plot of coffee interplanted with the false banana (Ensete ventricosum) was inspected. There was no other shade. There were numerous rocky outcrops.

Die-back was evident, and the coffee generally was small-leaved. Only one isolated pustule of leaf rust was found. The plot was sampled.

2.2.5.2 Yirgalem, elev. 6,000 ft. (11 November)

Yirgalem was formally known as Dalle, whence some coffee seed was obtained and planted in East Africa in 1942.

The coffee was planted as smallholdings near the dwellings; some old trees were seen. A young plantation in a valley was inspected. The seed from which the plants had been raised was said to have been obtained locally; there was a heterogeneous collection of types and these were sampled. Isolated occurrences of leaf rust were noted.

Unfortunately, through ignorance, the young plants had been earthed-up, giving a deep planting effect. The owner was keen to prune his trees but there was no one to show him how to do this. There was said to be a frost pocket in the valley bottom.

2.2.5.3 Biera, elev. 6,200 ft. (11 November)

At Biera old coffee plants occur as smallholdings or small plantations. In one holding inspected the limiting factor was couch grass which was very thick; it was being slashed at ground level, merely to facilitate harvesting and no attempt had been made to dig it out.

Isolated instances of leaf rust were observed and losses of coffee trees due to Armillaria root disease were almost certainly confirmed by external examination. The Antestia bug was found.

Here was seen the first individual pulpery for the production of washed coffee. It was observed that every stage of ripeness was included and mixed together for pulping. Apparently sixteen hours had erroneously been fixed as time required for complete fermentation and this was being adhered to regardless of temperature and stages of maturity of the bean. The routine was then 24 hours shade drying after washing, followed by uninterrupted sun drying. Under these conditions, it was inevitable that some fermentation continued during the shade drying, whilst the rapid sun drying resulted in parchment splitting and probable case-hardening of the bean.

2.2.5.4 Aleta, nr. Wondo (Colla plantation) (11 November)

Here again thick couch grass abounded in much of the plantation; the harmful effect of the coffee was obvious and yet little attempt was being made to eradicate it.

For some inexplicable reason there had been an application of lime in a circle round some trees. There was no pruning and some trees had many stems.

2.2.5.5 Yirga-Cheffe, elev. 5,900 ft. (12 November)

This was the nicest coffee observed by the team member in Ethiopia. Conditions seemed to be ideal and the coffee had every appearance of thriving in a natural environment, although admittedly it was just after the rains had ceased and not at the height of the dry season.

It was said to be a high rainfall area, having two rainy seasons August-October and April-May; there were no records available.

The young leaves were variable in colour, whilst the mature foliage had a very healthy appearance. No leaf rust was seen, although there was some evidence of "weak-spot". No Antestia was found. Occasional persistent calyces were seen on the fruits.

The coffee was grown as smallholdings, mostly under natural shade. The dominant shade trees were Albizzia sp., Cordia africana and Millettia ferruginea.

2.2.5.6 Dilla, elev. 5,100 ft. (12 November)

In the higher parts of Dilla old coffee trees were seen which had been stumped a few years ago. No selection of suckers had been undertaken and multiple stem coffee had resulted with up to 24 stems per plant. In one holding, susceptibility to leaf rust was variable.

At Wonago, a village 12 km south of Dilla, there were coffee trees which were said to be about 80 years old, but were likely to be at least 100 years old. They had never been pruned and they brought to mind the "apple-tree" system at Tukuyu in southern Tanganyika. Here also was seen the first private commercial central factory. The standard of acceptance of cherry which was being bought-in was very poor, the general condition of the factory was dirty and the machinery consisted of an antiquated aquapulper.

2.2.5.7 General impressions and recommendations for Sidamo

Most of the coffee-growing area appeared to be the remnant of a Podocarpus forest. All the coffee seen was grown in smallholdings or plantations, although it was reported by other members of the expedition that some spontaneous coffee was found in a forest above Wondo-Genet.

Except where some stumping had been attempted a few years ago, no pruning was carried out; pruning is the most urgent requirement.

The eradication of couch grass (Digitaria scalarum) is a primary necessity, and it is obvious that this is the major pest of cultivated coffee in parts of Sidamo as it is in parts of East Africa.

The standard of picking for the washed processing method must be drastically revised if any benefit is to be obtained from this procedure. Pulperies, both private and commercial, require the installation of modern machinery with regular maintenance and a high standard of cleanliness throughout.

The coffee at Yirga-Cheffe was the best and most naturally healthy observed.

2.2.6 Kaffa Province

2.2.6.1 Jimma Agricultural Technical School, (17 November)

At Jimma Agricultural Technical School, an international coffee variety trial was planted containing 49 varieties, selections or cultivars, of which a number were of Ethiopian origin. Unfortunately certain losses had occurred and the trial was no longer valid. No pruning had been carried out except desuckering, and as a result the trees were a dense mass of branches. The Antestia (Antestiopsis sp.) population was said to be very high, probably owing to these conditions. The soil was hard baked and there was considerable weed competition which coffee cannot normally tolerate. The area was unshaded and there was some scorching of the young leaves. The establishment of a shade trial is advocated under these conditions. There was evidence of biennial bearing.

Some Tanganyika selections were growing under those conditions, although the seed was not a direct importation from Lyamungu. The natural dark green mature foliage of N.39 was most conspicuous, but the copper-tipped characteristic of the young leaves was barely discernible. This is the first time the team member had ever observed any variation of this characteristic, presumably in this case due to the climatic conditions. Other Lyamungu selections seen were N.197, H.66, and KP.423, the yields of the latter having been the best in the early years of the trial. One of Sylvain's Ethiopian selections, S.2 Ennarea, was bearing very large fruits and large roundish beans; this tree was sampled.

2.2.6.2 Giren Experimental Station

The Giren Experimental Station is run as part of the Jimma Agricultural Technical School. Here was another replicate of the international coffee variety trial, containing the same 49 selections. Pruning and cultivation methods were similar to those at the School, with the additional hazard of couch grass and a die-back a few years old said to be due to frost. It was stated that KP.423 had also topped the yield results here in the early years before losses invalidated the trial.

In the variety collection, an unidentified coffee tree of the C. excelsa type was found to be highly susceptible to leaf rust, which was sampled.

At Giren there was also planted a progeny trial of selections made in the neighbouring Bada Buna forest (see 2.2.6.3). The basis of selection was unknown. This trial also was suffering from poor growing conditions, lack of pruning, and the effects of the supposed frost damage. It was difficult to see what could be derived from this trial, except possible selections based on individual tree records. A somewhat primitive pulpery was established at the station. A shade trial would also seem to be desirable here.

2.2.6.3 Bada Buna, elev. 6,600 ft. (17 November)

This forest about 10 km from Jimma and of secondary origin contains Croton macrostachys, Ficus spp. and Cordia africana, among other trees. Some old terraces were seen on one side of the hill which had a dryish appearance.

The coffee growing as part of the understory was said to be wild but this was extremely doubtful; there were no old trees and most of those seen were of a fairly uniform age. The coffee was obviously exploited and part of the predominantly graminaceous undergrowth was being cleared in preparation for the harvest. No other form of culture was practised, nor were the trees in any way pruned. Yields were obviously very low.

The trees had dark green-tipped leaves and there appeared to be two main fruit types; one was long and ribbed, and the other was smaller and rounder. Leaf rust was present. A leaf rust was also found severely infecting Gardenia sp. on the drier side of the hill; this also was sampled.

2.2.6.4 Limu - Sedecha, elev. 5,300 ft. (18 November)
Owner : Dejazmatch Johannes Girma

This could have been truly wild coffee, although the fairly dense forest, which included Albizzia sp. and Cordia africana was apparently secondary. Coffee trees of all ages were seen, including some very old ones of probably about 100 years under which self-sown seedlings had grown. All had green tip leaves.

The fruits were generally flattened, and the seeds were longish, although some roundish ones were collected in a representative sample.

The clearing of the undergrowth to facilitate harvesting was the only form of cultivation. The whole area appeared to be exploited.

2.2.6.5 Limu - Kossa, elev. 6,000 ft. (19 November)
Owner : Teclamariam Kassahoun

Both plantation and exploited forest coffee were seen. The plantation was terraced on steep hillsides. Some young plants were loose in the soil, and the method of planting must be suspect.

A small-fruited tree found at the corner of the back-yard was sampled as part of the representative sample.

In the forest, some in-filling had been carried out rather crudely, but the result was a fairly regular stand of coffee. There was evidence of Armillaria root disease. The trees had green tip leaves. Again, the majority of the fruits were flattened, enclosing a longish bean.

A very large nursery belonging to this plantation was inspected. A great deal of trouble had been taken over this, and on the whole the plants were well-grown. But, it appeared to be on too large a scale for one plantation to handle in one season. The impression gained was that well-grown nursery plants were being spoiled by bad planting-out methods.

2.2.6.6 Limu-Dembi, elev. 5,500 ft. (19 November)
Owner : Getahoun Birke

A small area of exploited coffee in secondary forest was inspected. The young tip leaves were green; most of the fruit was the flattened type producing a longish bean; a tree with small orange-coloured fruits was found and some seeds were included in the representative sample. A single tree selection with large elongated fruits and small dark leaves was sampled separately (F.14/64). This type was said to be favoured locally for seed.

2.2.6.7 Manna, near Agaro, elev. 5,500 ft. (22 November)
Owner : Gabrechristos Makonnen

Coffee was planted under forest conditions, and there was an attempt to establish a new plantation in poor soil conditions in a dry and exposed situation. Some tall weeds had been left between the rows as shelter, but these were depriving the soil further of its moisture without affording adequate protection. Artificial shade over each plant until it became established would have been more satisfactory.

Examination of some plants showed a poor root system, indicative of bad planting and possibly inadequate preparation of the planting hole.

The manager was shown how to establish the multiple stem pruning system. It was further suggested that any rejuvenation of the forest coffee should be by stumping blocks in rotation.

There was a large and tidy nursery, but planting methods must be improved if full advantage is to be taken of this early efficiency.

There was a satisfactory factory for processing by the wet method, but fermentation was being restricted to 24 hours and was being stopped in the evening, thus preventing the rapid removal of superficial moisture during the early stage of drying. It was suggested that the fermentation period should be extended for at least another 12 hours, but it was emphasized that fermentation time was dependent on temperature and ripeness of the beans and could not be dogmatically laid down as a time factor.

Some coffee sampled as (F.20/64) was growing in secondary forest with dominant trees of Acacia sp., Albizzia sp. and Cordia africana in the neighbourhood.

2.2.6.8 Chochi, near Agaro, elev. 5,512 ft. (23 November)

Coffee was growing in secondary forest consisting predominantly of Cordia africana, Albizzia sp., Ficus spp., Dracaena sp., Euphorbia sp., and Croton sp.

The undergrowth had been cleared at the edges, presumably in preparation for the coffee harvest, but in the interior the coffee was covered by creepers and the undergrowth was thick and impenetrable.

The young leaves were green, and some leaf rust was seen, as might be expected at this low elevation.

A representative sample from the area was collected and an additional sample was taken from a single tree with large elongated fruits and very long pointed beans.

2.2.6.9 Bore, near Agaro, elev. 6,200 ft. (7 December)

The area was fairly heavily shaded, with Millettia ferruginea as the dominant tree. The coffee was naturally unpruned and with green-tipped leaves. No leaf rust was seen but there was evidence of the presence of Armillaria root disease. A representative sample of coffee from the area was collected.

2.2.6.10 Gicho, elev. 6,000 ft. (7 December)

Village on Agaro-Gera Road. This was a small plantation and the coffee trees were regularly spaced. The young leaves were mostly green but some with copper tips were also present. The mature leaves were mostly small but variable in shape; considerable variability was also noticed in the fruit. Some leaf rust was seen.

A fairly large representative seed sample was collected covering a wide variation of seed shapes from small round to large pointed. One individual tree with light copper tip leaves and roundish fruits was sampled separately (F.43/64). It was lightly infected with leaf rust.

2.2.6.11 Doyo, elev. 6,000 ft. (25 November)
Owner : Teke Egano

This plantation was on either side of a valley about 5 miles from Jimma. There was a very heterogeneous collection of plants and it was understood that some were probably obtained from the nurseries of the Jimma Agricultural Technical School, the Gerin Experimental Station or the Prison. Some of the types found here are therefore probably not representative of Ethiopian coffee. Both copper- and green-tipped trees were found. A representative seed sample was collected and showed bean variation from very large (almost Maragogipe type) to small and roundish. In addition, two single trees were sampled, one having short broad mature leaves, and the other very dark small mature leaves and large fruits. Leaf rust was present on both.

A fairly efficient factory was operated here, but it required a larger pulper with a pre-grader, and greater attention to fermentation and drying.

2.2.6.12 Wush-Wush Plantation, elev. about 6,300 ft. (21 November)

This was secondary forest with Albizzia sp., Cordia africana, Dracaena sp., Ficus spp. and Euphorbia abyssinica being prominent. The forest had been thinned by stumping, in some places excessively, for the planting of coffee. This is an area of high rainfall, said to average 76 in. per year and well distributed. The lushness of the vegetation, the presence of tree ferns in the valleys and the excessive weed growth all confirm this. It would seem that the rainfall is too well distributed for successful coffee culture; furthermore, the weed growth

was out of hand; and in places the soil fertility must be suspect. Evidence of the latter was the comparative growth of Ensete ventricosum under normal conditions and on the site of an old stable, just over the boundary from the plantation. Finally the danger of Armillaria root disease must be considerable from the established method of forest thinning. In general the area would appear to be more suited to tea than coffee.

It appears that there is evidence, in the form of grindstones and the distribution of the Euphorbia, showing the existence of earlier habitations in the forest where the coffee seed for the plantation was collected. It could not therefore be said to be truly wild and had probably been exploited if not planted and cultivated up to 60 or more years ago before the area was devastated by wars.

A representative sample of seed from the plantation taken from green-tipped trees gave mainly large beans, some long and a few roundish. In addition three single trees were sampled individually, two because of their persistent leaves under heavy cropping conditions, and the third for its distinctive long fruits, producing large long beans. No leaf rust was seen on this plantation.

2.2.6.13 Wush-Wush Village

Growing outside a hut were a few trees with small leaves. Ripe fruit was scarce, but a very small sample was collected with two types of seed.

2.2.6.14 Balt, elev. 6,800 to 7,000 ft. (2 December)

Balt is a small largely open settlement on the north side of Maji mountain, near Maji. Forest remnants included occasional Cordia africana, Ficus spp., Euphorbia sp. and Erythrina sp. Coffee was found growing in very small plantings near the huts. It was suggested that the original seed, especially that giving large fruits, came from the Giaba area.

Four fruit types were collected from this small area, as follows :

- medium-large fruit with a persistent style; young leaves faintly copper, mature leaves large; "weak-spot" but no leaf rust; growing under the shade of Cordia africana and Ficus sp., at 6,800 ft.; origin said to be Giaba (F.31/64).

- medium-large fruit; young leaves copper-tipped; mature leaves fairly large, clean and glossy; no leaf rust; growing under semi-shade (F.32/64).

- very large fruit; young leaves dark copper-tipped; mature leaves medium; no leaf rust (F.33/64).

- small round fruit; young leaves copper-tipped; mature leaves small and narrow; no leaf rust; growing under the semi-shade of Ensete ventricosum collected from two similar trees (F.34/64).

There were no signs of Antestia, but there was an occasional leaf serpentine miner and leaf-miner scars.

2.2.6.15 Kursi, elev. 6,120 ft. (3 December)

Kusi is another small settlement in fairly open country on the south-west side of Maji mountain on the track to Giaba. The small plantings of coffee were grouped sparsely around the dwellings. There were occasional trees of Cordia africana, Dracaena sp., and Ficus sp. The land was inclined to be rocky.

Fruits were mostly medium to large, producing long narrowish beans. Trees were mostly copper-tipped but a single tree with green tips was sampled (F.38/64). Two other individual tree samplings were made, one from a tree with large broad leaves and large fruits giving a long narrow bean (F.37/64) and the other from two trees each displaying similar elongated fruits (F.36/64).

There was no leaf rust, but "weak-spot" was noticed. There was evidence of damage by serpentine miners and leaf-miner.

2.2.6.16 Kolu, elev. 5,100 ft. (5 December)

Kolu is a very small settlement on the south side of Maji mountain on the road to the Maji airstrip, and is the last remaining habitation before reaching that place in the semi-desert. In the neighbourhood, below Kolu, there is evidence of earlier cultivation in the form of stone-edged terraces, which were said to be of considerable antiquity; they are now in disuse.

The few isolated plots of coffee were in flower at the time of the visit, but it was possible to obtain a few small fruits, giving mostly longish beans.

2.2.6.17 Maji - General considerations

Apart from the above mentioned places, it was possible to obtain seed from farther afield in the Maji area by sending out messengers through the good offices of His Excellency the Governor of Maji and Mr. Harold Kurtz of the American Mission. The following places were sampled :

Geisha mountain	- Tui	- F.57/64
	- Geisha	- F.58/64
	- Gorei (Barda)	- F.59/64
Giaba	- Beru	- F.60/64
	- Giaba	- F.71/64
	- Gai	- F.72/64

These two localities, and in fact the whole district around Maji, are of particular interest to East Africa. Firstly the Geisha cultivar, and in particular the Lyamungu selection V.C.496 which has been used so extensively in the Lyamungu breeding program (Fernie, 1962), reputedly originated either on Geisha mountain or possibly in the Maji market. As well as resistance to leaf rust races I and II, there is a degree of resistance to coffee berry disease in some of the Geisha selections (Firman, 1964).

Secondly, from enquiries and conversations with a number of persons at Maji, it is possible that the Giaba area was the most likely source of the coffee growing on the Boma plateau across the border in the Sudan, as suggested by Thomas (1942). It is the Rume cultivar from the Boma plateau which has shown considerable resistance to coffee berry disease (Firman, 1964).

2.2.7 Illubabor Province

2.2.7.1 Teppi, elev. 4,300 ft. (5 December)

Around the perimeter of the airfield at Teppi, there were exploited coffee trees, mostly old and straggling, some with green young leaves and others faintly copper-tipped. The harvest was well advanced. There was considerable leaf rust, as might be expected at this low elevation. A seed sample was collected.

2.2.7.2 Gore, elev. 6,500 ft. (25 November)

Here, a smallholding of planted coffee was inspected. Both green and copper-tipped trees were seen, bearing a range of fruit types yielding beans from long narrow to roundish. A representative sample was collected.

2.2.7.3 Alle, elev. 5,800 ft. (24 November)

The plot inspected showed every appearance of being spontaneous coffee (i.e. not planted) in a portion of the forest. The spacing was completely irregular and spontaneous young plants were growing at the base of older trees. There was not, however, a complete range of ages, nor were any very old trees seen here.

Dominant trees in the forest included Acacia sp., Cordia africana, Ficus sp., and Croton sp. Coffee plants were mostly with green-or faintly copper-tipped leaves but one individual tree sampled separately (F.24/64) was predominantly copper-tipped. There were variable fruit shapes with some persistent calyces, and beans varied from small to long and pointed. Some leaf rust was noticed.

2.2.7.4 Mattu, elev. 5,200 ft. (24 November)

Here again, coffee plants had the appearance of being spontaneous, although how much planting and interplanting had taken place in the past it is now impossible to say. All coffee trees appeared to be green-tipped and a number of them were draped in moss and lichen.

Leaf rust was fairly widespread but some few trees were highly susceptible. Fruits were generally large, some with persistent calyces. Seeds were large, some long and some broadish. A representative seed sample was collected.

The dominant trees noted in the forest were Albizzia sp. and Ficus spp.

A drive was afoot to encourage the use of hand pulpers by individual growers and to boycott the central factories of the merchants. This was apparently meeting with some success, judging by the lack of business at the factories seen. The standard of acceptance of mixed pickings was very low; there was further evidence of under-fermentation and too rapid drying; aqua pulpers were being used for mucilage removal. Altogether the appearance of the product and the general quality appeared to be of no interest whatever to the processing merchants.

An unusual sight was the line of merchants' agents along the roadside, complete with portable platform scales, soliciting for custom from passers-by with cherry for sale, in a manner more reminiscent of an older profession in a sophisticated city.

Altogether, the impression was that this was a depressed area, with a deliberate policy of discouraging coffee production enforced and accentuated by lack of attention to roads. The potential is considerable.

Rainfall records from the station at Gore airfield show this to be a high rainfall area. Although the moss-draped coffee trees tend to support this contention, the vegetation nowhere had that lushness seen at Wush-Wush. It is to be wondered how typical the conditions are at the airfield, in its position atop a hill.

2.3 REMARKS ON AREAS NOT VISITED

In addition to the visits described above, other members of the expedition visited and sampled more widely in the Gera, Mizan Teferi, Ainamba and Teppi areas of Kaffa and Illubabor provinces where some valuable observations were made. Ultimately a seed sample was obtained from Zeghie and from Eritrea. It is, however, a serious omission that due to lack of time no member of the expedition visited any part of Wollega, Gemu Gofa, Arussi, or Bale provinces.

It was reported from Wollega that a serious malady was causing a widespread loss of crop there; it was later suggested that this might be due to Antestia damage, but it was a pity that members of the expedition did not have the opportunity to see this for themselves. In this connection it should be noted that Sylvain (1958) reported an unidentified disease from the Ghimbi district in Wollega Province, which he considered to be caused by an infection of the vascular system and associated with conditions of poor drainage. In addition Wollega might be an interesting link between the coffee types in Kaffa and Illubabor provinces to the south and Gojjam in the north. A survey of Ethiopian coffee is very incomplete without samples from this area.

Similar remarks apply to the coffee areas of Gemu Gofa province which might provide a link between Kaffa and Sidamo coffee types, whilst Bale might provide a link with the Harar types.

2.4 PLANTED COFFEE

In considering the coffee of Ethiopia, it is necessary to distinguish between the spontaneous forest coffee and that which has obviously been planted either as plantations or as smallholdings, even though much of the forest coffee may have been, and probably was planted by man at one time or another.

2.4.1 Plantations

The plantations are comparatively modern, few in number, and represent a small percentage of the total acreage and production of coffee in Ethiopia. Some are run by foreign companies, but there appears to be an increasing interest in this form of production by enterprising Ethiopians. There is unfortunately a serious lack of knowledge and experience of modern coffee plantation methods and practices among owners and managerial staff alike, and this is reflected in the general condition of the plantations.

The complete absence of any form of pruning is the worst fault; this in turn had led to biennial bearing and die-back under certain circumstances, whilst one instance of severe Antestia infestation may be at least partially attributed to the same cause. There was also no appreciation of the damage caused by couch grass (*Digitaria scalarum*) and other obnoxious grasses and competitive weeds.

The standard of nursery management on the whole was good, although it was often on too large a scale to allow efficient planting out in the field. Planting methods were definitely suspect.

There was a genuine willingness to make use of fertilizer and sprays without any realization of the conditions for, or the economics of, such practices.

Seed had generally been taken from forest coffee locally, and in some cases certain mother trees had been selected for their large and usually long but not necessarily desirable beans. In some instances, very heterogeneous material was observed and this also makes pulping and processing more difficult.

Processing methods would seem to have been based on erroneous advice, particularly in regard to fermentation time and to drying. There is a need for larger pulpers, a better knowledge of adjustment and maintenance of machinery, and some form of pre-grader. Picking standards need to be much more exacting.

2.4.2 Smallholdings

These were small plots of coffee, usually round or near the dwelling house, and are similar to smallholdings found in other parts of Africa. The trees near the house were usually healthy and thriving, due to the deposition of refuse; the rest would vary according to the location and to the energy of the owner. The complete lack of pruning was common to all; only in the Dilla area had some rejuvenation by stumping been attempted, and then all the advantage had been lost by the failure to reduce the resultant suckers to a selected few.

The origin of the seed in these cases was more difficult to establish. For recent plantings, it is reasonable to assume that the seed was taken from neighbours or from the local market. No doubt this process has been going on for some time, especially in areas like Sidamo and Harar, where the majority of the coffee production was of this nature. The original introductions to such an area, however, are unknown and must remain so. In Kaffa and Illubabor it can be assumed that seed had been taken over a period of many years from spontaneous coffee plants growing in forest areas.

Most of the coffee from the smallholdings was picked in various stages of ripeness and sun-dried in the cherry by the owner. There were a few central pulperies, established and maintained by merchants, where cherry was bought in and wet-processed. The standard of acceptance of cherry was always poor, and processing conditions were invariably primitive, with little knowledge of correct fermentation and drying procedures.

2.5 SPONTANEOUS FOREST COFFEE

By far the greatest amount of coffee in Ethiopia is derived from spontaneous forest coffee, and the potential for increasing it still further is probably enormous although inestimable. The origins and dispersal of the coffee in these forests are certainly wrapped up in Ethiopian history and Strenge's (1956) account of the wild coffee in Kaffa province was confirmed at least in part by personal conversations and by observation.

It is certain that settlement sites of an earlier era existed in these forests, and proof of the finding of ancient grindstones and the distribution of the candelabra Euphorbia abyssinica was confirmed in the Wush-Wush area. Here also was seen the rapid regeneration of forest in a known area of planted coffee which had since been abandoned.

In the Limu area there was seen the method of in-filling the irregular stands of coffee on the forest in order to produce a more economic unit, also described by Strenge (1956). Proof was also obtained here of the bad planting described by the same author.

The status of the coffee found in the forests has been well reviewed by Sylvain (1955; 1958) and it has not been possible for the present expedition to throw any further light on the subject. It can therefore only be repeated that Arabica coffee is apparently spontaneous in the forests of southwestern Ethiopia where it has been exploited for a number of years.

From information obtained in the Maji area of Kaffa province, added support is found for Thomas' suggestion (1942) that the Arabica coffee found by him on the Boma plateau in the Sudan may have been introduced there originally "from the main mass of the Abyssinian highlands, of which the plateau in an outlier". It is possible that the Giaba area may be this centre of dispersal. This is of great importance to East Africa because of the degree of resistance to coffee berry disease exhibited by trees raised from seed collected in the Rume valley on Nelichu hill on the Boma plateau. It was unfortunately not possible to visit the Giaba area personally, and it is to be hoped that the seed samples collected there by messengers are truly representative.

Since the planted coffee was never pruned, it was not likely that the forest coffee would be, even where it had been exploited for a great many years. This in fact was the case, and in most instances a mass of useless wood was evident and yields were obviously very low. Instances of death were seen, probably caused by Armillaria root disease, but it was not possible to confirm the presence of this pathogen.

2.6 COFFEE TYPES

Whether the coffee plant is truly wild, escaped, abandoned, exploited or cultivated matters little when a collection of Ethiopian coffee types is being compiled.

The method of seed collection has been described earlier. It should however be explained that the representative samples were based on obvious differences of leaf colour, leaf shape and size, fruit shape and size, bean shape and size.

Individual tree samples were based on unique characteristics, and in addition to the above, such factors as leaf persistence under conditions of heavy cropping and absence of leaf rust were considered.

Under the conditions of Ethiopia, the leaf characteristics exhibited would not appear to be a reliable means of differentiation bearing in mind the strong seasonal and environmental influences to which the Arabica coffee plant is so susceptible. It is only in the progenies, raised under reasonably uniform conditions, that one can expect to assess fully the coffee types collected, although a certain amount of natural outcrossing is bound to have occurred.

It was possible to differentiate the fruits by both size and shape and these factors are probably fairly constant. The dominant type was fairly large and flattened, producing longish beans.

Bean type is obviously of great importance, and an attempt was made to separate each seed sample according to its bean shape and size. There was often a preponderance of longish beans, but some medium and roundish ones were separated out and it will be interesting to see how far this characteristic is reproduced in the progenies. The most unique cherry, very round but malformed with a bent centre cut, was collected from Welkite, and this type was not found anywhere else.

A doubt is felt about the origins of the coffee seen at Doyo near Jimma, which could well include an admixture of some types introduced from outside Ethiopia. This could also be true of some of the coffee at Gera in the Gera district, since this had the same ownership.

2.7 DISEASES AND PESTS

2.7.1 Diseases

2.7.1.1 Leaf rust - *Hemileia vastatrix* Berk. and Br.

The distribution of leaf rust appeared to be altitudinal, which is presumably a temperature effect. It could also be an indication of resistance to at least some races of the fungus and, where the intensity varied, an indication of race distribution. The rust samples collected by the expedition and submitted to the Coffee Rust Research Centre in Portugal should elucidate the rust race situation in Ethiopia, and should also prove of great benefit to East Africa, both in furthering the knowledge of possible races to be encountered, and in being complementary to the seed collection.

Apart from the altitudinal effects, leaf rust was not seen by the team member in Gojjam province, specifically Finote Selam and the Zeghie Peninsula, although in the latter place it might not yet have manifested itself owing to the later season. It was also not seen on Maji mountain, but it is not really possible to separate the altitudinal effect there, and in any case the coffee plots were small and isolated. A further surprise was the apparent absence of leaf rust at Wush-Wush in spite of the wet climate.

It appeared that the rust pustules were often parasitised at an early stage by *Verticillium hemileiae*. Nowhere did it appear that the disease was likely to assume epidemic proportions under present conditions of culture. If cultivation is intensified, however, the position might well change.

The condition known in East Africa as "weak-spot" was apparently present in Ethiopia. This might be a hypersensitive reaction to leaf rust.

The use of copper sprays would probably be of benefit on intensive plantations and smallholdings, since some control of leaf-fall might be expected even in the absence of leaf rust.

2.7.1.2 Brown eye-spot - *Cercospora coffeicola* Berck. & Cooke

The brown eye-spot was seen most severely in the Harar area, where the conditions would appear to favour its existence. Documented material was not taken for confirmation. It is known in East Africa that the Harar strain of Arabica coffee is particularly susceptible to brown eye-spot, and this was also confirmed in the Shashemene area where a plantation was known to have been planted with seed obtained from Harar. The marginal nature of the Harar area and the lack of shade there also provide conditions suitable for the persistence of this disease.

2.7.1.3 Brown blight - Colletotrichum coffeanum Noack

The existence of this disease, as it is known in Tanganyika, was suspected particularly in the Harar area in association with a sun-scorch condition of the nearly mature fruits on unshaded coffee, but documented material was not taken for confirmation. Observed in the same area was considerable hail damage which is also frequently associated with brown blight. Krug (1959) suspected that the virulent form of this fungus, by which he presumably means coffee berry disease, existed in Harar, but this does not appear to have been confirmed. Certainly in East Africa the Harar strain is known to be most highly susceptible to the disease.

Pathological confirmation of the presence of Colletotrichum coffeanum in any form is urgently required.

2.7.1.4 Root rot - Armillaria mellea (Vall.) Sacc.

The presence of this universal root disease was suspected in practically all areas, but again not confirmed pathologically. The methods of thinning and clearing the forests were such as to favour the spread of this fungus, which might be found to be causing far more damage than is realised.

2.7.2 Insect pests

Insect pests are fully covered in chapter 5. Mention will be made here only of the observed occurrences of a leaf skeletonizer, various leaf-miners including the serpentine miner on mature terminal leaves, snail damage, slight berry moth damage, and occasional scale damage. None of these appeared to be of economic importance, although it is possible that the skeletonizer might cause severe defoliation under certain conditions.

The severe infestations of Antestia at three locations in the Jimma area might in part be due to the dense unpruned condition of the trees; on the other hand it appeared that the denseness of growth was being intensified by branch proliferation due to the activities of the Antestia, so that a vicious circle was established.

2.7.3 Miscellaneous disorders

2.7.3.1 Die-back

Die-back was seen in numerous exposed unshaded localities, often associated with an apparent nitrogen deficiency and frequently directly attributable to the debilitating effect of couch grass (Digitaria scalarum) in competition.

Other instances of die-back were also seen due to neglect (mostly cultural), over-bearing (a comparative term in any case), and bad planting with twisted roots.

Crop control by pruning, good cultural practices and the provision or retention of shade are recommended to overcome most of the observed instances of this disorder.

2.7.3.2 Stem-pitting

Although Krug (1959) recognised this malady as "bottling" in the Shashemene district, it was not observed during the current expedition.

2.7.3.3 Mineral deficiencies

Of the known visual symptoms of mineral deficiencies in the leaf, the most common were those of nitrogen and iron in unshaded coffee. The latter was particularly noted in the east Chercher Hills area.

2.8 ASSOCIATED PLANTS

2.8.1 Trees

A most interesting feature was the monotonous regularity with which Cordia africana was found associated with coffee, both planted and spontaneous. This was true from Zeghie Peninsula on Lake Tana in the northwest, to the Chercher Hills in the east, and to Maji mountain in the southwest. This species or one very closely related, is also indigenous to many of the coffee growing areas of East Africa, and is often planted there as a shade tree. It appears to have none of the attributes of a good shade tree and yet coffee thrives under it.

Another dominant tree in all the areas visited was a species of Albizzia, probaly A. Schimperiana Oliv. This is another interesting and relevant association, since Albizzia spp. are recommended as shade for coffee in those areas of Tanzania where shade is considered desirable. This association of Cordia and Albizzia was also noticed by Sylvain (1958).

In Sidamo province from Lake Awasa southwards to Yirga-Cheffe, remnants of a probable Podocarpus forest were observed. Likewise at Bonga in Kaffa province large scattered trees of this species were in evidence. Remnant trees of Junipus procera were also seen.

Other commonly associated trees in various localities included Ficus spp., Millettia ferruginea, Croton macrostachys, Acacia spp., and Dracaena sp. The occurrence of Euphorbia abyssinicum is interesting and frequently out-of-place by East African standards. Its use as a hedge plant in the Bonga area, especially, and some of the regular patterns of its distribution in the forests would appear to denote abandoned dwelling sites (Strenge, 1956).

2.8.2 Rubiaceae

Where Rubiaceous plants were found with leaf rust, specimens were collected and passed to Dr. Narasimhaswamy for forwarding to Dr. Branquinho d'Oliveira at the Coffee Rust Research Centre in Portugal. Among the Rubiaceous plants noted were Randia sp. , Pavetta sp., Gardenia sp. and Pentas sp.

2.8.3 Weeds

In cultivated plots it was interesting to note the frequent occurrence of weeds commonly associated with coffee in East Africa, including Galinsoga parviflora, Bidens pilosa, Ageratum conyzoides and Digitaria scalarum.

2.8.4 Intercrops

The only permanent intercrops seen were the false banana (Ensete ventricosum) and Khat or Chat (Catha edulis). In Tanzania, the banana as an intercrop is known to have a depressing effect on coffee yields, and it is likely that the false banana

would have a similar effect. Intercropping with Khat was seen only in the Chercher Hills of Harar province and at Welkite in Shoa province. Coffee plants do not tolerate competition and therefore any intercropping should be discouraged.

2.9 SEED COLLECTIONS

2.9.1 Seed samples

A complete catalogue of the seed sown at the Coffee Research Station, Lyamungu, Tanzania is incorporated within the inventory*. Of the 196 samples sown, 52 (including 3 duplicates) were Fernie's own direct or indirect collections, 23 samples were given to him by Dr. Narasimhaswamy and 3 samples by Dr. Meyer; the remainder were sent from the Jimma Agricultural Technical School by Mr. F.E. Bolton with the assistance of the Executive Secretary of the National Coffee Board of Ethiopia as part of a general distribution, according to sample size and availability, from collections made by Messrs. Meyer, Monaco and Narasimhaswamy.

Fernie's own samplings are all from single trees (occasionally 2 trees) or representative trees from any plot or area. The representative samples were deliberately taken from trees apparently exhibiting obvious morphological differences as well as from the dominant type. All samples, where collected through an agency, have been described as random samples, but whether these are true random samples without bias, it is not possible to say.

Where the information was definitely available, the observed presence or absence of leaf rust (Hemileia vastatrix) has been indicated. Apparent absence of leaf rust does not of course imply resistance necessarily.

Before sowing, an attempt was made to sort the seed visually according to obvious differences of shape and size. The sowings were then made on this sub-sample basis. Differences were apparent even from single trees and no attempt has been made to analyse these figures; it is however obvious that a longish bean is of frequent occurrence in many areas. From the quality aspect, it is expected that the rounder and more squat Bourbon type of bean will be the most acceptable.

A unique bean, almost completely round with a crooked centre-cut with a distinctly malformed appearance was collected at Welkite, Shoa province (F.8/64). This type was not seen elsewhere. Sylvain (1955) included a Welkite type - S.15 - in his grouping, but failed to mention this distinctive characteristic; in fact he likened it to the Harar type and suggested that it originated in the province of Gemu Gofa which was not visited by the team member.

It is unfortunate to record that a mixing of some of the later samples occurred whilst undergoing inspection and treatment in quarantine locally. These are indicated in the Appendix.

2.9.2 Germination and establishment

The seeds were sown in freshly prepared nursery beds at Lyamungu. The sowing of Fernie's own collection was completed by mid-January so that none of these seeds were more than two months old after harvest; the sowing of the remainder was completed within the next two months. Germination was variable but generally reasonable, after bearing in mind that many samples were necessarily taken at times other than the optimum mid-season for the locality. Unfortunately, an invasion of slugs did some damage to the earlier samples before control measures could be introduced.

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* Appendix VIII

The number of seedlings raised beyond the cotyledon stage is shown in the Appendix, but due to distortion and obvious retardation it is certain that the number to be planted in the field will be still further restricted. The unevenness of growth of the young seedlings is marked, and the observations made by Narasimhaswamy (1965) regarding the occasional occurrence of seedlings with apparently 3 or 4 cotyledons can be confirmed.

2.9.3 Future proposals

All usable seedlings have been planted out at Lyamungu in the field at a spacing of 9 ft. x 4½ ft. The area selected is shaded with mature trees of Albizzia maranguensis. In due course it is hoped that all plants will be screened individually for their reactions to coffee berry disease (Colletotrichum coffeanum) and leaf rust (Hemileia vastatrix), and every effort will be made to obtain further data on quality, yield, and vigor. Selections will be propagated vegetatively and distributed to the other East African countries which require them.

2.10 RECOMMENDATIONS

2.10.1 General

At the present time coffee yields are low and the quality is extremely poor. On the other hand, production costs to the average grower are negligible, and it is understood that the prices received for the product are good. Further, it is apparent that the total quantity could be immediately increased by improvements in road communications alone, since the existing potential is still not fully exploited. In these circumstances, and bearing in mind that coffee is an over-produced commodity, any large-scale modernization and improvement program should be entered into only with extreme caution.

A vital consideration would seem to be the question of markets. An improved product should normally be expected to ensure better prices or, as an extremely pessimistic view, be the sole means of disposing of an over-produced commodity. Quality improvement will almost certainly require increased production costs, and so will a number of, but not all, cultural improvements designed to increase bean size and yields per unit area. It would therefore seem essential to determine initially whether Ethiopia can enter the traditional quality markets on a large scale, and be suitably rewarded accordingly.

The most important aspects which could effect an immediate improvement are briefly outlined and discussed below. If adopted, these recommendations could be put into immediate effect through an efficient extension service based on experience gained in East Africa.

2.10.2 Pruning

To all intents and purposes no attempt is being made to rejuvenate the established trees. As a result, yields are very low and bean size decreases because more of the crop is borne on small sub-lateral branches.

The simplest method of rejuvenation is by stumping the old stems to encourage a new cycle of strong young stems which will arise as suckers from the stump, the best of which are kept for future production purposes.

It is recommended that any holding be sub-divided into say seven parts and that each part then be stumped in successive years on a seven-year rotational cycle. The stumping should be carried out by means of clean cuts with a saw at 18 inches above ground level, and the resulting suckers thinned to and maintained at a maximum of four per tree. If possible the wounds should be protected with a paint or dressing to lessen the ingress of rot and other organisms.

Only where production is intensive on the plantation scale with a regular spray program, etc., should consideration be given to a variation of the system. Some form of pruning where the height of the tree does not exceed 6 feet is then indicated, to facilitate spraying and picking, but all elaborate pruning systems must be rejected.

2.10.3 Harvesting

Only ripe cherry should be picked, for only thus can a preponderance of immature beans be avoided. In any case with the development and adoption of wet processing it is essential that discriminatory picking be adopted, since stages in the process are dependent on uniform material. The establishment of central pulperies by cooperatives, and the enforcement of a high standard of acceptance of cherry from the outset by the growers' own representatives, is probably the best way to achieve this. The standard of acceptance seen at merchants' pulperies was incredibly low.

2.10.4 Processing

Quality coffee can only be produced by the wet processing method, and this requires only ripe cherry. From the installations seen, the following suggestions are offered for improvement :

(1) instal disc-pulpers with modern adaptations (instead of drum pulpers or aquapulpers) of a size in keeping with the size of the holding or plantation.

(2) instal pre-graders or washing channels.

(3) revise fermentation timings to ensure that fermentation is complete. Fermentation time is largely dependent on temperature although ripeness of the cherry and the degree of agitation are other factors. It cannot be simply stated as 16 - 20 hours, which seems to be the usual procedure.

(4) introduce the 2-stage fermentation method recently developed in East Africa. This requires soaking under water for 24 hours after fermentation and washing are complete.

(5) remove superficial moisture within a period of 24 hours if possible; drying should be in the shade during hot weather.

(6) during subsequent drying, cover during the heat of the day, i.e. from about 11:30 a.m. to 3:30 p.m., and dry slowly.

(7) ensure complete cleanliness throughout the factory at all times.

(8) ensure that pulpers and other machinery are properly set and maintained.

(9) consider the establishment of properly designed and managed central pulperies, preferably owned and run by growers' cooperative societies.

2.10.5 Planting material

Both the spontaneous and obviously planted coffee generally produced beans with a wide variation of shape and size. The impression was received that malformation was fairly common and that the dominant type of bean was somewhat elongated and therefore likely to be unacceptable in the best quality market where a squat bean of the Bourbon type is most favoured. In addition, a variety of shapes and sizes intensifies the difficulties of efficient processing. Obviously, evaluation of the existing material would be a major project of a Coffee Research Service as part of its selection program, but some time must elapse before sources of proven planting material are located locally and exploited for the benefit of all growers. In the meantime, the existing material may be the limiting factor in the production of quality coffee, and it might be as well to determine and assess the types from each area before embarking upon an elaborate quality production program.

The use of Harar seed, unless it is required for a specific market, should be discouraged in certain areas. In East Africa this seed is recognised as producing an undesirable type of bean for the quality market. In addition, the trees are known to be highly susceptible to a number of diseases, including leaf rust and brown-eye spot.

2.10.6 Locations

Before any expansion of the plantation industry takes place, it is suggested that the suitability of proposed sites be carefully considered. The Harar area and the adjacent eastern end of the Chercher Hills appeared to be marginal for successful coffee cultivation, and in any case coffee was obviously taking second place to Khat or Ç̣hat (Catha edulis).

At the other extreme, the climatic conditions prevailing at Wush-Wush, and particularly the well distributed rainfall appear to be unsuitable for coffee. Here again an alternative crop such as tea would appear to be more suited.

The large plantation in the Suntu area was unfortunately not visited.

2.10.7 Shade

It would seem that shade is probably desirable for coffee in Ethiopia. The main consideration is the suppression of couch grass (Digitaria scalarum) which in certain unshaded areas was obviously as much the major pest of coffee as it is in parts of East Africa, and the debilitating effect of which was certainly not appreciated. Apart from temperature effects, other favourable considerations for shade are cheaper production, especially due to the reduced nitrogen requirements, a lessening of the risk of overbearing, a reduction of hail damage, and better growth under high altitude conditions. These advantages are thought to outweigh the possible disadvantage of lower yields, which in fact may not be real.

2.10.8 Planting

Although planting operations were not observed, the impression was received that insufficient care and attention were given to this aspect. Certainly some young plants were found to be very loosely affixed in the soil, and others showed signs of distress, which could also have been due to lack of after-care.

2.10.9 Diseases and pests

Diseases and pests did not appear to be a limiting problem in the spontaneous coffee, but this does not mean that they might not well become so under conditions of intensive cultivation. This point must always be borne in mind in any development program.

The loss of trees due to root disease (Armillaria mellea) was suspected in most areas. To reduce this risk, it is necessary to eliminate undesired forest trees by ring-barking to ensure slow death and depletion of starch reserves; similarly all tree stumps and roots must be thoroughly removed.

Reports of a serious condition in Wollega province were received during the mission, but unfortunately no member visited that area. It was later suggested that the damage might have been caused by Antestia. If this is confirmed control measures other than by pruning may have to be instituted.

2.10.10 Meteorological data

It is essential to establish simple meteorological stations in the coffee areas to provide basic data on rainfall distribution and intensity, hail, temperatures, and sunshine hours. The siting of some of the existing stations for other purposes, e.g. at the airfield at Gore, hardly seem to typify the area and the data are therefore misleading.

2.10.11 Future coffee expeditions

(a) No further major expedition should be planned for Ethiopia until a thorough screening and assessment of the progenies raised from the seed collected has been carried out. Since screening for coffee berry disease resistance and the assessment of quality, as well as yield recording, can only be carried out when the trees are fruiting, a few years must elapse before full results are available.

(b) If progenies from any localities should then prove to be of interest for the characteristics of (i) coffee berry disease resistance and (ii) rust resistance, preferably combined with quality, a further expedition should be mounted to sample those areas intensively.

(c) There would appear to be a case for a minor expedition to sample those areas in Ethiopia not covered by the 1964 expedition.

(d) Future expeditions should be provided with an executive officer in the host country who should make all arrangements for the reception, itinerary, transport and accommodation, etc. of members before their arrival. All members should be consulted about all aspects prior to the convening of the expedition, and active cooperation and liaison should be maintained with the appropriate organizations in the host country.

(e) In future, arrangements should be made for efficient preparation and storage of seed samples.

(f) Consideration should be given to the organization of seed collections from other centres where coffee types with particular characteristics have been located, e.g. :

Reunion (Bourbon) - East African quality coffee.
Other Mascarene Islands - Bourbon types, and possibly low caffeine coffees.
Timor - Leaf rust resistance and coffee berry disease resistance.
Yemen - Associations with Ethiopian coffee.

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3. REPORT ON VISIT TO COFFEE AREAS IN ETHIOPIA, 1964-65

by

R.L. Narasimhaswamy
Deputy Director (Extension)
Coffee Board Research Department, Mysore, India[1/]

3.1 INTRODUCTION

Efforts were directed towards a collection of coffee seeds of all the recognizable varieties. A total of 80 collections were obtained - two from Gojjam, three from Harar, six from Shoa, six from Sidamo, 54 from Kaffa and eight from Illubabor (see Appendix VIII). They included collections from single trees or from three or four trees or, in the case of random samples, from a large number of plants depending upon the frequency of occurrence of the variations. Variations in the tree habit, morphological and reproductive characters as well as ecological conditions were kept in view.

3.2 COFFEE FORESTS

Forest coffee was seen growing in Kaffa and Illubabor provinces and in the forest of Wondo-Genet, Shoa province, about 7°7' N, 38°40' E, at an elevation of 1,800 m. It is, however, not clear whether the coffee plants seen in the latter locality were escapes from the nearby plantation coffee. Plants in both localities appeared to have close resemblances in leaf and fruit characters, e.g. leaves tapering towards the petiole and the driptip, fruits longish with a small and not exserted navel. While the planted (now abandoned) coffee nearby showed leaf rust, the coffee in the forest did not. The forest contained the tree complex as in other areas, e.g. Podocarpus, Celtis, Pygeum, Dracaena, and Aningeria. Thickets of Adhatoda were common.

In Kaffa province forest coffee was seen in: (1) Sapa, about 7°58' N, 36°48' E, 1,610 m, 49 km north of Jimma; (2) enroute from Gera to Afallo, about 7°43' N, 36°18'E, elev. 1,900 m; (3) Chara, 8 km west of Bonga on the road to Wush Wush plantation, elev. 1,610 m; and (4) at Ainamba elev. 1,500 m. In these areas coffee grows freely without any effort where the forest is not thinned. In some other areas, the tall trees of the upper story appeared to have been thinned to allow light, and the underbush had been cleared. These practices were seen to best advantage in the holdings of Ato Shone Seda's forest coffee in Sapa Dildye, about 8°5' N, 36°54' E, elev. 1,630 m, 53 km north of Jimma; at Ato Getahune Birke's place at Saredo, about 20 km from Suntu; in the Agaro neighbourhood about 2 km from Agaro on the Gera road; and at Ainamba. In these areas coffee trees were growing extremely close together, often several to a square meter, and multi-stemmed.

En route from Ato Getahune Birke's Denbi farm, 5 km from Suntu, towards Jimma the forest was examined. Coffee was seen close to the road only and had not penetrated deep inside. In the forest of Bada Buna about 10 km northeast of Jimma, the penetration of coffee deep into the forest from the adjoining (now abandoned) planted coffee was evident. These may be taken as examples of naturalization of coffee in the forest.

1/ At the time of the Coffee Mission Expedition, Mr. Narasimhaswamy was Botanist with the Central Coffee Research Institute, Coffee Research Station, Chikmagalur District, Mysore State.

In Illubabor province forest coffee was seen in the Teppi area e.g. 8 km west at Arira-Daremmo; in the forest 8 km east and 12 km southwest to the Baco River past Korcha on the Mizan Teferi trail, at 1,000-1,320 m. At Arira-Daremmo it was a great experience to see spontaneous coffee growing deep inside the forest and along the trail to Korcha. The forest had the usual complex of Celtis, Ficus, Cordia africana, Randia urcelliformis, Dracaena steudneri, and Albizia. Epiphytic growth on coffee included species of moss, orchids, Peperomia, Macrosorium punctatum (fern), Platycerium angolense (fern), and species of Loranthaceae, among the most conspicuous plants seen.

"Ciferri (Sylvain, 1958), suggested that the plants considered as wild might have come from trees which had escaped cultivation because, he inferred, coffee is not a component of the original forest but only of forests of secondary growth in poor condition due to the felling of trees in the interest of cultivation or exploitation. Russ stated, ' I do not place any credence in the often repeated statement that Caffa is the natural home of coffee. It is not a natural component of these forests but naturalizes easily and is so widespread around the site of old plantations which often requires careful inspection and study of the forest composition to determine as much.' Von Strenge (1956) who lived for some time in actual coffee forests, has written: 'The places where truly wild coffee is still to be found are, however, limited to the small areas of primary forest which still survive. Nowadays, the greater part of the Kaffa Forests are secondary. So-called 'wild' coffee is also found in these. The question arises whether this is really wild coffee, that is, bushes derived from wild stands in primary forest, which have survived its thinning, or from some cause escaped clearance, or whether it is secondary wild coffee, which was planted when these areas were settled and cultivated and then remained when the settlements were again abandoned.'"

H.F. Mooney (1962) in a letter defining the home of wild coffee in Ethiopia says "I would draw a line from Gurrafarda northwards to Bure (WNW of Gore); thence SE through Gore to Agaro and on to Jimma; from Jimma more or less SW to include Bonga; thence curving westward to include Sheo Ghimmira and Mizan Teferi to Gurrafarda. Within that area the rainfall is of the order of 60-90 inches and the wild coffee seems to prefer altitudes of from 4,500 to 6,000 ft." Travelling extensively through Kaffa and Illubabor, he is of the opinion that there is hardly any forest left which could be designated as primary. All have been subjected to shifting cultivation at some time; and it is probable that western Ethiopia (west of Jimma) was much more densely inhabitated before the Kaffa wars of Menelik's time, 80 years or more ago. The same is true of most parts of Ethiopia.

In March 1963 Mooney again expressed the opinion that "There is not the slightest doubt that there are extensive areas of real wild coffee often forming quite dense stands, in the forests of Kaffa and Illubabor ..... As far as I can judge on my present knowledge, the main area of the wild coffee would be included within a line starting from Bonga and running NE to Agaro thence WNW through Gore to Bure on the Baro river, then south to Teppi and Mizan Teferi, and back to Bonga. It may extend slightly further south, but I doubt it as the rainfall drops considerably a short distance south and west of Teppi. I found no truly wild coffee west of Dembidollo."

"There is no doubt that many of the coffee trees now seen in the forest may be the remnants of previous plantings, but this does not preclude the existence of truly wild formations. It is a fact that a number of coffee forests exist, and, whether or not they consist of wild specimens, they offer conditions worthy of more thorough studies." (Sylvain, 1958).

The distribution of coffee forests in the provinces of Wollega, Illubabor, Kaffa, Gamu Gofa, and Harar is indicated by Sylvain (1955,1958), at latitude 6° to 9°N and longitude 34° and 40° E. Due to the brief period of the FAO Coffee Mission, it was impossible to visit all the places where spontaneous coffee exists.

3.3 CULTIVATED COFFEE

Cultivated coffee was seen in all the areas visited. Two systems are followed: (1) In a coffee forest the planter thins out the upper story of tall trees, clears the brushwood, and allows development of the existing coffee. There is no organized spacing for the coffee plants. The plants usually are multi-stemmed and untopped. Good examples of this method were seen at Ato Shone Seda's holding in Sapa Dildye and at Ato Getahune Birke's Saredo farm. (2) In the second method, coffee is regularly planted either in the open or under shade. Cordia africana, Albizia schimperiana, Croton macrostachys, and Millettia ferruginea are some of the trees commonly met with when coffee is grown under shade. The false banana (Ensete ventricosum) is found frequently in small family holdings. Such small holdings around dwelling huts are very abundant. Big plantations examined during the expedition were: Messrs. Mitchell Cotts and Ato Tufa's plantations near Shashemene; Ato Teka Egano's plantation in Doyo near Jimma; Ato Getahune Birke's Denbi plantation near Suntu; Messrs. Galanti-Teka Egano Co. plantation at Gera, and Ato Shibeshi's Minch estate near Mizan Teferi airstrip.

Since a large amount of the coffee produced in Ethiopia comes from spontaneous and naturalized coffee in the forest and from holdings around dwellings, a feeling exists that there is little need for establishing large scale organized and intensive cultivation practices. There appears to be a genuine feeling that any high production attempted may bring about a condition of excess of coffee on the commercial market that would upset the economic factors of stability in Ethiopia, especially since coffee is said to account for 50 to 60 percent of the country's export earnings.

"In the Province of Harar coffee is grown as an orchard crop .... The trees are set at a distance of about 3.5 x 3.0 meters, several seedlings being set in the same hole, as in Yemen and Brazil, often making a composite 'tree' of two or three plants. The seedlings are set in wide trenches about 30 cm. deep. No shade is used. The adult plants may reach a height of five meters and are not pruned until they reach 20 or 25 years when they are sometimes stumped and a new cycle of growth starts." (Sylvain, 1958). Coffee is often irrigated in Harar. It appears as though in this province cultivation of Khat, Chat (Catha edulis) may compete with coffee.

In the big plantations visited cultivation did not appear to be intensive, e.g. manuring in Mitchell Cotts estate near Shashemene is said to be done once in two years or so with Nitrophoska at 400 grams per tree. It is applied at 200 grams per tree in Ato Teka Egano estate. Soil cultivation is done more to keep down growth of rank grass and other troublesome weeds. Pruning practices or disease control, particularly leaf rust, are not considered essential.

Ethiopia produces mainly cherry coffee since its major export is to the United States of America which prefers this type of coffee. Limited quantities of washed coffee are produced to cater to markets like West Germany. At Dilla in the Sidamo province in the National Coffee Board Depot, small hand pulpers were seen. It appeared that 150 had been sold in 1964 to growers. At Mr. A. Teddine's plantation in Wonago village near Dilla and at Chochi on the old road to Agaro community pulping equipment was seen being used to process fruits from many small growers in the neighbourhood. At these units, the fruits may also be purchased outright from the grower and processed as washed coffee.

Before coffee is moved from the interior for final disposition at Addis Ababa for export auctions, quality control checks are made at convenient centers, e.g. Jimma. After inspection and certification, the coffee moves to Addis Ababa by lorry. The firms which export coffee are held responsible for the quality of the exported coffee until it is received at the destination in a satisfactory manner.

Movement of coffee from the interior by mules and transport from Maji, Mizan Teferi, and Teppi to Jimma by air-craft is very common. However, considerable coffee may be held up in the interior. If more roads are opened, coffee may be moved from the interior to market more efficiently with increased quantities becoming available for export. Coffee is still the hidden wealth of the Ethiopian interior.

Coffee was tasted in practically all the places visited. It is generally acid to taste. But the Gimira coffee in Mizan Teferi was less acid with a taste similar to Indian coffee.

Seed movement within the country for propagation purposes does not appear to be extensive, perhaps on account of the reputation of the Harar variety used for raising planted coffee in Harar and other provinces. Other than in Harar province this was seen in the estates visited in Wondo-Genet near Shashemene and in places in Kaffa. Seeds from spontaneous forest coffee in Limu (formerly Ennarea) have been used in the neighbourhood for raising planted coffee. In the Teppi-Mizan Teferi-Ainamba region "Sheko coffee" is much used. Usually seed from the spontaneous plants in forest areas is used in the immediate neighbourhood for raising planted coffee. The seedlings raised by Jimma Agricultural Technical School in recent years for supplies to growers are also from local seed in Kaffa province.

Authorities of the Tana Plantation Co. met at Mizan Teferi airstrip, stated that 75 percent of the acreage in their plantations is from seeds from local forest coffee. The remaining 25 percent was obtained from selections in Kenya. In the Mitchell Cotts plantation near Shashemene, specimens were inspected of 24 collections sent by Dr. P.G. Sylvain. These included Bourbon, Caturra, Maragogipe, San Ramon, Blue Mountain, and Purpurascens. These selections were also seen in the trial plots at Jimma Agricultural Technical School. A plot of about 100 to 150 plants of Purpurascens (Arba Gogou red-tipped) was seen in Ato Tufa's plantation in Wondo-Genet near Shashemene.

The cultivated coffee in open situations and at comparatively high altitudes showed symptoms of nutritional disorders, e.g. iron chlorosis, nitrogen deficiency as well as zinc deficiency. At Ato Getahune Birke's Saredo plantation deficiency symptoms akin to potash were noticed. Such symptoms were not met with in coffee in the forests.

3.4 VARIETIES

3.4.1 Variation Range

The following range of variability was recorded:

1. Free growth, plants ranging up to 25 ft. in height, with many stems from the base; spreading, erect, or drooping branches; orthotropic branches arising all over the crown and such branches only from the stem.

2. Tip leaves green, brown, dark brown, copper.

3. Leaves broad and large; broad and short (small); linear-oblong; small and narrow linear; roundish-oblong resembling S.353 (India); resemblance to Angustifolia; resemblance to big-leaved C.eugenioides; leaves with cuneate-base, rounded base, broad base; drawn out driptip, short driptip;

leathery or comparatively thin; flat, erect or drooping; dark green or not; distinctly wavy to smooth margin and a tendency of margin to curve inwards.

4. Internodes short, medium or long.

5. Fruits small; round; roundish; long and narrow; long and big; large and broad; large squat-shaped with broad base and top (rectangular); flat on two sides or comparatively rounded; Kint and Coorg type; with or without persistent calyx lobes; with small or big navel; ripening deep red, red or light orange yellow; when ripe cropping with the slightest touch or adhering to the plant.

6. Beans roundish and small; long and narrow; oblong and large; big and bold; pointed at one end and rounded at the other; rounded at both ends; bean abnormalities low to high; colour bluish, greyish, greenish-greyish, and yellowish.

7. Varying degrees of leaf rush development to freedom from leaf rush under field conditions.

Combinations of one or more of the above characters in an individual plant or in a group of plants were seen as follows:

1) Plants with free and spreading growth, short internodes, small narrow linear leaves, bronze-tipped leaves, small roundish or long big fruits, small roundish beans or long narrow and pointed at one end. Plants with this association of characters were seen at Dilla, Welkite, Doyo, Sapa, Kossa, Gera, Bonga, Ainamba, and Jimma.

2) Sheko coffee is characterized by free, unrestricted and vigorous growth, plants up to 25 ft. high, leaves large, rounded at the base, with a slightly drawn out drip tip, straight to nearly straight on the margin, sometimes with a tendency to curve inwards, fruit large, squat-shaped, the big beans bold or long and pointed at one end or rounded at both ends. Plants with this association of characters were seen at Ainambaand Debre Werk near Mizan Teferi, and in the Teppi region, at Gera, Bonga, and Omonadda.

3) Wobba type coffee with linear big leaves with a tendency to droop were seen in Gera as well as in Mizan Teferi.

4) A sample of clean coffee from Harar town gave oblong to roundish oblong beans of the Kent and Coorg type known in India and beans that were narrow and linear-oblong of the Rume and Burbuk type. Similar types were seen in a sample from Ato Teka Egano's estate in Doyo as well as in the Teppi market and in Jimma. A sample of largish bean with yellow colour coming from Harar province, was seen in the National Coffee Board office in Addis Ababa.

The general impression gained was that a very wide range of variation exists in the coffee examined in Kaffa, Sidamo, and Illubabor provinces. Kaffa province appeared to be the richest in this regard. In fact, all the variations listed could be met with in this province.

Table I gives analyses of coffee samples from the places visited. Occurrence of flat beans, pea berries and defective beans is recorded. The percentage of defective beans is high - over 20 percent in the samples from Harar, Welkite, Teppi, Mizan Teferi, Debre Werk, Ainamba, and in one sample each from Sapa, Gera, and Chara. Defective beans due to insect damage are common in the samples from Teppi (Arira and forest area), Mizan Teferi, Debre Werk, and Ainamba. Many spotted beans (Cercospora?) were noticed in the samples from Sapa, Gera, Teppi, and the Mizan Teferi regions. The samples from Harar, Welkite, Bada Buna, Sapa and a few samples from Doyo, Kossa, Bonga, and Gera contain considerable malformed beans. The samples from Teppi, Mizan Teferi, and Debre Werk were generally low in this type of defective beans.

"The presence of numerous types of coffee (in Ethiopia) has been recognised for a number of years although a thorough taxomonic survey is still lacking. The various type classifications proposed are still tentative, as all the coffee producing districts have not been explored for this particular purpose." (Sylvain, 1958). This is still true to-day. Pending such a detailed study, it is preferable to talk about occurrence of character differences. It is from this stand-point that the seed collections are important. Seed collections from areas in Ethiopia differing in ecological conditions will be raised in contiguous plots at Central Coffee Research Institute. Raising them under similar conditions of environment "will help to determine how far climatic differences alter the expression of the germ plasm" (Sylvain, 1958), and, also help to show clear differences due to genetic constitution.

All the seed collections were sown under quarantine conditions at Central Coffee Research Institute under specific accession numbers. After germination, before unfolding of the cotyledonary leaves, they were transplanted to polythene bags prior to planting in contiguous trial plots in the field during September.

Before despatching seeds from Ethiopia to C.C.R.I., India, we sorted out all defective beans. This has introduced a certain amount of selection in the seed collections.

The seedlings at time of reporting (1965) have produced one to two pairs of leaves. Even at this stage differences are noticeable, e.g. Angustifolia characters are seen in some of the collections as detailed below:

TABLE 1

Expedition No.	C.C.R.I. India No.	Source of seed collection	No. of seedlings showing Angustifolia characters	Percentage
1	2	3	4(a)	4(b)
E-5	2602	Debrezeit	28	51.8
E-18	2608	Yirga-Cheffe	4	8.2
E-587	2613	Welkite	2	3.4
E-592	2627	Sapa Dildye	1	1.4
E-606	2643	St.George Hotel in Bonga	17	32.7
E-607	2644	Bonga	30	44.1
E-266	2645	Balt	1	3.5
E-614	2647	Teppi	5	33.3
E-610	2650	Daremmo	5	63.3
E-612	2653	Forest near Teppi	12	31.6
E-118	2654	Koroha on trail to Mizan-Teferi	10	45.5
E-620	2655	Ainamba Rest House	2	66.6
E-116	2672	Ainamba	2	4.0

Note: Number of seedlings for observation is only 8 and 3 respectively in C.C.R.I '50 and 2655.

The high percentage recorded in C.C.R.I. 2643, 2644 and 2655 is understandable since the parent plants at Bonga and Ainamba Rest House compound had similar characters. The parent plants for C.C.R.I. 2602 collection at Debrezeit did not show indications of such characters and the occurrence of a high percentage of Angustifolia seedlings in this collection is interesting.

The plants in Teppi, Daremmo-arira, forest near Teppi, and Korcha on trail to Mizan Teferi have big broad leaves with straight or very gently undulating margins. No indications of small linear leaves were seen among any of these plants. But among the seedlings raised from seed collections from these areas, C.C.R.I. 2647, 2650, 2653, and 2654, quite an appreciable percentage show the Angustifolia characters. It will be interesting to watch the further development of these seedlings.

Parent plants from which seed collections of C.C.R.I. 2636, 2637, 2640 are described in the inventory as having tip leaves with brown to deep brown or deep dark brown; C.C.R.I. 2638 and 2681 as having deep brown to purple or copper; and C.C.R.I. 2645, 2646, 2651, and 2676 as having copper; and C.C.R.I. 2675 as having copper or green colour. In none of the seedlings raised from these collections, at time of writing (1965), is there any indication of either dark brown, deep dark brown or copper colour in the tip leaves.

Seeds were collected from parent plants showing some characteristics of certain coffee selections grown in India, for example:

C.C.R.I. 2614, 2634, and 2607 resemble Kents as to leaves and fruit;
C.C.R.I. 2600 and 2638 resemble S.353 (selection of C.C.R.I.) as to texture of leaves; and
C.C.R.I. 2617 resembles S.31 (original mother plant at C.C.R.I.) in all characters.

The most variable coffee plants seen were at the Ato Teka Egano estate in Doyo and Messrs. Galanti-Teka Egano Co. estate at Gera and in populations in the forest southwest of Gera towards Afallo. The estate in Doyo has used seedlings from the Jimma Agricultural Technical School as well as local sources. The estate at Gera was using materials under the names Ennarea and Wobba, both of which originated in Kaffa Province. At Doyo plants can be seen with characters of S.288, S.333, S.795 (Coffee Board of India Research Department, 1954-55), and S.353 - selections of C.C.R.I, India, and S.26, S.31, S.44 and such other mother plants at Central Coffee Research Institute, India. It should be mentioned that the plant materials at Central Coffee Research Institute might be of hybrid origin, in all probability being the descendents of the original C. liberica - arabica hybrids or Hamilton (Coffee cultivation in India, 1959).

Working on a small seedling population of C. arabica of Ethiopian origin, Carvalho (1959) at Campinas commented on the existence of a well accentuated genetic variability in otherwise well-marked varieties. In addition to the alleles responsible for the characteristics of Semperflorens, Bourbon, and Typica, for example, these varieties also show green and brown colour of young leaves, semi-erecta, macrocarpa, less well developed calyx, and other less known variations. Carvalho is of the opinion that cross pollination is perhaps high in Ethiopia, as compared with Brazil, resulting in the large variation observed.

Anderson (1961) says: "In Ethiopia, for instance, building upon the field studies of my student Hugh Rouk, I was able to demonstrate that the variation in the so-called wild plantation of forest-grown coffee at Bada Buna (near Jimma, Kaffa province) was due to introgression between two strains of Coffea arabica.

"In the Bada Buna forest there is taxonomically more variation between the coffee bushes than in all the Coffea arabica cultivated in the New World.

Bada Buna is a case of penetration of coffee deep into the forest from the adjoining (now abandoned) planted coffee and thus an example of naturalisation in the forest. From the account of Anderson this coffee shows a very wide variation which is due to introgression between two strains of C. arabica. Comparatively, the variation in Bada Buna forest is milder. It is much more extensive in other places, e.g. estates in Doyo and the Gera district of Kaffa Province.

3.4.2 Description of Main Varieties

Representatives of C. arabica var. abyssinica Chev. and the cultivar 'Purpurascens (Cramer) were identified by Sylvain in several regions. C. arabica 'Xanthocarpa' (Carminhoa) Froehn. and C. arabica 'Polysperma Burck were identified by Le Jeune (Carvalho, 1959). C. arabica 'Semperflorens K.M.C. and C. arabica 'Typica' Cramer have also been reported.

Sylvain (1955-1958) in a tentative classification of the main types, cites:

(1) Ennarea, a green variety similar to C. arabica var. abyssinica characterized by the large size of the fruits.
(2) Jimma or Kaffa, the coffee most commonly found in the forests and characterized by a calyx which is more developed than those of other varieties and which adheres to the fruit until maturity suggesting a closer relationship to C. arabica 'Bourbon' (Choussy) B. Rodr. than to C. arabica 'Typica' Cramer.
(3) Agaro, a type somewhat similar to Jimma and generally having large leaves, seen only in plantations.
(4) Cioccie, quite similar to Agaro in vegetative habits but different in the shape of the fruits and seeds which are roundish with an index between length and width in the neighbourhood of Ennare.
(5) Irgalem, a rather small-leaved, green-tipped type with a bushy habit.
(6) Dilla, a bronze-tipped, rather large-leaved type.
(7) Arba Gougou, red-tipped with typical reddish colour of the young flushes.
(8) Harar, a notably rank grower, bronze-tipped with leaves sometimes very large.
(9) Zeghie, a type similar to Ennarea.
(10) Loulu, a type purportedly containing a high percentage of fat in the pulp and a low ratio of clean coffee from fresh cherries.
(11) Welkite, a rank grower having some similarity to the Harar type, large-leaved and green-tipped.
(12) Wollamo, a type with both bronze and green tips occurring in the same locality and having rectangular fruit with a flattened apex.

The foregoing classification by Sylvain is a listing of what he found for practical purposes only and not a formal classification.

León (1962) includes brief descriptions of Ethiopian coffees, in a study of collections at the Interamerican Institute of Agricultural Sciences, Turrialba, Costa Rica. The genetic variability observed in Ethiopia by Sylvain and others is not fully included in these collections. He has placed the existing material under four groups:

Kaffa is characterized as a medium sized plant, not very vigorous, with many orthotropic branches from the base; leaves narrowly elliptic with the base and apex pointed, margins smooth; fruits larger than in Typica. Kaffa would include Zeghie S. 13, Mattu S. 7, Lekemti, Anfillo, Gudar, Jimma, Galla Sidamo, and Jimma 1, 4, 6 collections. León feels that this may be considered as a subspecies.

Semi-erecta is characterised by the growth of lateral branches at a very acute angle from the stem and very narrow leaves.

Tafarikela S.8 is characterised by the tall plant, longer internodes, big broad leaves markedly elliptical and thick, with wavy margins; flowers and fruits similar to Typica but the fruits are long. This differs from Kaffa by size and shape of the leaves. It includes Arussi 11, Jimma Tana S.3, Wallamo S.16, Irgalem, etc.

Geisha introduced from the trial plots in Kenya-Tanzania is characterized by orthotropic branches from the base, a dense crown; leaves oblong-elliptic, obtuse to acute at the base, apex pointed; fruit bigger than in Typica and ripening late.

Apart from these four groups there are others, e.g., Irgalem with similarities to Bourbon; Harar with similarities to Kaffa and Typica; Jimma intermediate between Kaffa and Typica; Cioccie S.6 with characteristics of Kaffa and Typica plus linear leaves and irregular inflorescence; Agaro-4 like Bourbon and Typica; Jimma 3, Dilla, and Dilla Alghe resemble Typica; and Ennarea S. 2 distinct by itself.

The most complete description of Ethiopian coffee appears to be by Chevalier (1947) who applied the name Coffea arabica var. abyssinica Chev. to plants growing in Ethiopia. "He mentioned as main differences from other varieties with normal fruits and leaves the fact that the plant was growing spontaneously and that its fruits were borne on long pedicels" (Sylvain, 1958). The other varieties mentioned by Chevalier originated in plantations or in cultivated areas and are not known in the spontaneous state (Chevalier, 1947). Sylvain (1955) believes that Ennarea most closely resembles the var. abyssinica of Chevalier.

In the genetic analysis at Campinas in Brazil, plants of Ethiopian origin with characteristics distinct from Bourbon and Typica but showing var. abyssinica characters were tested. It was seen that some coffee plants classified as var. abyssinica gave, in their progeny abyssinica, Typica and, abyssinica plants with smaller leaves. Plants classified as abyssinica but with leaves similar to Bourbon, others having leaves with wavy margins, and still others with smaller leaves did not give in their progeny typical abyssinica, but abyssinica with smaller leaves of the Bourbon type. On the basis of these studies the abyssinica characteristic is mentioned as controlled by more than one pair of genetic factors (Carvalho, 1959). Thus, in the progenies studied existence of variation is evident.

Coffee growing in Teppi-Mizan Teferi areas called "Sheko coffee" exhibits fairly common characteristics, e.g. free, vigorous and spreading growth; height up to 25 ft.; many-stemmed from the base; leaves large, broad, cuneate with a broad base, short to pronounced drip-tip, smooth to slightly wavy margin, tip leaves light to dark brown; fruit big, large, squat-shaped or long, flattish, with small navel ripening red. This type is prevalent in the Sheko forest in Ghimira sub-province of Kaffa province. It has been freely used in raising planted coffee in this area. In all probability this may be the Jimma or Kaffa types of Sylvain which he mentions as the coffee most commonly found in the forests and very likely the parent form of other cultivated Coffea arabica. Some of the fruits have calyx lobes, but great variation can be seen in this character even on the same tree. Carvalho (1959) rightly points out that the expression of this calyx character is always highly influenced by the environment. Hence undue importance should not be attached to this character.

Seed collections from the Teppi area, C.C.R.I. 2647, 2650, 2653, and 2654, have given rise to 31 percent and 63 percent of seedlings with Angustifolia characteristics. Their further development is being watched with interest.

From the foregoing it appears there is so far no clear and specific definition of any botanical variety in Ethiopia. The FAO Expedition could not cover sufficient territory nor had sufficient time for a detailed study to establish such a variety. A thorough taxonomic and cytogenetic survey is essential before the very wide variations seen among the Ethiopian coffees are classified as characterizing distinct varieties.

3.5 SPECIES OCCURRENCE

Only Coffea arabica was seen in the places visited, although C. excelsa and C. canephora are grown in the trial plots at the Jimma Agricultural Technical School. C. arabica is undoubtedly the species par excellence in Ethiopia.

The character description of C. arabica given by Chevalier (1947) may be amended as follows: Plants develop as a small tree, growing up to 8 meters (25 ft.) tall (in the areas visited no indications were seen of the leaves persisting for 2 to 3 years). Leaves up to 10-12 cm. wide. Calyx terminated by a truncated limb with 5 lobes, which are pronounced or not, and persisting until fruit maturity or not. Mature fruit sub-globular, ovoid, oblong or squat-shaped, orange-red to red on ripening, 12 to 31 mm. long. Beans sub-globular, ovoid, oblong, linear-oblong, either rounded at both ends or pointed at one end and rounded at the other, grey, blue, bluish grey, or yellowish.

The modification in the description would also apply to that given by Cheney (1925) and Coste (1955).

"Judging from the way the coffee plant grows in the areas visited and from the extent of forest coffee reported by others, it may be stated that the coffee plant unquestionably is spontaneous and naturalized in rain forest areas in south-western Ethiopia" (Meyer, 1965). There is an urgent need for a better survey of this area and in adjoining parts of Sudan, and perhaps as far as Uganda and Kenya for a better understanding of the origin and distribution of the Arabica coffee plant. Even in Ethiopia the extent of the species east of the Great Rift Valley - whether spontaneous or naturalized - needs to be surveyed. The few coffee trees seen in the forest in Wondo-Genet near Shashemene open the way for further possibilities, hence a survey in these areas east of the Rift is essential.

3.6 DISEASES AND PESTS

3.6.1 Leaf Rust

Leaf rust (Hemileia Vastatrix Berk. and Br.) appears quite widely on Coffea arabica. It was seen and collected at Hirna in the Chercher Hills en route to Harar in Harar province; at Wondo-Genet near Shashemene in Shoa province; Dilla-Yirga Cheffe region in Sidamo province; Doyo, Omonadda, Bada Buna, Sapa, Limu, Gera, Agaro, Mizan Teferi, Bolku, and Ainamba regions in Kaffa province; and Afallo and Teppi region in Illubabor province. But leaf rust was not observed to be on an epidemic scale except perhaps in a few isolated and localized fields e.g. in the Chercher hills of Harar province.

An extensive survey spread over the full year covering all the seasons would give valuable information on the seasonal development and severity of the rust in the various coffee regions. Such a study is badly needed from Ethiopia where C. arabica grows spontaneously under a variety of soil and climatic conditions.

Observations indicate that the coffee leaf rust appears to be kept in check by environmental conditions and heavy parasitization of the rust fungus. It is essential to understand how these operate. Information can then be used to good advantage in other coffee growing areas affected by coffee leaf rust epidemics and also perhaps to understand how the fungus itself came to be associated with Coffea (Narasimhaswamy, 1965).

The natural check on the leaf rust fungus may be altitudinal (temperature), hyper-parasitization, resistance to existing races of the fungus, and sparse sporulation.

d'Oliveira (1959, 1960) recorded the existence of races I, II, and III in Ethiopia, race III not being found outside Ethiopia. Most of the Ethiopian coffees tested belonged to Group E (Bourbon type). Four other groups found are: Group D (Kent type); Group C (Geisha type); Group G (Balehonnur type); and, Group I (Sylvain type).

Spore collections were made in the areas visited in Ethiopia, where leaf rust occurrence was noticed, for despatch to Dr. d'Oliveira in Portugal. Over 50 such collections were made available for rust screening purposes.

3.6.2 Material Collected

Aschersonia goldiana Sacc. and Ell., a parasitic fungus on scale insects found on the coffee plant in the Teppi forest areas, was collected and sent to the Central Coffee Research Institute for culturing.

Specimens of rusts on 11 Rubiaceae, including Gardenia lutea Fresen., Pavetta sp. and Galium sp. and 27 rust specimens from plants belonging to various families of flowering plants, were taken. These were sent to Dr. M.J. Thirumalachar, Superintendent Research, Hindusthan Antibiotics Ltd., Pimpri near Poona, India. Material of Rubiaceae was given to Dr. Meyer.

3.7 AFFINITIES

The pronounced polymorphism of C. arabica and C. canephora, two species of economic importance, are commented upon by Krug and Carvalho (1952). Krug (1959) goes a step further: "All these species and many others not mentioned here are characterized by a pronounced polymorphism, a great array of their variants still occurring in the wild stage."

From results of genetic analysis, Carvalho (1952) concludes that C. arabica is probably an allotetraploid. In supporting this, Narasimhaswamy (1962) ennumerates the work of others regarding the occurrence of forms in other species and in the hybrids among these, with close resemblance to C. arabica. Such occurrences are reported outside Ethiopia, up to 300 or 400 miles south of the acknowledged area of natural C. arabica spread (Wellman, 1961).

Cramer (1957) is positive that C. congensis approaches C. arabica on the one hand, while on the other, C. congensis is a species with many divergent forms, some of which tend in the direction of other species. He has noted the resemblance of C. eugenioides to a slender and smaller leaved form of C. arabica as well as the resemblance of some to C. congensis with respect to the shape of berry, leaf and tree. He has recorded the preliminary hypothesis of Hille Ris Lambers that C. arabica, C. congensis, and C. eugenioides may have come from one original type.

Repeated observations by explorers on the unique occurrence of C. arabica in Ethiopia and the existence of high variability in this species, including the variations in cultivated material in various countries; its wide occurrence as a spontaneous plant in south western and western parts of Ethiopia; and the reporting of other species and hybrids that resemble closely C. arabica, requires a wide survey in areas adjacent to Ethiopia in the Sudan, Uganda, and Kenya for the existence of such closely related coffee plants. These will have very great evolutionary significance.

3.8 RECOMMENDATIONS

1. Another expedition appears essential to make an extensive survey of all forest coffee areas and the areas adjacent to these e.g., east and southeast Sudan, north and northeast Uganda and north Kenya. Such an expedition would require one year at least with proper ground work, before it commences to function.

2. A survey of Arabian coffee areas to settle the question of the natural distribution of Coffea arabica is required.

3. International collaboration should be established in:

   (a) the classification of variation in Coffea arabica occurring in the area of its natural distribution;

   (b) genetic analysis of Coffea arabica from the area of natural distribution inclusive of leaf rust resistance;

   (c) a study of the natural check on development and spread of leaf rust on the spontaneous coffee in Ethiopia;

   (d) a study on physiological aspects of the spontaneous coffee in Ethiopia;

   (e) a free exchange of information and workers under the aegis of FAO.

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TABLE 2.

ANALYSIS OF COFFEE SAMPLES IN THE COFFEE AREAS VISITED IN ETHIOPIA DURING FAO COFFEE MISSION

Place of collection	Leaf and fruit character	Number of sound beans		Number of defective beans	Remarks regarding defective beans
		Flat	Pea berry		
(1)	(2)	(3)	(4)	(5)	(6)
1. Harar	Market place:Random sample	224	32	247(49.1)	Bits included
2. Welkite (i)	Random sample	85	7	58(38.7)	
(ii)	Roundish fruits	123	24	64(30.3)	
(iii)	Long, big fruits	70	5	91(54.9)	
3. Bada Buna	Random sample	157	5	24(12.9)	Insect damage included
4. Sapa (i)	Long, big fruits	50	6	3(5.1)	
(ii)	Large,big fruits squat-shaped	142	5	38(20.5)	-do-
5. Doyo (i)	Roundish fruits	147	11	27(14.6)	-do-
(ii)	Large,big fruits	99	4	13(11.2)	-do-
(iii)	Long, big fruits	104	6	12(9.9)	-do-
(iv)	Narrow linear leaves	27	10	7(15.9)	
(v)	a. Random sample	163	5	17(9.2)	-do-
	b. "	464	97	84(13.0)	Bits included
6. Gera (i)	a. Random sample	70	9	12(13.2)	
	b. "	141	10	30(16.6)	
(ii)	Small narrow linear leaves; big, large fruits	61	11	14(16.3)	
(iii)	Wobba type:Linear drooping big leaves; and large,big squat-shaped fruits	146	6	25(14.1)	
(iv)	Roundish broad leaves; long, big fruits	52	8	14(18.9)	
(v)	Linear, small leaves; small, roundish fruits	141	8	19(56.3)	
(vi)	Large, big leaves; and, large squat-shaped fruits	81	19	13(11.5)	
(vii)	Ennarea type plants with big squat-shaped orange-yellow fruits	89	9	15(13.3)	
(viii)	Ennarea type plants; big squat-shaped, red fruits	101	12	17(13.1)	
7. Sapa Dildye (i)	Large big squat-shaped fruits	156	13	8(4.5)	
(ii)	Small roundish fruits	167	19	6(3.1)	
8. Kossa	Narrow linear leaves and roundish fruits	131	26	23(12.3)	

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Note: Figures in parentheses denote percentages.
Items 1, 5(v), 6(i)a, and 13(i) are samples of clean coffee and the others are dry parchment samples.

T A B L E 2. (contd.)

Place of collection	Leaf and fruit character	Number of sound beans		Number of defective beans	Remarks regarding defective beans
		Flat	Pea berry		
(1)	(2)	(3)	(4)	(5)	(6)
9. 5 km.from Afallo:					
(i)	Linear, small leaves long, big fruits	67	6	13(15.1)	
(ii)	Big broad leaves;large big squat fruits	149	11	20(11.1)	
(iii)	Linear, narrow small leaves;large squat fruits	168	9	16(8.3)	
(iv)	Random sample	92	13	7(6.3)	
10. Agaro	Random sample	155	10	23(12.2)	
11. Bonga (i)	Linear small leaves; long,big fruits	118	64	11(5.7)	
(ii)	Linear small leaves; small, roundish fruits	153	18	29(14.5)	
12. Chara near Bonga	Random sample:Big large, leaves;big large,squat-shaped fruits.	59	7	21(24.1)	
13. Teppi (i)	Market place (Random sample)	249	32	122(30.3)	Bits included
(ii)	Town: Big broad leaves; big,squat-shaped fruits	153	12	83(33.5)	Many spotted
Arira (i)	Random sample: -do-				
	-do-	65	6	5(6.6)	
(ii)	-do-	124	42	172(50.9)	Number insect damaged and spotted
Korcha	-do-	148	15	42(20.5)	Many spotted
Teppi forest(i)	-do-	93	9	33(24.4)	-do-
(ii)	-do-	93	5	16(14.0)	-do-
14. Mizan Teferi	Large big leaves; large squat-shaped fruits	262	13	76(21.9)	-do-
15. Debre Werk	Broad,thick,dark-green leaves;smallish fruits	228	10	79(24.9)	-do-
16. Ainamba Forest Coffee:	Big large leaves; large squat-shaped fruits	105	16	32(20.9)	-do-

Note: Figures in parentheses denote percentages.
Items 1, 5(v)b, 6 (i) a, and 13(i) are samples of clean coffee and the others are all parchment samples.

TABLE 3

GERMINATION DETAILS OF SEED COLLECTIONS OF COFFEA ARABICA

FAO COFFEE MISSION

Expedition No.	C.C.R.I India No.	Number of seedlings germinated and transplanted to polythene bags	Percentage germination	Number of seedlings with 3 and 4 Cotyledonary leaves
(1)	(2)	(3)	(4)	(5)
E - 9	2599	65	75.5	4
E - 7	2600	64	71.1	2
E - 12	2601	42	77.7	1
E - 5	2602	62	82.6	11 (12%)
E - 20	2603	24	82.7	-
E - 17	2604	71	69.2	-
E -584	2605	45	90.0	4
E -583	2606	31	65.9	-
E - 19	2607	39	66.1	1
E - 18	2608	54	79.4	1
E - 21	2609	30	50.0	1
E -585	2610	3	50.0	-
E - 72	2611	75	73.3	1
E - 36	2612	56	76.8	8 (12%+)
E -587	2613	70	93.3	6
E - 71	2614	76	85.5	1
E -586	2615	60	85.7	30 (50%+)
	2616	44	88.0	1
E - 30	2617	131	87.6	3
E -588	2618	99	99.0	-
E -591	2619	6	15.0	-
E -589	2620	71	71.0	2
E -590	2621	81	81.0	-
E -597	2622	61	81.3	3
E -600	2623	61	83.5	-
E -599	2624	64	86.4	5
E - 88	2625	50	83.3	-
E -598	2626	45	79.0	6 (12%+)
E -592	2627	93	86.9	-
E -593	2628	23	85.1	-
E - 80	2629	75	83.3	-
E -602	2630	35	79.7	-
E - 81	2631	87	80.5	1
E -604	2632	87	87.0	-
E -603	2633	84	84.0	-
E - 89	2634	78	78.0	4
E -605	2635	63	90.0	-
E - 87	2636	50	83.3	-
E -596	2637	68	84.0	3
E -595	2638	70	97.1	-
E -601	2639	69	69.0	-
E -594	2640	79	79.0	-

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TABLE 3 (contd.)

Expedition No.	C.C.R.I. India No.	Number of seedlings germinated and transplanted to polythene bags	Percentage germination	Number of seedlings with 3 and 4 Cotyledonary leaves
(1)	(2)	(3)	(4)	(5)
E -609	2641	21	77.7	-
E -608	2642	60	85.7	-
E -606	2643	79	79.0	-
E -607	2644	82	82.0	-
E -266	2645	30	42.8	-
E -267	2646	10	21.0	-
E -614	2647	44	41.9	-
E -264	2648	16	27.1	-
E -611	2649	66	61.6	-
E -610	2650	44	63.7	-
E -269	2651	51	51.0	-
E -613	2652	36	48.0	-
E -612	2653	65	81.2	-
E -118	2654	64	59.2	-
E -620	2655	4	50.0	-
E -619	2656	22	50.0	-
E -114	2657	99	92.5	-
E -615	2658	37	67.2	-
E -123a	2659	82	75.9	-
E -123b	2660	77	85.5	-
E -618	2671	55	73.3	-
E -116	2672	60	80.0	-
E -616	2673	53	70.6	-
E -617	2674	84	84.0	-
E -260	2675	18	75.0	-
E -257	2676	14	73.6	-
E -126	2677	89	82.4	-
E -525	2678) 2682)	23	72.7	-
E -124	2679	84	77.7	1
E -125	2680	96	88.8	1
E -524	2681	100	92.1	1
E	2683	85	85.0	-
E -621	2684	99	91.6	-
E -555	2706	23	44.2	-
E -556	2707	71	55.4	-
E -579	2708	25	50.0	1
E -580	2709	47	69.1	-
E -464	2710	18	86.0	-

4. CONSIDERATIONS ON THE GENETIC VARIABILITY OF COFFEA ARABICA POPULATIONS IN ETHIOPIA

by

L.C. Monaco
Genetics Department
Instituto Agronômico, Campinas, S. Paulo, Brazil.

4.1 INTRODUCTION

Coffea arabica L., economically the most important species of the genus, shows some remarkable features which distinguish it from the other species of the genus. Firstly, it represents the only polyploid species so far identified. C. arabica has 44 somatic chromosomes, whereas the remaining species are diploids with 22 chromosomes. Very little is known about its origin and as far as polyploidy is concerned there have been claims that it is an allopolyploid species. Based on morphological comparisons and its crossability with some species of the sub-section Erythrocoffea, Monaco and Carvalho (1964, unpublished) have suggested the possibility of C. arabica being an allopolyploid and that C. canephora and C. eugenioides may have participated to some extent to its formation and evolution. On the other hand, Narasimhaswamy (1964), based on the analysis of a hybrid between C. liberica and C. eugenioides, claimed that these two species are the probable components of C. arabica.

It should, however, be recalled that there is no good evidence which rules out the possibility of Arabica coffee being a true autotetraploid or at least a segmental allotetraploid.

Secondly, C. arabica is the only self-compatible species of the genus. The diploid species are all self-incompatible of the gametophytic type. The rate of out-crossing is variable according to the region and to the mutant used as marker. The Cera mutant for instance, gives an out-crossing of ten percent whereas for the angustifolia marker only 1.6 percent of the seeds are of hybrid origin under conditions at Campinas (Carvalho and Monaco, 1962). Very little is known about the mode of reproduction of the Arabica coffee in Ethiopia, although the rate of out-crossing may be expected to be higher than the ones mentioned above.

Finally, the geographic distribution of C. arabica is restricted to the plateau of southwestern Ethiopia. It is the only species occurring in that country. There is some evidence that C. arabica occurs in the southeastern Sudan on the Boma plateau. Thus, C. arabica follows one of the typical patterns of distribution of polyploids, i.e., peripheral expansion outside the range of distribution of the other diploid species of the genus. Self-compatibility would have provided opportunity for quick occupation of the new region away from the original range of distribution. The expansion of the coffee plant in Ethiopia seems to be accomplished with the help mainly of animals, among which the baboons and monkeys are important distribution agents.

4.2 GENETIC VARIABILITY

The analysis of major genes in a population is fairly easy when the factors have complete penetrance. There are some references about a few mutants isolated from commercial plantations which also occur in "spontaneous" coffee populations. Sylvain (1958) mentioned the Purpurascens and bronze alleles and Lejeune (1958) described the factor Xanthocarpa. Detailed study of some coffee progenies derived from a group of plants introduced from Ethiopia has been reported. Carvalho (1959) indicated the presence of the following alleles in that material: Br and br for growing tip colour; T and t which characterise Typica and Bourbon respectively; se for Semi-erecta, and Ab for Abyssinica, and sf for Semperflorens present in the so-called "Erythrean Moca" coffee. The mode of inheritance of some other mutants is still being analysed.

However, when the gene expression is variable or when the characteristics are under polygenic control, the identification of the genotypes is much more difficult. Special techniques are required to allow a more precise classification of the genic contribution to a particular characteristic. In this case the environment plays a remarkable role. For instance, the environmental effect may represent about 90 percent of the total variance for yield. Production tests for progenies derived from plants with very different total yield, revealed that all the progenies studied had practically the same mean. The commercial classification of coffee beans from the same tree indicated a variation in length from $^{12}/_{64}$ to $^{20}/_{64}$ of an inch. These measurements clearly indicate that any observation about the fruits much consider an average value and the corresponding standard deviation. Leaves have also been shown to be extremely variable according to the season and the growing conditions. Shaded trees tend to have larger leaves than plants growing in the sun. Consequently, the value is relative in any comparison involving plants growing under different light intensities. Conditions of fertility and age of the plant also may have strong influence on the expression of characteristics under polygenic determination. For instance, the cultivar Caturra after some years of high yield shows a decrease in production and also the fruits and the seeds become smaller. The leaves are smaller and die-back becomes quite evident.

These factors clearly indicate that we must be very careful when comparing the information gathered in populations growing in different conditions of growth and light intensities. More precise information will be obtained by studying the progenies selected in this expedition. Despite certain difficulties, some valuable conclusions will emerge from the large amount of data collected.

To better understand the results of the present observations and also the data already existing in the literature, the characteristics controlled by major genes from those under polygenic determination are discussed separately below.

4.3 QUALITATIVE CHARACTERISTICS

The inheritance of some of the mutants from Ethiopia has been studied in Campinas using either Typica or Bourbon as standards. Unfortunately, some of these characteristics could not be scored in all populations. Young leaf colour, for instance, was not classified for all populations because in some cases the place was too heavily shaded, whereas in others the plants were not growing at all. Fruit colour was not easily classified due to different stages of ripening or because of conditions in some very poorly managed plantations.

4.3.1 Branching

The material from Ethiopia analysed in Campinas revealed that some of the introductions carry an incompletely recessive gene se (semi-erecta) which produces plants with a relatively denser growth. The primary lateral branches form an acute angle with the stem. This mutant is quite different from the

erecta factor described elsewhere. The semi-erecta mutant was found in several places visited, especially in the Bada Buna forest. Unfortunately, no evidence exists for the sources of seeds which gave rise to this population near Jimma. In regions like Kossa and Denbi, the plants have the same characteristic type of branching. It seems, however, that in these localities the coffee is not "spontaneous", but originates from seeds traced back to the vicinity of Jimma; the seedlings were distributed by the Agricultural Technical School at Jimma. Besides semi-erecta branching, the plants also have smaller leaves, lighter red fruits and green-tipped shoots. Apparently the same mutant was observed along the trail from Gera to Afallo.

Concerning type of branching, most of the coffee populations carry the normal allele. In some areas, the coffee trees were too old with branches appearing only on the top which prevented any study to estimate the frequency of the se allele in the populations.

4.3.2 Young Leaf Colour

Two alleles for the colour of the growing tip have been described; Br (bronze) and br (green). The Br allele is characteristic of Typica which is considered the coffee introduced from Ethiopia to Yemen and from there to other parts of the world. On the other hand, br is found almost exclusively in the Bourbon variety. The Purpurascens (pr) gene also affects the young leaf colour.

Observations made in material introduced indicated the possibility of the existence of more than two alleles or perhaps more than a single locus affecting the growing tip colour. According to the author's own observation during the expedition, at least four different types appear in the natural populations - green, bronze, light brown, and "chocolate". Green and bronze-tipped plants have been identified in the populations at Konga, Bada Buna, Sidamo, and Teppi and practically all other areas visited.

The frequency of each one of the two alleles was determined in a few populations but in no case do they follow a binomial distribution. For instance in the plantation at Konga and Soddu both alleles appear with equal frequency. This would be expected since coffee does not represent a panmictic population and selection of the mother trees has been carried out by the natives. Bronze-tipped plants are found almost exclusively in the Harar plantation, whereas green-tipped plants form most of the coffee plantation at Lake Tana.

The "chocolate" tipped coffee trees have been found in a plantation at Gera belonging to Teka Egano-Galanti Co. The genetic material is of various origins but referred under a general designation of Ennarea coffee. Purpurascens plants were found in a commercial plantation near Shashemene. The seeds for this plantation were taken from a single Purpurascens tree which exists near the forest of Kantheri in the garden of a farm. There is no indication of the origin of this plant. The mutant has to be crossed with gene pr to see if the same locus is concerned.

4.3.3 Fruit Colour

Two alleles affecting fruit colour have been described - the yellow and red pericarp. Anderson (1961) reported the existence of a light red fruit in the forest of Bada Buna. The same mutant has been identified in Campinas among the introductions made some years ago. There is no doubt that the light red fruit mutant is a component of the Bada Buna population. It was also found in several other areas such as Afallo, Bonga village, Doyo, Gera and probably

near Teppi (figures 5-B.2, 6-A.1, and 11-D.3, 10-A.3). There is no information about the mode of inheritance of this gene.

The fruits with light red pericarp seem to have a thinner shell like the mutant Xanthocarpa. This characteristic may be of value in a coffee breeding program since mutants with a thinner pericarp give a better output than forms with dark red fruits.

4.3.4 Persistent Sepals

One of the characteristics of the cultivated forms is the absence of persistent sepals on the fruit disc. On the other hand, a single gene has been described, Goiaba (sd) which conditions the presence of long persistent sepals even in the ripe fruit. Some authors claim that the presence of persistent sepals is a characteristic of primitive forms. Some species of the genus, as for instance Coffea kapakata, have very well developed sepals. A different type of persistent sepals was identified in several populations including those from Bada Buna, Doyo, Denbi, Sapa, Dildye, and Gera. The expression of this factor is quite different from that of the sd allele. Its classification is very difficult because of its low penetrance. The environment plays an important role in the expression of this mutant. Sometimes only a few fruits in the whole plant may exhibit the mutant characteristic. Consequently, its identification and the study of the mode of inheritance is more difficult. Persistent sepals in Ethiopian coffee seem to behave as a recessive in crosses with Typica. When plants carrying the new gene are crossed with the mutants Goiaba and Macrodiscus (Md) which are incompletely dominant, the heterozygotes Sd/sd and Md/md are indistinguishable from the homozygous mutant. The interaction of any of these two alleles with the gene for persistent sepals found in the Ethiopian coffee allows us to classify the plants carrying the new factor (A. Carvalho, personal communication).

4.4 QUANTITATIVE CHARACTERISTICS

The data obtained by the measurement of samples of fruits and leaves for a group of plants selected in each area visited are discussed below.

4.4.1 Leaf Measurement

A sample of ten leaves, the third leaf on a branch, was collected for each plant selected. The leaves were picked in different branches at about four to five feet from the ground. Sometimes, due to the poor vegetative growth, the leaves were taken from wherever possible. Individual leaves were measured for length, width and basal angle. For each selection, variance and coefficient of variation were considered and for each population the mean, standard deviation of the mean and the confidence limit were calculated. The data for each population are shown in Table 4.

TABLE 4: Mean values, standard deviation of the means and confidence limits for the length, width, and basal angle of leaf samples collected during November and December 1964 in some coffee populations from Ethiopia.

Locality	Length			Width			Basal Angle		
	mean	$s_{\bar{x}}$	limits	mean	$s_{\bar{x}}$	limits	mean	$s_{\bar{x}}$	limits
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Bonga	13.70	0.354	13.01-14.39	5.58	0.195	5.20-5.96	38.48	1.452	35.64-41.32
Teppi	13.40	0.404	12.61-14.19	5.24	0.175	4.90-5.92	37.22	0.914	35.43-39.01
Gera 'B'	11.00	0.327	10.36-11.64	4.84	0.178	4.49-5.19	43.16	1.858	39.52-46.80
Afallo	11.80	0.389	11.04-12.56	4.72	0.194	4.34-5.10	42.14	1.304	39.58-44.70
Gera 'A'	12.98	0.457	12.09-13.87	5.10	0.195	4.72-5.48	36.94	1.414	34.15-39.73
Ota	11.50	0.438	10.64-12.36	4.80	0.208	4.39-5.21	40.14	1.759	36.69-43.59
Fichi	11.77	0.496	10.80-12.74	5.00	0.163	4.68-5.32	42.03	1.549	38.99-45.07
Dildye	10.51	0.325	9.87-11.15	4.19	0.147	3.99-4.48	33.07	0.879	31.35-34.79
Saredo	11.99	0.447	11.11-12.87	4.75	0.246	4.27-5.23	36.31	1.483	33.40-39.22
Katenna	9.82	0.396	9.04-10.60	3.76	0.186	3.39-4.13	38.96	1.624	35.74-42.18
Denbi	11.46	0.435	10.60-12.32	4.32	0.227	3.87-4.77	33.92	1.458	31.03-36.81
Limmu	11.50	0.449	10.78-12.38	4.55	0.335	3.85-5.25	43.75	2.102	39.35-48.15
Sapa	11.49	0.470	10.57-12.41	4.81	0.183	4.45-5.17	44.41	1.581	41.11-47.51
Doyo	10.91	0.435	10.06-11.76	4.51	0.189	4.14-4.88	42.45	1.746	39.03-45.87
Bada Buna	12.13	0.449	11.25-13.01	4.44	0.191	4.07-4.81	35.25	0.970	30.45-34.25
Kantheri	14.40	0.572	13.24-15.56	5.83	0.282	5.26-6.40	38.80	1.668	35.43-42.17
Soddu	12.47	0.614	11.21-13.73	5.57	0.347	4.86-6.28	45.47	9.798	25.47-65.47
Konga	12.20	0.306	11.56-12.84	5.90	0.228	5.42-6.38	50.95	2.755	45.18-56.72

In order to understand better the variation within population as well as to visualise the extreme value measured in each population, graphs (figs. 1, 2, and 3) were organised. Most of the populations had leaf mean comprised in the interval between 10.5 to 12.5 cm. A few exceptionally long leaves were found in the coffee plants from Wondo-Genet, Gera, Teppi and Bonga. The latter two regions had the widest amplitude of variation, although most of the samples were not different from the general mean. Near Bonga, one coffee tree was selected which had very small leaves resembling very closely those of the mutant Mokka, but certainly not carrying the mo allele. The leaves of Kossa-Kabenna selections are very small, falling outside the range of distribution of the other populations.

Leaf width showed less variability than length but in some respects correlated with leaf length. The leaves of plants analysed from Konga and Soddu are among the largest measured. Considering the proportion between length and width as well as leaf texture, these samples would appear to resemble Abyssinica.

The samples from Bonga and Teppi are characterised by a few individuals completely outside of the distribution. At least two types may be considered in these two localities: one with longer leaves and narrow basal angle like Typica, the other with leaves resembling Bourbon Vermelho but sometimes with larger leaves. One of the samples from Bada Buna 3.3 cm. wide and a basal angle of about 19° was quite similar to the mutant Angustifolia. Another plant with very narrow leaves with a small basal angle was found in Sapa-Dildye.

A remarkable observation was made on the coffee plantation of the Tekka Egano-Galanti Co. at Gera where a large number of plants seem to be abnormal. The phenotype of these plants recalls the same characteristics observed in aneuploid coffee plants. It is impossible, however, to make any further observations about the importance of this finding since the plants were of different origins and were growing without shade. It would appear reasonable that only a nutritional deficiency is concerned. The frequency of such plants is much higher than the normal occurrence of aneuploids. It is very hard to conceive that these plants are the product of interspecific segregation or progeny from hexaploid or octaploid forms which occur spontaneously. As the farm usually selects the mother trees or the seedling, the abnormal plants such as polyploid forms would be eliminated. Cytological examination of these plants is required before a definite conclusion may be reached. Progenies of these plants will be studied to check the meiotic behaviour of the descendents.

4.4.2 Fruit Measurement

As in the leaf samples, ten fruits were measured for each selection. This number gives a fairly good estimation of the parameter desired. The mean value for the three dimensions measured, length, width and height, as well as the standard deviation for the mean and the confidence limits are entered in Table 5.

TABLE 5: Mean values, standard deviation of the means and confidence limits for length, width, and height of fruit samples collected during November and December 1964 in some coffee populations which occur "spontaneously" in Ethiopia.

Locality	Length			Width			Height		
	mean	$s_{\bar{x}}$	limits	mean	$s_{\bar{x}}$	limits	mean	$s_{\bar{x}}$	limits
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Bonga	16.39	0.245	15.91-16.87	14.08	0.182	13.72-14.44	11.55	0.153	11.25-11.85
Teppi	16.96	0.230	16.51-17.41	14.05	0.180	13.70-14.40	11.85	0.130	11.60-12.10
Gera 'B'	16.99	0.250	16.50-17.48	15.30	0.204	14.90-15.70	12.69	0.158	12.38-13.00
Afallo	16.39	0.260	15.88-16.90	14.15	0.189	13.78-14.52	11.99	0.191	11.62-12.36
Gera 'A'	15.52	0.246	15.04-16.00	13.88	0.220	13.45-14.31	12.08	0.178	11.73-12.43
Ota	16.93	0.249	16.44-17.42	14.67	0.242	14.20-15.14	12.38	0.206	11.98-12.78
Fichi	16.21	0.248	15.72-16.70	14.07	0.191	13.70-14.44	11.69	0.186	11.33-12.05
Dildye	17.06	0.244	16.58-17.54	14.08	0.169	13.75-14.41	12.09	0.145	11.81-12.37
Saredo	16.14	0.273	15.61-16.67	14.39	0.165	14.07-14.71	12.25	0.133	11.99-12.51
Kabenna	15.64	0.275	15.10-16.18	13.48	0.166	13.15-13.81	11.40	0.153	11.10-11.70
Denbi	18.24	0.342	17.56-18.92	14.38	0.252	13.88-14.88	12.36	0.213	11.94-12.78
Limmu	18.00	0.245	17.49-18.56	14.80	0.210	14.36-15.24	12.55	0.277	11.97-13.13
Sapa	16.77	0.250	16.28-17.26	15.15	0.190	14.78-15.52	12.65	0.197	12.26-13.04
Doyo	17.70	0.301	17.11-18.29	14.45	0.251	13.96-14.94	12.51	0.211	12.10-12.92
Bada Buna	16.75	0.241	16.28-17.22	14.02	0.223	13.58-14.46	11.87	0.189	11.50-12.24
Kantheri	17.35	0.310	16.70-18.00	14.20	0.273	13.63-14.77	12.20	0.231	11.72-12.68
Soddu	16.55	0.301	15.94-17.16	14.55	0.209	14.13-14.97	12.75	0.180	12.39-13.11
Konga	15.70	0.297	15.08-16.32	13.10	0.199	12.68-13.52	11.50	0.237	11.00-12.00

Within the same population the three dimensions are related but marked differences were noted in some of the populations. Small fruits like those of the Mokka mutant (E-419, fig. 4-$B_{3,6}$) and as large as fruits of Maragogipe were found in Bonga (E-411, fig. 4-$A_{3,6}$), Doyo (E-301), Gera (E-347, fig. 5-$A_{3,5}$), and Teppi (E-462, fig. 6-$B_{3,6}$).

Likewise, for the leaf samples, graphs were prepared visualizing the mean value, the limit of confidence and the extreme values for each population (figs. 7,8,9). The samples from Kossa-Kabenna (figs. 10-A,B,C and 11-D3), Konga, and Gera A are characterised by short fruits whereas those from Denbi, Limmu, and Doyo have fruits usually longer. The fruits collected in the Forest of Sapa are very characteristic as being broader than the fruits from other regions. The fruits being long and broad but somewhat flat recall the jerry-can shape (fig. 10-$A_{3,4,5}$). In general, the fruit width is less variable than the length.

The most extreme types are again observed in the regions of Bonga and Teppi. The samples from Kossa-Kabenna, Konga, and Bonga had flatter fruits than other regions. The samples from Doyo and Gera are quite variable, but these two regions do not represent areas of spontaneous coffee. They constitute plantations with seedlings of various origins.

Apparently the commercial defects, peaberry and elephant beans, occur in a frequency within the normal value observed for coffee plantations. One plant was found in the plantation of Ras Adergachew which had an exceptionally high amount of elephant beans, i.e., more than one seed developed in a single locule (fig. 4-$A_{1,4}$). It seems that the factor or factors controlling the high frequency of elephant bean may also be found in Ethiopia. It would be of interest to check if the occurrence of elephant bean is associated with high frequency of empty locules, as described for the cultivar Mundo Novo.

4.5 DISCUSSION AND CONCLUSION

The success of any breeding program depends on the genetic variability that the breeder has at hand to make selections. Coffee in Latin America, due to its origin, has given very little response to selection. The present plantations of the cultivar Typica may be considered as an enormous population derived from one or very few coffee trees. Consequently, very little variation should be expected within this cultivar. Indeed attempts to improve the yielding capacity of Typica by the pedigree method have resulted in failure. Similarly, the cultivar Bourbon Vermelho was formed from a few seeds accidentally introduced to Brazil long ago. Also within the Bourbon Vermelho, individual selection produced very disappointing results concerning yielding capacity. Although this cultivar is a better yielder than Typica, only very few more productive lines could be isolated during almost twenty years of continuous selection.

Approximately forty major genes have already been found in commercial plantations, mainly from Brazil, from both Typica and Bourbon cultivars. However, concerning polygenic variation, it seems that the number of generations which have elapsed is not sufficient to differentiate the original material by means of mutations in the polygenic systems. Advanced generations of natural or artificial hybrids between these two cultivars and new introductions were of great significance to the development of the cultivars presently under cultivation. An example is the cultivar Mundo Novo, which is derived from a group of selected lines from a population of descendents of a natural hybrid between Bourbon Vermelho and Sumatra. Comparison between the new selections and the original population revealed that selected progenies produce, on the average, up to 90 percent more than unselected material. This cultivar produces approximately 200 percent more clean coffee than Typica.

The need for further improvement of the present cultivars not only with respect to yield but also selection for certain important chemical components for quality and aroma, uniform ripening, as well as for disease and insect resistance, has led some international organizations, especially FAO, to attempt to preserve the genetic variability observed in Ethiopia. Some collections made by Sylvain have been studied in a few places. The data collected in Campinas, for instance, indicated that the progenies introduced from Ethiopia differ from each other in several characters but in no instance was the yielding capacity better than that of Mundo Novo. Some of these progenies were characterised for very late or precocious fruit maturation. A great amount of variation was also found with respect to bean size and resistance to Hemileia vastatrix (Carvalho, Monaco and Scaranari, 1962).

The evidence of genetic variability in the coffee population in Ethiopia as well as the possibility of extinction of this valuable gene pool due to cutting and exploitation of the remaining forest in which coffee occurs "spontaneously", led FAO to organise the present expedition. There is no doubt that the variation observed is larger than the variability analysed in many billions of coffee trees cultivated in the tropics. As expected, most of the variation is of a quantitative nature and only a few known major genes were identified in the areas visited. The factors semi-erecta (se), bronze (Br) and green (br), purpurascens (pr), abyssinica (Ab), and possibly angustifolia were found. A few new types, such as "light red pericarp" and "chocolate" and "light brown-tipped" plants were recorded. The genes t and T which have been shown to occur in Ethiopia could not be evaluated since their determination is made only in progeny of crosses with Murta.

The variation observed in the leaf dimensions could be considered as covering the range between Typica and Bourbon with few extreme samples resembling Mokka and Maragogipe. Besides the variability in leaf size and of the basal angle, two other characters must be considered: the presence of plants with light green shiny leaves and others with long "drip-tip" leaves on plants growing in the dense forest. In samples collected at Afallo and Teppi, for instance, the leaf tips reached more than 20 mm. in length. In the populations growing in the open, the leaves are rounder and paler. The plants thriving under shaded conditions usually have leaves with a narrower basal angle and almost always have the longest leaves. No correlation was found between leaf dimensions and the altitude where the plants are growing.

Fruit measurements revealed the occurrence of some forms which may be used in a breeding program aiming to increase bean size. Plants selected at Doyo, Gera, and Bonga have large fruits which seem to be controlled by polygenic rather than by a single gene with a pleiotropic effect like Mg. The fruit size seems to be transmitted independently from the other characteristics of the plant. For instance, the selection from Doyo (E-291) has fruits about 20 mm. long and leaves like Bourbon Vermelho. It remains to be seen if the increase in fruit size will result in a reduction in the number of fruits per plant as in Maragogipe. A complete chemical analysis of the components of the coffee bean is also needed. It has already been shown that genetic variation for niacin, oil content, caffeine and soluble solids is found within the cultivars of C. arabica.

Concerning the origin of C. arabica, very little can be added to what is already known. The genetic variability is indeed reasonably high but this fact does not lead to any conclusion about the area where the species were first formed. Other species likewise autogamous, for instance tomato, present the same characteristic of having the centre of variation and domestication not coinciding with the area of origin. Consequently, additional exploration is needed to determine the extreme limits of the distribution as well as the genetic composition of coffee populations in these areas.

From the evolutionary standpoint it seems that one of the most promising areas to be explored is the Boma Plateau in the Sudan near Ethiopia, where Arabica coffee is known to occur. A further search should concentrate on the area to the north of Lake Rudolf and the rain forest area along the Omo River in Ethiopia. A search should be made for possible contact of C. arabica with diploid species, such as C. eugenioides, C. canephora, and perhaps C. congensis. Lebrun (1941), however, considers that C. congensis has a restricted distribution in the Congo and does not reach the area of Lake Rudolf. More information should be obtained in that area about the origin of C. arabica, although it is probable that its ancient ancestry may have already become extinct. Unfortunately, the almost complete lack of historical data hinders further speculation about the role of man as related to the distribution of C. arabica. A second follow-up expedition to the above mentioned regions might contribute further knowledge on the centre of origin of C. arabica.

Fig.1: Variation within and between populations of Coffea arabica for leaf length in samples collected from some regions visited. For each population the length of the horizontal line gives the total range of variation, the blank space the mean and the horizontal bar the confidence limit for the character.

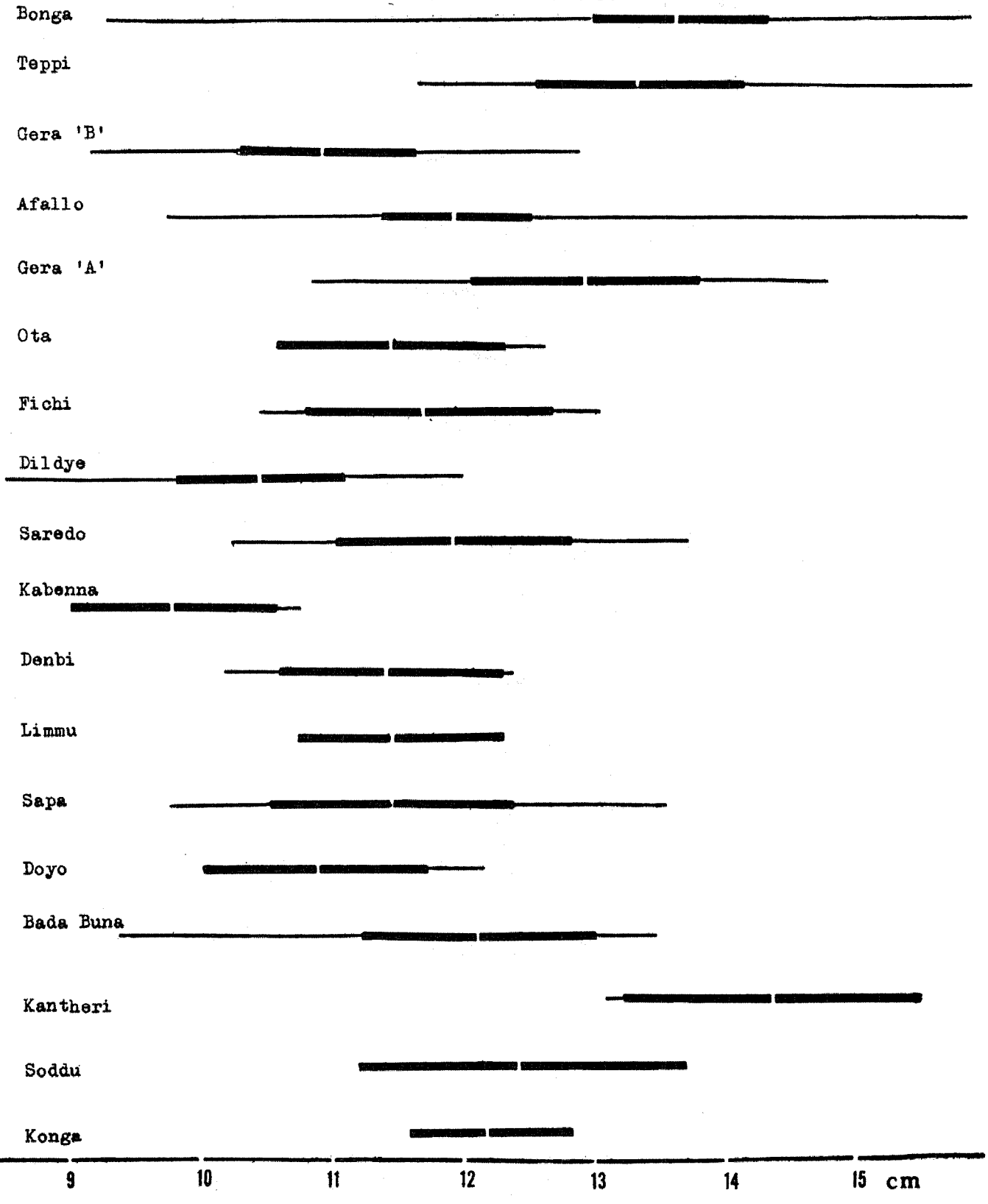


Fig.2: Variability observed in leaf width in samples selected from different regions in Ethiopia. For each population the length of the horizontal line represents the total range of variation, the blank space the mean and the horizontal bar the confidence limit for the character.

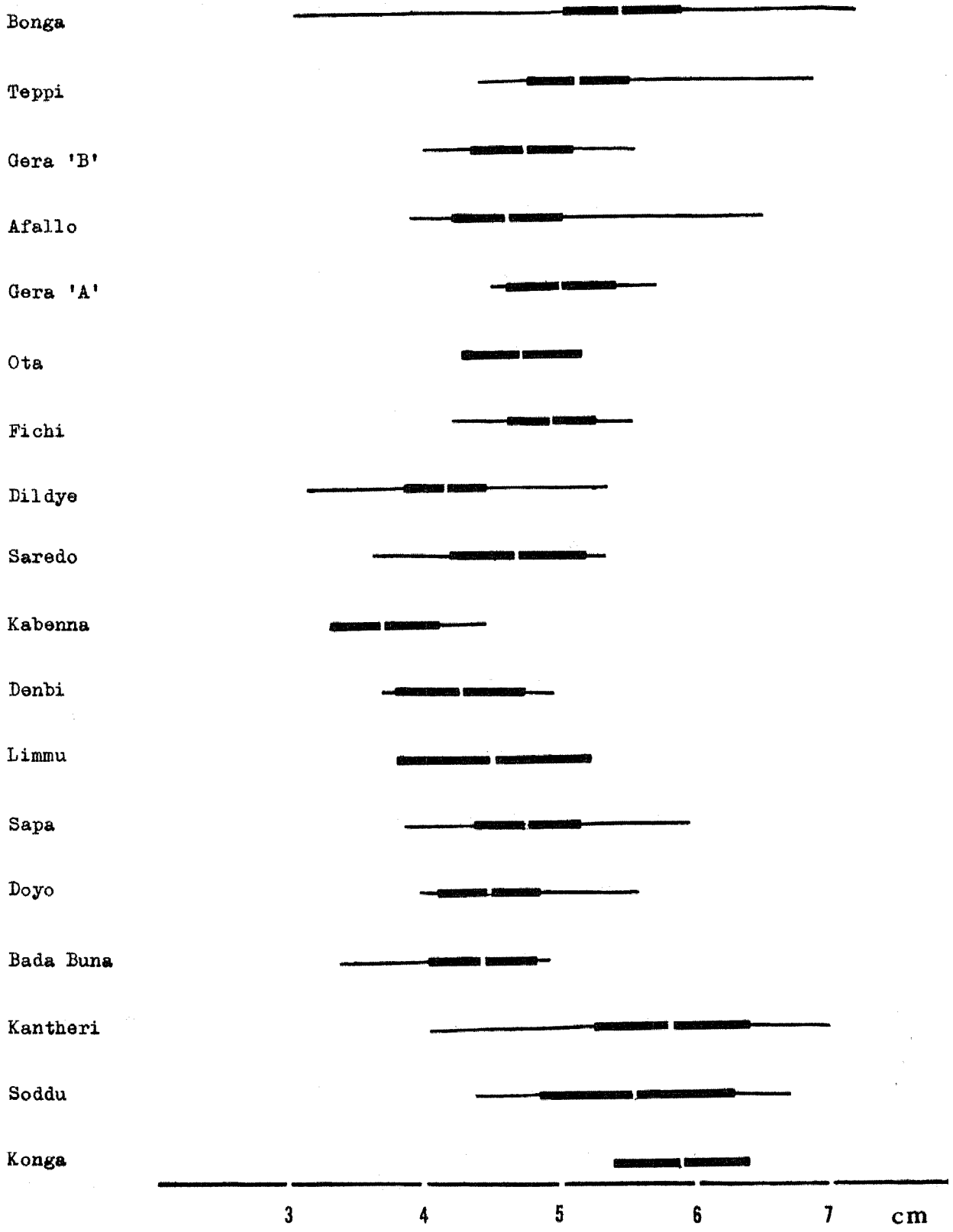
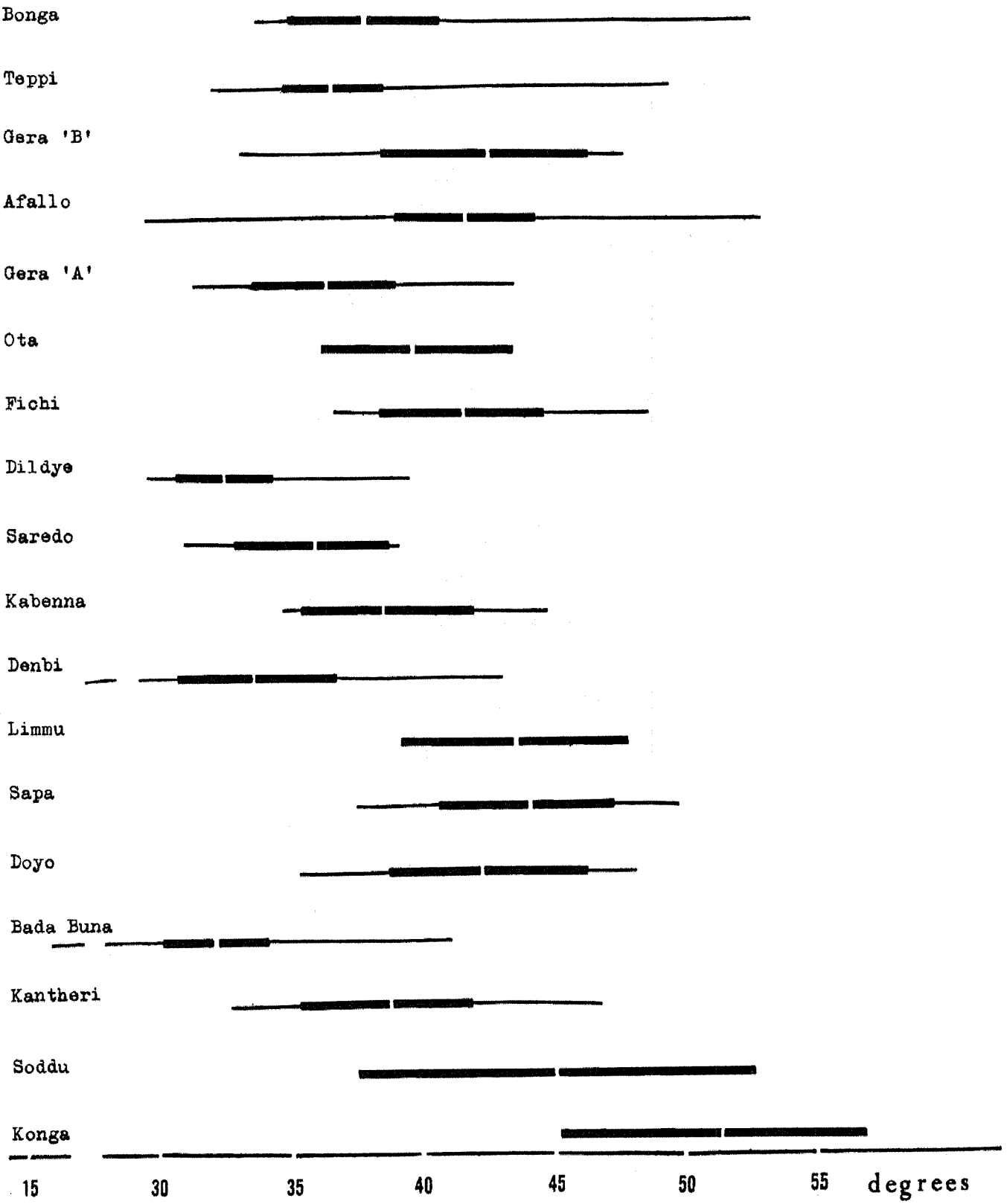


Fig.3: Variation in the leaf basal angle recorded in the different coffee populations visited in Ethiopia. For each population the length of the horizontal line stands for the total range of variation, the blank space the mean and the horizontal bar the limit of confidence for the character.



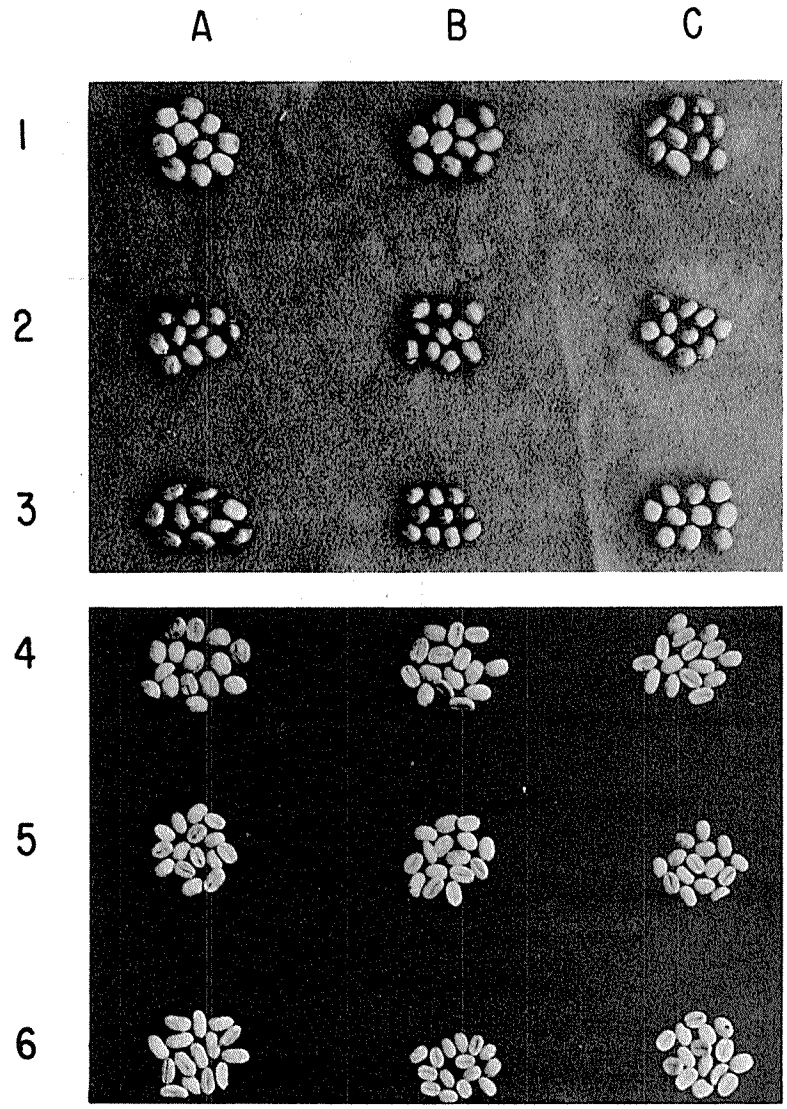


Fig.4: Samples of pulped and non-pulped coffee fruits picked in the region of Bonga, Kaffa Prov.

A: 1,4(E-408); 2,5(E-409); 3,6(E-411)
B: 1,4(E-412); 2,5(E-410); 3,6(E-419)
C: 1,4(E-418); 2,5(E-417); 3,6(E-421)

The numbers in parentheses represent the field number of each introduction.

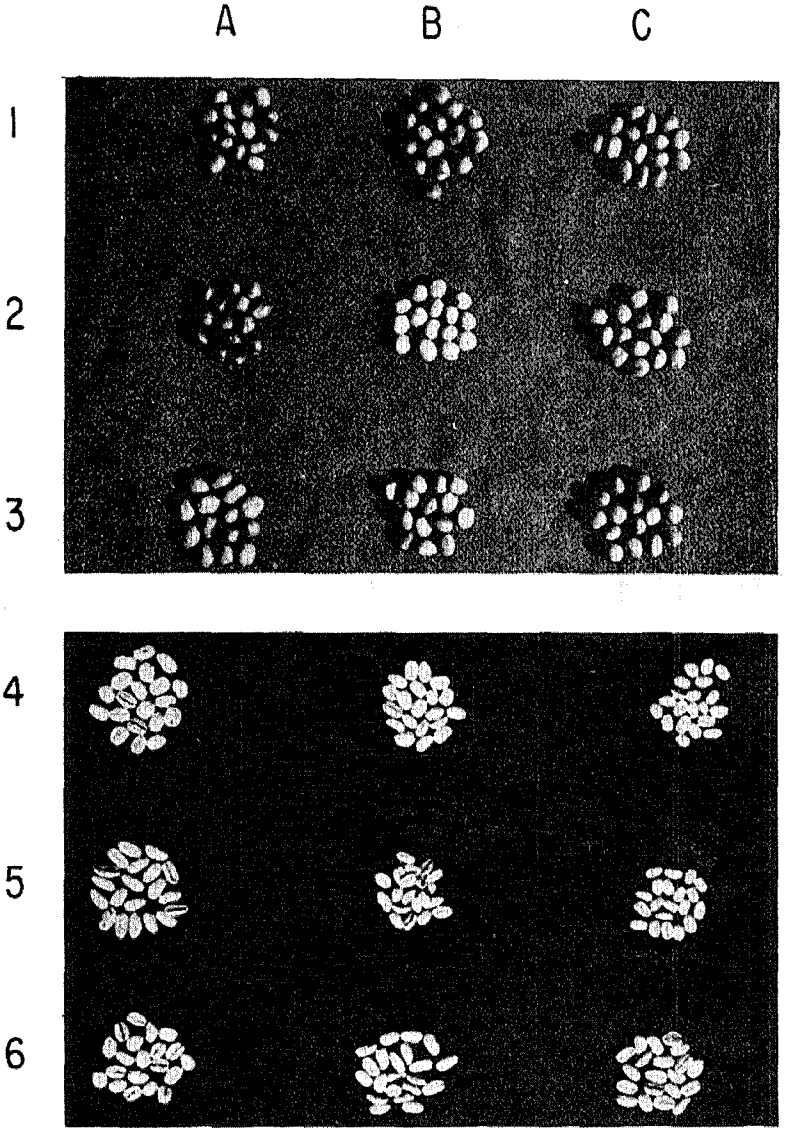


Fig.5: Samples of ripe cherries and pulped coffee collected in the plantation of Teka Egano-Galanti Co., Gera, Kaffa Prov.

A: 1,4(E-330); 2,6(E-332); 3,5(E-347)
B: 1,4(E-351); 2,5(E-342); 3,6(E-345)
C: 1,4(E-341); 2,5(E-346); 3,6(E-350)

The numbers in parentheses represent the field number for each introduction.

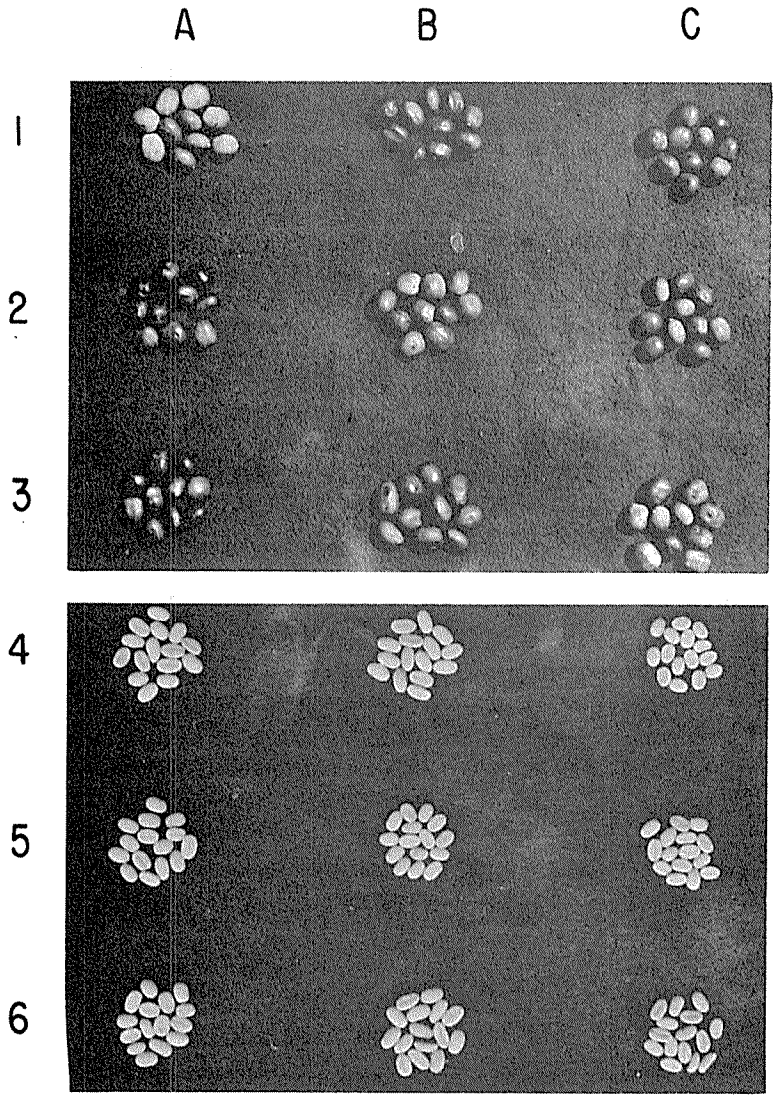


Fig.6: Whole and pulped fruits of samples collected in the Teppi region, Illubabor Prov.

A: 1,4(E-450); 2,5(E-454); 3,6(E-456)
B: 1,4(E-460); 2,5(E-461); 3,6(E-462)
C: 1,4(E-463); 2,5(E-465); 3,6(E-446)

The numbers in parentheses represent the field number for each introduction.

Fig.7: Variation within and between populations of coffee in Ethiopia with respect to fruit length. For each population the length of the horizontal line represents the total variation, the blank space the mean, and the horizontal bar the confidence limit, t 5%, for the character.

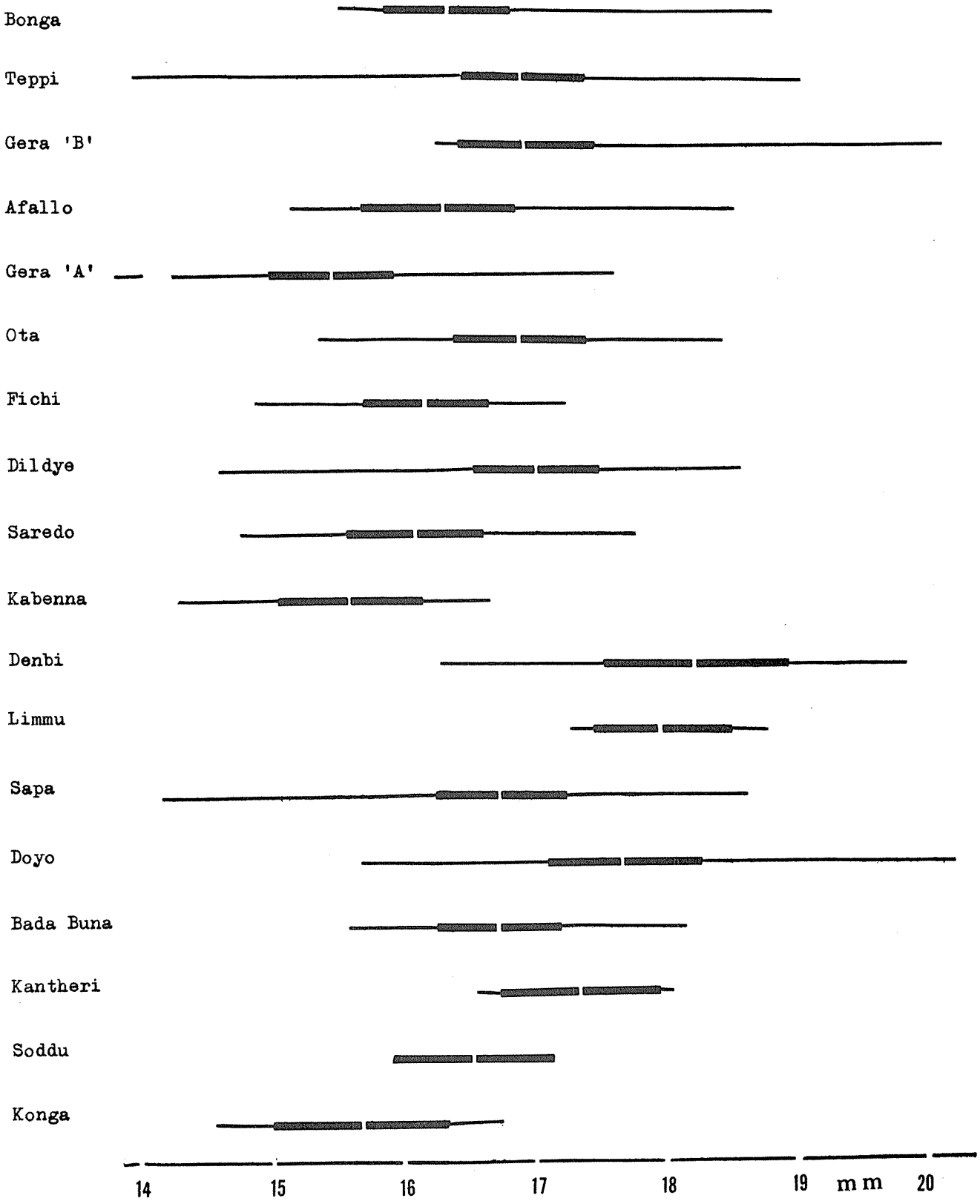


Fig.8: Variability within and between coffee population from Ethiopia for fruit width. For each population the horizontal line stands for the range of variation, the blank space the mean and the horizontal bar the confidence limit, t 5%, for the character.

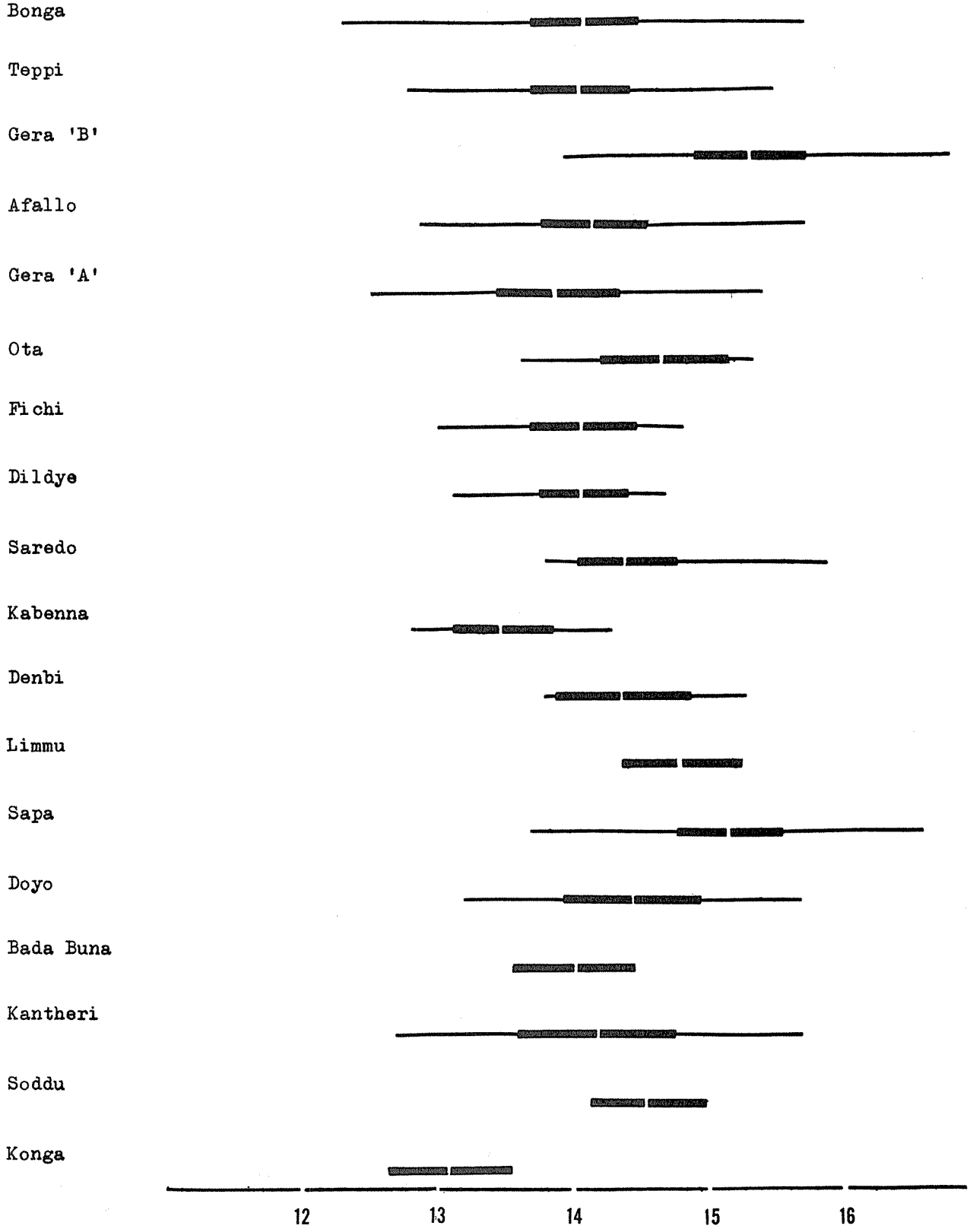
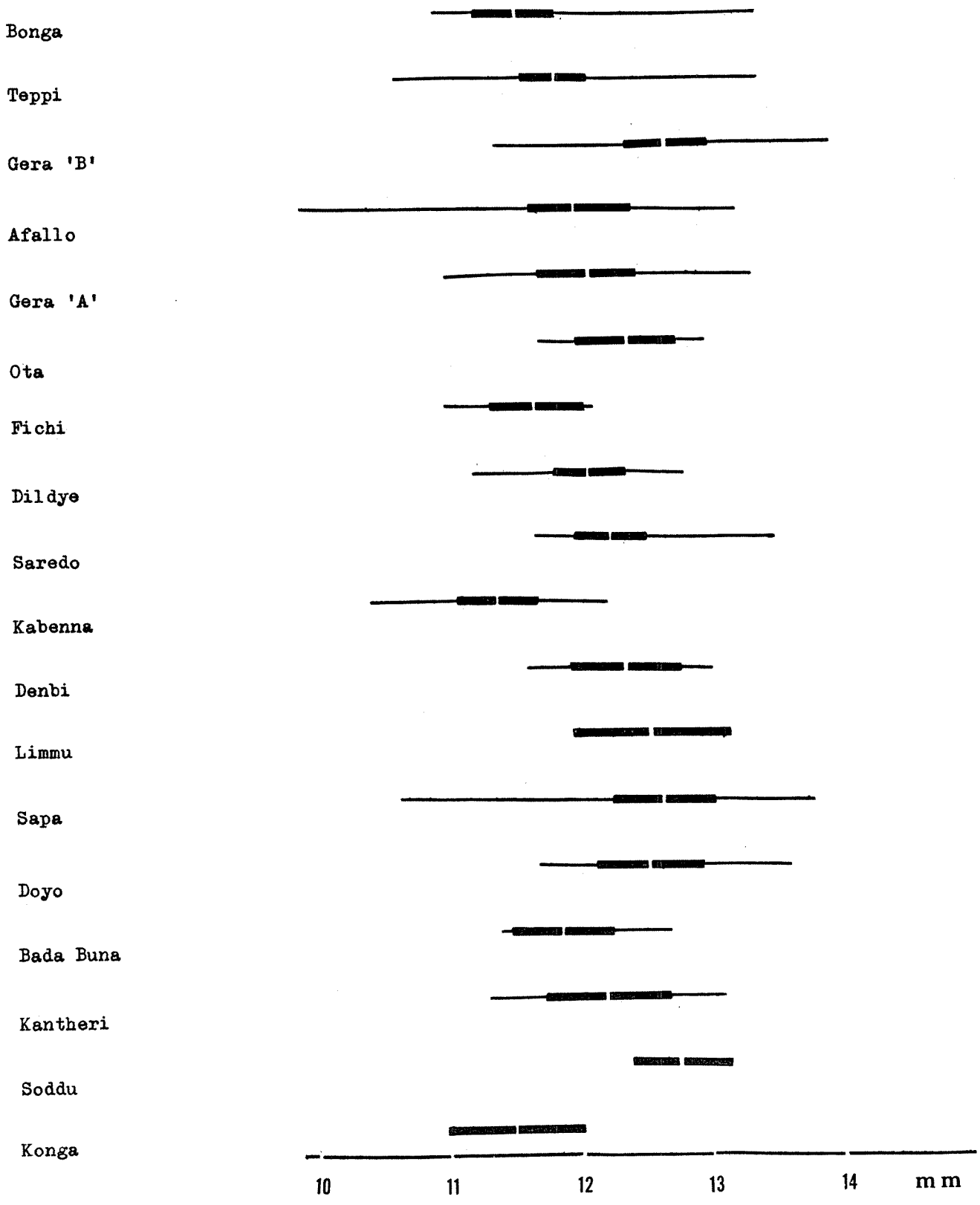


Fig.9: Variation within and between coffee populations from Ethiopia for fruit height. For each population the length of the horizontal line gives the total range of variation, the blank space the mean and the horizontal bar the confidence limit, t 5%, for the character.



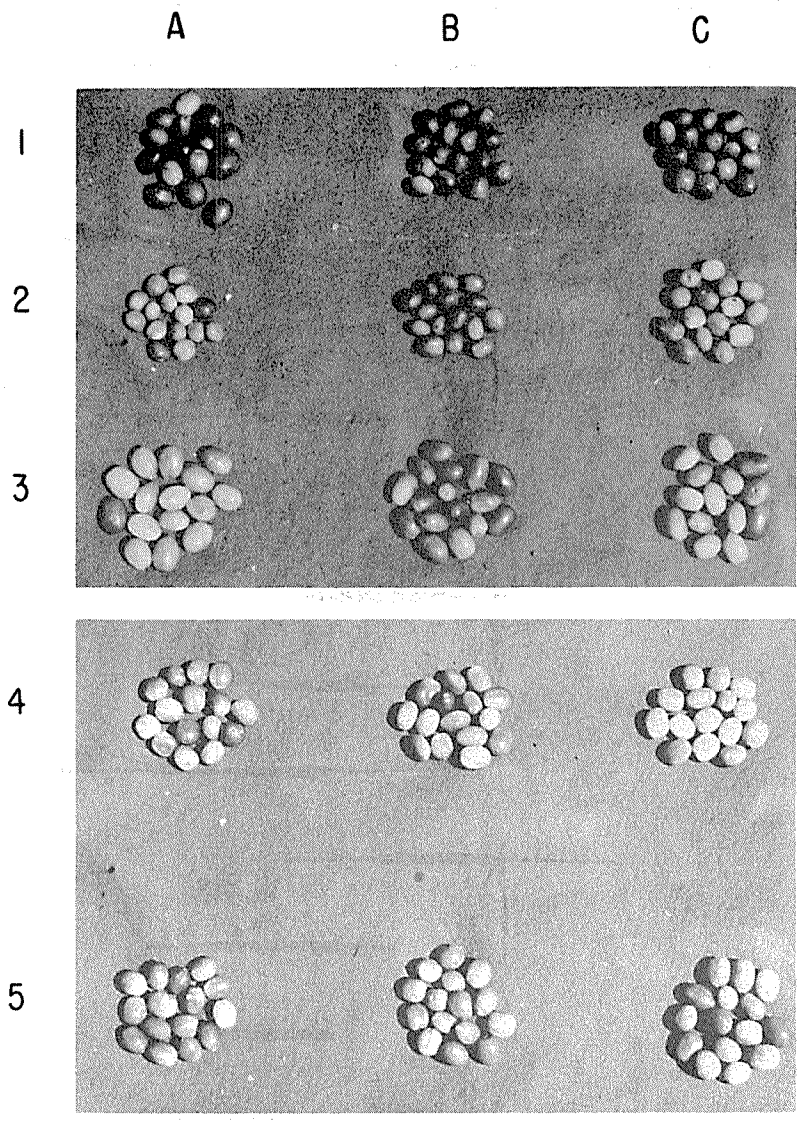


Fig.10: Variation in fruit size from samples collected in the regions of Saredo (1), Kabenna (2), Denbi (3), and Dildye (4 and 5).

A: 1(E-316); 2(E-493); 3(E-310); 4(E-295); 5(E-297).
B: 1(E-320); 2(E-494); 3(E-311); 4(E-294); 5(E-293).
C: 1(E-322); 2(E-496); 3(E-314); 4(E-398); 5(E-296).

The numbers in parentheses represent the field number for each introduction.

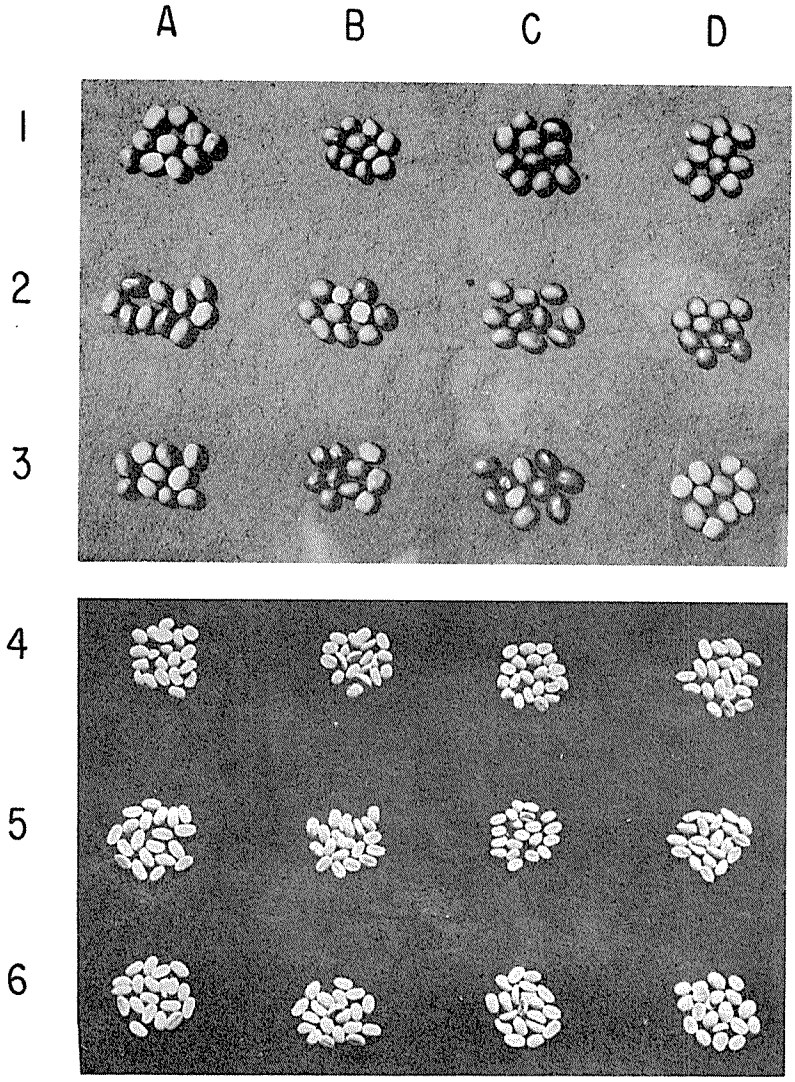


Fig.11: Pulped and non-pulped fruits collected from selected plants in the region of Limmu, Sapa, Saredo, Denbi, and Kabenna, Kaffa Prov.

A: 1,4(E-323); 2,5(E-312); 3,6(E.495)
B: 1,4(E-475); 2,5(E-477); 3,6(E-481)
C: 1,4(E-316); 2,5(E-319); 3,6(E-322)
D: 1,4(E-291); 2,5(E-300); 3,6(E-299)

The numbers in parentheses represent the field number for each introduction.

5. OBSERVATIONS ON COFFEE PESTS IN ETHIOPIA

by
D.J. Greathead
Entomologist
Kawanda Research Institute
Uganda

5.1 INTRODUCTION

Very little published information is available on the pests affecting coffee in Ethiopia. As part of the FAO Coffee Expedition, a survey of coffee pests was therefore attempted. However, in the short time available, it was not possible to visit all the areas where coffee is grown, nor to do more than collect samples and note types of insect damage. Moreover, the season (October-December) at which the expedition visited Ethiopia was not ideal for the study of insect pests, as many are only active either during the rains or when the crop is at an earlier stage of development. For the study of pests other than fruit flies, an ideal visit would be about June, or preferably for the entire cycle.

Although the report presented here gives only a very brief and incomplete picture of coffee insect pests in Ethiopia, it is hoped that this will nonetheless be of use. A list of pests and other insects collected on Coffea arabica is given in Appendix VI.

There is particular interest in coffee pests in Ethiopia as southwestern Ethiopia is believed to be the area of natural distribution of Coffea arabica. In this area coffee still grows under semi-natural conditions, but even where there is apparently untouched coffee, evidence exists of former cultivation (Strenge, 1956). Completely wild coffee may possibly be still found in the forest in the triangle between Gore - Teppi - Gechia, but time did not permit a visit to this area. In areas where coffee was merely being exploited (many places in the Agaro and Limu districts of Kaffa, and between Gore and Mattu in Illubabor) rather than being intentionally cultivated, though pests occurred, none were present in numbers suggesting that they ever caused economic damage, with the possible exception of the leaf skeletonizer (Epiplema sp. near dohertyi). In the other areas and single plots there were a few signs of serious pest outbreaks. The most notable of these was the very high population of Antestiopsis intricata on three plots near Jimma, which are some of the most developed and farthest removed from natural conditions in Kaffa province.

Sylvain (1958) discusses the possibility of the presence of the coffee berry borer, Hypothenemus (Stephanoderes) hampei in Ethiopia. A special watch was kept for this pest, but no evidence of its presence was obtained. Several people including factory managers claimed that Hypothenemus damage occurred in coffee and drew attention to beans with tunnelling in them. This damage is similar to that caused by Hypothenemus but the holes are larger (about 2 mm in diameter as

against 1 mm) and less regular in outline. This damage was found to be caused by berry boring moths (Olethreutes (Tortricidae)). In addition, samples from most coffee growing areas were examined at the headquarters of the National Coffee Board. It is concluded that Hypothenemus is almost certainly absent from Ethiopia.

Previous experts visiting Ethiopia to study coffee have commented on the pest situation. The first was Sylvain (1955, 1958) who noted a leaf-miner, probably Leucoptera sp., a berry moth, Apate sp., and the occasional presence of scales and fruit flies. He was followed by Lejeune (1958) who gives an annotated list of pests with suggested control measures. The list of pests from Lejeune's paper is reproduced by Huffnagel (1961). In the present account Lejeune's records are incorporated and acknowledged, and notes on the pests found included with references to studies which will be of assistance to workers in Ethiopia.

The cooperation of the Commonwealth Institute of Entomology in indentifying the preserved material and giving it priority so that the names could be used in this report is gratefully acknowledged. In many instances they have not been able to give precise identification owing to the relatively poor state of knowledge of the African insect fauna, particularly that of Ethiopia. Before economic entomology in Ethiopia can develop on a sound basis, a detailed survey of insects associated with plants of economic importance will be essential.

Examples of most of the species collected have been retained for the collection of the British Museum (Natural History), London. A set of specimens as complete as possible has been sent to Ethiopia, and the remainder retained at Kawanda Research Station, Uganda, for the time being.

5.2 PESTS OBSERVED

The order of the pests reported below is arranged according to the damage caused.

5.2.1 Pests of vegetative growth

5.2.1.1 Leaf feeders

- Leucoptera caffeina Washbn. (Lepidoptera : Lyonetidae) Blotch leaf-miner.

Coffee trees in all areas visited showed traces of blotch leaf mines. In no area was the damage to the leaves at all common, and very few of the mines were occupied by larvae. It is possible that the miner is more common later in the dry season than at the time of the present survey (in all areas at the beginning of the dry season).

The eggs of L. caffeina are laid on a row along a rib of a leaf, and those of L. meyricki separately in a patch away from a vein. The eggs persist after hatching, and thus their arrangement enables the mines of the two species to be distinguished. Many mines were examined in all the areas visited and all were those of L. caffeina. This is of interest as the two species occur together in East Africa, L. caffeina being almost confined to coffee growing under shade and L. meyricki, though present in shaded coffee, is more common on unshaded coffee (Notley, 1948, 1956). Unshaded coffee was observed around Harar, Chercher Hills, Wondo Anberber and at the Jimma Agricultural Technical School, whereas most other coffee was more or less heavily shaded. No differences in incidence of L. caffeina between shaded and unshaded coffee were noted.

Lejeune (1958) had reported the presence of L. caffeina in Ethiopia, and remarked that it is serious under heavy shade and after rain. In the areas visited, as noted above, there was no indication of a heavier infestation under shade, and it did not look as if serious outbreaks were likely in any of the areas seen.

Samples of mined leaves were taken wherever possible so as to rear parasites and confirm the identity of the host.

The following Hymenopterous parasites were reared :

Elasmidae	Elasmus sp. ?johnstoni Ferr.
Eulophidae	Chrysocaris lepelleyi Ferr.
	Achrysocharis richiei Ferr.
	Pediobius coffeicola Ferr.
Braconidae	Apanteles bordagei Gir.

Except that the Elasmus is probably a different species, the parasites are the same as those in East Africa. Further collecting is likely to extend this list to include others of the parasite complex there.

A similar moth (genus near Leucoptera) was found mining in the leaves of Pavetta aff. oliverana growing amongst coffee on the Zehie Peninsula, Lake Tana Gojjam Province.

- Acrocercops sp. (Lepidoptera : Gracillaridae) Serpentine moth miner.

Acrocercops sp. was found mining in coffee leaves in Sidamo, Kaffa and Illubabor. The mines consist of a sinuous silvery tunnel gradually increasing in width and ending in a whitish blister, usually at the edge of the leaf and causing it to curl upwards. The centre of the mine is almost always marked by a contrasting reddish line of frass which shows through the dorsal surface of the mine. Young fully grown leaves near the tips of shoots seem to be preferred. The mines of this species are less damaging to the leaf and are probably of no practical importance.

This Acrocercops sp. is almost certainly that reported by Lejeune as Gracillaria coffeifoliella Nietn. (Acrocercops caloptilia) from many parts (unspecified) of Ethiopia and in East Africa as A. aletreuta Meyr. (=chalybophanes Mayr.). The diversity of specific names applied to serpentine miners of coffee, and the confusion in pest lists as to the correct genus, indicate the need for caution in coming to conclusions as to the distribution of many of the pests reported from Africa.

The following Hymenopterous parasites were reared :

Eulophidae	Derostenus coffeae
	Cirrospilus sp. 1
	Cirrospilus sp. 2

D. coffeae is also known as a parasite of Leucoptera spp. The two Cirrospilus spp. have not previously been collected.

- Melanagromyza coffeae Konigsb. (=M. coffeae Hering) (Diptera : Agromyzidae) Serpentine miner.

In Sidamo, Kaffa and Illubabor provinces, a small number of the serpentine mines of Melanagromyza coffeae were found. The mines differ from those of Acrocerops sp. in being entirely silverish and ending on the surface, usually away from the margin, in a silvery blister through which the blackish puparium of the fly can be seen. The miner is less common than Acrocerops sp., and equally unimportant.

It is known from Kenya (Le Pelley 1959) and also occurs in Uganda. No specimens were reared to the adult stage, owing to the difficulty of finding occupied mines and the high rate of parasitism always found with this species. Only one parasite was reared in Ethiopia, a Cirrospilus sp. (Eulophidae) different from the two reared from Acrocerops sp. and also previously unknown.

- Epiplema sp. near dohertyi Warr. (Lepidoptera : Uraniidae) Leaf skeletonizer

In all areas visited except Harar and the Chercher Hills, damage due to Epiplema sp. was noted. Except on the Zeghie Peninsula and in Sidamo province most skeletons were old and no larvae were seen feeding. Specimens were reared from Sidamo.

The larvae feed on the undersurface of the leaves leaving the veins and the upper epidermis which results in patches of skeletonised leaf. This pest, if common, can cause defoliation but in none of the areas where it was observed was there sufficient damage to impair the trees. It was noticeably more common in "forest coffee" than under light shade or in the open.

In spite of the caution of the systematists, it would seem likely from field observations that this skeletonizer is in fact E. dohertyi, well known in East Africa as a minor pest.

- Snails

In areas where coffee was growing under dense shade, leaf damage was caused by snails of the genus Africarion (Urocyclidae). This damage was not great on well grown trees but would be serious in nurseries if they were established under such conditions.

- Other leaf and nursery pests

No pests were seen in coffee nurseries nor were leaf feeding insects noted other than the miners, skeletonizers and snails.

Lejeune (1958) reports the following pests :

Agrotidae	Agrotis segetum Schiff.	Arussi province
Tenebrionidae	Gonocephalum simplex F.	Harar and Arussi provinces
Gryllidae	Brachytrupes membranaceus Drury	Various regions

None of these are specific pests of coffee but are general feeders which have been reported from many unrelated plants (e.g. see Le Pelley, 1959). Similarly Plusia sp. (Agrotidae) was reared from a larva found on a leaf at Wondo Anberber during the present survey.

5.2.1.2 Sucking insects

- Scale insects (Hemiptera : Coccidae)

Sporadic small outbreaks of scale insects, usually affecting only a few trees, were observed where ants were in attendance. As usual on coffee in Africa scales showed every appearance of being kept under control by their natural enemies in the absence of ants. In these circumstances control is easily effected by painting the base of the trunk with a dieldrin solution so as to exclude ants and allow natural enemies to control the scales.

Small infestations of Coccus alpinus de Lotto (green scale), a small flattened greenish scale affecting leaves and young shoots, were found in Harar province at Combolchia and Hirna, on coffee growing in the open. The ant Monomorium sp. was associated. The Hymenopterous parasites Aphytis sp., Coccophagus sp. (both Aphelinidae) and Metaphycus sp. (Encyrtidae) were reared from a sample at Hirna. Lejeune (1958) reports this scale as the commonest in Harar and Arussi, using the name Lecanium africanum which is incorrect (de Lotto 1960). C. alpinus also occurs in East Africa.

Ctenochiton arborescens Laing was associated with C. alpinus at Combolchia. This is a small whitish scale with a papillate margin. This is presumably the scale referred to as Asterolecanium by Lejeune (1958).

Selenaspidus articulatus Morgan, a greyish limpet-like scale was found on leaves at Yirgalem in Sidamo but was not common.

Stictococcus formicarius Newst. was the most common scale in Kaffa and the Gore - Mattu area of Illubabor, but unless ants were present, as at Wush-Wush plantation near Bonga in Kaffa where Crematogaster ?africanus Mayr was in attendance, and Mattu where Myrmecaria eumenoides Gerst. was in attendance, only isolated individuals were present. This is a brown cushion-like scale feeding on twigs, petioles and peduncles. One specimen of the Hymenopterous parasite Coccidioxenos sp. (Encyrtidae) was reared from the Mattu sample.

Rolaspis sp., a mussel-like scale, was present in small numbers at Jimma Agricultural Technical School. Odd individuals of Ceroplastes sp., a white waxy scale, and Pseudococcus sp., a mealy bug, were also seen in the Jimma area.

- Toxoptera aurantii Boy. (Aphididae) Green fly

This widespread (see C.I.E. Map No 131, 1961) and polyphagous aphid is present on coffee in Ethiopia. It was previously reported from Ethiopia by Lejeune (1958) under the synonym T. cammeliae Kalt. In the present survey it was found in small numbers in the Harar area, Sidamo, Welkite in Shoa and in Kaffa. The young coffee shoots are attacked and can be damaged but it is unlikely to be important.

- Capsid bugs (Hemiptera : Miridae)

Odd individuals of mirid bugs were found on young shoots at various localities in Kaffa. The five collected belong to four genera and only two, from the same locality, are referred with doubt to Lygus coffeae China which is a pest in East Africa. Owing to the rarity and absence of symptoms on the plants it is not possible to decide whether any of these were merely resting on coffee or feeding on it. However, the presence of mirids attacking coffee is likely, but the small numbers found suggest that mirids are not important in Kaffa province.

- Antestiopsis spp. (Hemiptera : Pentatomidae)

Antestiopsis is more important as a pest of fruits and is discussed under 5.2.2. When it feeds on young shoots repeated branching occurs causing the production of many unproductive shoots.

5.2.1.3 Stem borers

- Moth borer (Lepidoptera : Cossidae)

The coffee field officer at Yirgalem reported the presence of a stem borer. He was able to show examples of the damage caused by the borer, which consisted of borings in the young wood of the tip of the main stem causing die-back. In the time available it was not possible to find living examples of this pest; however, a preserved mature larva of a coccid was produced.

This pest is said to cause considerable damage in the area, and may account for references by growers to the "white borer".

- Other borers

No signs of other stem borers were seen, but the white borer (Anthores leuconotus) was said to occur in Sidamo especially in the Wondo Anberber area.

The presence of the following coleopterous borers has been reported by previous investigators :

Cerambycidae (Lamiinae)

Anthores leuconotus Pasc.	-	Kaffa (Lejeune, 1958)

Bostrychidae

Apate monacha F.	-	Kaffa, Arussi (Lejeune, 1958)
A. indistincta Murray	-	Shoa (Ambo) (Lejeune, 1958)
Apate sp.	-	Wollega (Ghimbi) (Sylvain, 1955)

All these species are known from East Africa. A. leuconotus appears to be confined to the eastern part of tropical Africa, and A. monacha is widespread in tropical Africa (Coste, 1955).

It is possible, as Lejeune does not report A. leuconotus from Sidamo, that the reports of A. leuconotus from the area refer to the moth borer.

5.2.2 Fruit pests

5.2.2.1 Antestiopsis spp. (Hemiptera : Pentatomidae)

In Sidamo, Kaffa and Illubabor, A. intricata (Ghesq. & Car.) is present, generally at a very low level (i.e. less than one per ten trees examined). Its general distribution is from the Ivory Coast to the extreme west of Kenya, and south to Katanga through Kivu in the Congo (Greathead, 1966a). It has thus a typically West African distribution. Throughout most of its range it increases in numbers on cultivated coffee to well above the accepted danger level (in most

parts of East Africa regarded as two per tree) unless controlled with insecticides. In the places where it was observed in the present survey it would appear to be under natural control as no outbreaks are reported and the growers are unaware of its presence. On the coffee plots at the Jimma Agricultural Technical School and the Experimental Farm at Giren, and also at the plantation at Doyo near Jimma belonging to Ato Teka Egano, the situation occurring elsewhere within its range prevails. Counts of up to 120 per tree have been made at the Agricultural School in Jimma (Ato Yilma Yemane Barhan, personal communication). The coffee in these places shows excessive branching caused by Antestiopsis as a result of which the trees have become very dense.

In these places it appears that the natural balance is upset. In the time available it was not possible to investigate the causes, particularly as it was so difficult to find any Antestiopsis in other localities. At harvest time when there are no large green fruits, the preferred and most satisfactory food both for survival and for egg production (Le Pelley, 1942), the population falls off dramatically and does not increase again until the new crop begins to develop. The fall-off was apparent in that there were on a rough estimate not more than 10 Antestiopsis per tree in mid-November compared with the high counts obtained earlier in the season. A comparison of population dynamics with special reference to mortality factors on the Jimma School coffee and on a nearby "forest" should produce valuable information.

The plots where these outbreaks have occurred require action to control the population of Antestiopsis. The immediate necessity is pruning to reduce the dense cover which provides shelter required by the bugs. Then if populations remain at a dangerous level, spraying with a non-persistent insecticide should be instituted. An increase in shade would probably also reduce the population through helping to prevent the coffee trees becoming over dense.

There were no parasites in the two clutches of eggs found at Jimma, which were the only eggs found. Nymphs also were rare and did not yield parasites. Among the sample of 18 adult Antestiopsis from the Jimma Agricultural Technical School, three were found with the extruded stages of a Strepsipteron which as far as could be determined correspond with Corioxenos antestiae Blair which occurs in parts of East Africa (Kirkpatrick, 1937). The egg of Tachinid, presumably a species of Bogosia, was found on a specimen in a sample of 13 adults from Ato Teka Egano's estate at Doyo near Jimma.

These records suggest that some, at least, of the parasites known in East Africa are also present in Ethiopia (Greathead, 1966b).

At a single locality, Sabata, near Addis Ababa, a second species of Antestiopsis was found on some coffee trees growing near the Ghion Restaurant. This was A. orbitalis ghesquierei Car., a form previously known from the Western Congo, and localities around the shores of Lake Victoria (Greathead, 1966a).

It is the western subspecies of an extremely variable species which had not previously been detected north of Mount Kenya. It is of interest that the locality is at a relatively very high altitude and in a different vegetation zone. The distribution of A. intricata seems to be linked with the distribution of forest and that of A. orbitalis with drier savannah and deciduous woodland vegetation.

5.2.2.2 Olethreutes sp. (Lepidoptera : Tortricidae) Berry boring moth

In all areas visited bored cherries were noted. Where small green fruits (i.e. at Zeghie, Harar area, Sidamo) were found, a few larvae were observed boring into groups of fruits leaving an entrance hole about 2 mm in diameter and masses of dark granular frass between the fruits. Large green fruits and ripe fruits were being attacked but many more showed scars or holes from attack when the fruits were smaller. Examination of the beans in damaged fruits showed simple borings with a rather uneven roughly circular entrance hole in lightly damaged fruits, and partial or complete destruction of the bean where damage was heavy. This bean damage was also observed at coffee factories and in samples of prepared coffee. The larvae move from one fruit to another in a cluster, feeding on the developing beans. In the early stages several fruits at the same node are found exhibiting damage, but as severely damaged fruits do not develop but dry up and are shed, only one or two damaged fruits are found.

As the caterpillars are active when the fruits are young, few caterpillars for rearing were obtained. Only one adult was reared and it has been identified as an Olethreutes sp. female.

Lejeune (1958) lists only one berry borer, the Pyralid Prophantis smaragdina (Butler) (Thliptoceras octoguttale) from Kaffa. The appearance of the damage caused by this moth, though similar to that of Olethreutes, differs in that the webbing is spun between the fruits. Webbing was not noticed in the present survey, and it is concluded that the principal borer in Ethiopia is Olethreutes sp., though T. octoguttale, which is the principal species in East Africa, and other boring moths are probably also present.

Crop losses due to this pest must be high as partly damaged beans are common in processed coffee and the more seriously damaged beans would never reach this stage. Owing to the season it was not possible to make more observations as in most areas the susceptible stage was long past.

5.2.2.3 Trypetidae fruit flies

The larvae of fruit flies are practically universal in ripe fruits. As they feed on the pulp of the fruit and do not damage the beans they are not serious pests, and control measures against them are not necessary. In the Congo, Stolp (1960) has concluded that they are a cause of a taint, so they are of potential importance.

Two species, Ceratitis rosa Karsch, the Natal fruit fly, and Trirhithrum coffeae Bezzi, were reared, and also seen as adults on coffee trees. The first is a well-known pest of fruits in eastern and southern Africa (C.I.E. Map 153, 1963). It has previously been recorded from coffee in East Africa (Le Pelley, 1959). T. coffeae was previously known from coffee in East Africa (Munro 1934, Le Pelley 1959) and also the Congo and Cameroon (Coste, 1955).

Two Braconid parasites were reared from a sample containing both C. rosa and T. coffeae from the Bada Buna forest near Jimma. These have been identified as an Opius (Biosteres) sp. near desideratus Bridw. and an Opius sp. of the africanus Szepl. group.

Lejeune (1958) reports Ceratitis capitata, the Mediterranean fruit fly, from coffee cherries. This species can easily be confused with C. rosa and his may be an erroneous report. If not, it is the first record of this pest from Ethiopia (see C.I.E. Map No 1, 1951).

5.3 AREAS VISITED AND PESTS NOTED

5.3.1 Gojjam Province

- Fenote Selam, elev. 5,700 ft. (1,730 m) (25 October)

A small isolated area of densely growing unpruned coffee growing under heavy Albizzia shade was visited. The crop was only just beginning to ripen. Traces of Leucoptera were seen and each tree showed signs of damage by Epiplema. As in other places with very heavy shade, some leaf damage is caused by snails.

- Zeghie Peninsula, Lake Tana, elev. 5,600-5,800 ft. (1,700-1,780 m) (26 October)

The entire peninsula is covered with forest trees with coffee growing beneath, under deep shade and completely unpruned. A few old Leucoptera mines and traces of Epiplema damage were seen. A few cherries were attacked by Olethreutes.

5.3.2 Harar Province

- Harar area, Chercher Hills, elev. 6,000 ft. (1,820 m) (5 November)

Owing to the spread of the cultivation of Chat (Catha edulis), little coffee is now growing in the northern drier part of the Chercher Hills. Coffee in this area is mainly growing in the open and is often irrigated. In this area Coccus alpinus is common but other pests appear to be unimportant. Damage caused by Leucoptera, Olethreutes and Epiplema was noted and a few young shoots attacked by Toxoptera aurantii also seen.

- Asbe Teferi area, elev. ca 5,200 ft. (1,580 m) (6 November)

Probably owing to higher rainfall, coffee in this area was in good condition. Few signs of pests other than Coccus alpinus were seen, and this only where it was attended by ants. It was interesting to note that Leucoptera, though rare, was more severe on coffee under shade than in adjoining unshaded plots.

5.3.3 Shoa Province

- Wondo-Genet area, elev. 5,900 ft. (1,800 m) (10 and 13 November)

The Wondo-Genet area which lies along the base of the wall of the Rift Valley is heavily cultivated, mostly in large plots or on estate scale. Except for the lack of pruning, coffee is well cared for and under light planted shade or in the open. Antestiopsis was found, but at well below the economic level. All three leaf miners were present, but only Acrocercops was common. Most trees seemed to have a few mines but as the damage is negligible growth is not affected. Epiplema was also present but uncommon.

There were reports of damage to trees being caused by the white stem borer but no examples could be found.

5.3.4 Sidamo Province

- Yirgalem area, elev. 6,000-6,200 ft. (1,820-1,880 m) (11 November)

This area appears once to have been Podocarpus gracilior forest and scattered trees of great size still exist. Coffee is grown in small peasant plots often intermingled with the false banana (Ensete ventricosum)and in large plots and small estates. Epiplema and all the leaf miners were present though rare, as was Antestiopsis. A coccid borer attacking the tip of the main stem and thus stopping further growth appears to be common in the area.

- Wondo, elev. ca 6,000 ft. (1,820 m) (11 November)

Coffee around Wondo was in poor condition often dying owing to the lack of weeding. Couch grass was particularly bad. Under these conditions pests have little effect on cropping, only the leaf miners and Epiplema were noted.

- Dilla area, elev. 5,600-6,500 ft. (1,700-1990 m) (12 November)

Dilla lies in what appears from the vegetation to be a drier area than Wondo or Yirga Cheffe. Some very old trees were seen. Epiplema was common and damage due to Antestiopsis and Olethreutes seen in processed coffee examined at pulperies.

- Yirga-Cheffe, elev. 6,300-6,800 ft. (1,910-2,090 m) (12 November)

An area of high evenly distributed rainfall, completely covered with forest trees under which crops are grown. Small peasant plots of coffee seen here were the most vigorous and healthy looking seen anywhere.

Epiplema and Olethreutes were the commonest pests, though neither was very common. Leucoptera, Melanagromyza and Toxoptera were also present in small numbers on most trees.

5.3.5 Shoa Province

- Welkite, elev. 6,600 ft. (2,000 m) (16 November)

In the cultivations surrounding Welkite and neighbouring villages small plots of coffee occur among false banana in an otherwise exposed grassy landscape. The trees were not in very good condition and moderately attacked by Acrocercops and Toxoptera. Leucoptera and Epiplema were also present.

- Sabata, elev. 7,800 ft. (2,390 m) (15 November)

The remains of a small plantation growing around the Ghion Restaurant are chiefly noteworthy for the high altitude at which the trees are growing, and the presence of Antestiopsis orbitalis ghesquierei which was not found elsewhere.

5.3.6 Kaffa Province

- Bada Buna Forest, elev. ca 5,700 ft. (1,730 m) (17 November)

This is an open secondary forest of dry appearance with abundant traces of terracing indicating its status. The coffee growing there was very straggly with weak stems and little crop. Epiplema can be common judging from the many damaged leaves. Acorcercops and Olethreutes damage was also common, whereas Leucoptera caffeina was very rare.

- Jimma area, elev. 5,600-5,800 ft. (1,700-1,780 m) (17-25 November)

In the neighbourhood of Jimma, a number of plots of coffee grow under cultivation. Those at the Jimma Agricultural Technical School, Gerin Experiment Station and Ato Tekka Egano's estate at Doyo were examined. All were heavily infested with Antestiopsis. Both as a result of Antestiopsis damage, lack of pruning and growth in the open these trees were extremely dense, encouraging Antestiopsis further. This is of great importance indicating that although Antestiopsis is rare under the more natural conditions of shaded coffee, it is a potentially serious problem as estate growing develops. Most of the other pests recorded in this report were also present as rarities.

- Agaro and Limu, elev. 4,800-6,000 ft. (1,480-1820 m) (18-23 November)

In the districts of Agaro and Limu, all gradations from "coffee forest", i.e. exploited forest with semi-wild coffee, to estates are to be found. In the forests coffee grows into tall straggly trees which are not touched except at harvest time when the undergrowth is cut out to facilitate picking. It is thus very variable in age and condition. There, Antestiopsis, though present, was very rare. Leucoptera caffeina, Acrocercops and Olethreutes also were rare. The commonest pest was Epiplema which though not active at the time was judged to be the most important pest, although probably seldom abundant enough to cause sufficient defoliation for control to be worthwhile. Damage by Africarion was frequent in the forests.

On the estates the nurseries were particularly impressive both in their layout and upkeep, and in the absence of pests, though curworms, white grubs and snails doubtless cause losses at times. The older coffee on these estates was also remarkably pest free; though most of the pests listed were found, none were seen in large numbers.

- Wush-Wush plantation, elev. ca 6,000 ft. (1,820 m) (20-21 November)

This plantation cut out of secondary forest near Bonga represents an attempt at large scale estate production, but the rainfall seems to be too high for an ideal coffee area. The coffee was growing under high thin shade and mostly very straggly and held back by weed competition. No pests were at all abundant though Epiplema, the three leaf-miners, Olethreutes and Stictococcus were present.

Small plots nearby on the Bonga road were in better condition and likewise not severely attacked by pests.

5.3.7 Illubabor Province

- Gore - Mattu area, elev. 5,200-5,800 ft. (1,580-1,780 m) (25 November)

Coffee grows here under the same conditions as in Kaffa, although the area is more isolated and less exploited. In one plot at Alle, Antestiopsis was estimated to be close to the economic level of two per tree and is clearly potentially important. A bad infestation of Stictococcus was seen in a plot on the banks of the Sor river. Like other coccid infestations observed, it was induced by ants and would almost certainly disappear if these were controlled.

5.4 CONCLUSIONS AND RECOMMENDATIONS

Allowing for the short time of the survey and the unsuitable timing for the study, it was concluded that pests seldom if ever are of importance in "coffee forests", but that in plantations outside forest, especially in the absence of shade, pests can cause damage sufficient to warrant control measures. To anticipate such outbreaks, studies of the reasons for these are required. It is of particular interest to other coffee growing countries that studies of Antestiopsis spp. should be made to discover the reasons for its extremely low incidence in "coffee forests", as Antestiopsis spp. are the most important insect pests of Arabica coffee in most parts of Africa where the crop is grown. Losses of crop in Ethiopia from Olethreutes sp. should be assessed, as control of this pest will probably prove desirable. Hypothenemus hampei is considered to be absent from Ethiopia. It is of interest to note the absence of Leucoptera meyricki, which is the more important of the two species of Leucoptera attacking Arabica coffee in East Africa, and that in Ethiopia L. caffeina occupies its habitat.

Any further expeditions to investigate coffee pests should either make their visit earlier in the season, or preferably follow through the cropping cycle if time is available.

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APPENDIXES

APPENDIX I

ITINERARY OF THE FAO COFFEE MISSION

15 October 1964 to 15 January 1965

by

F.G. Meyer
(in cooperation with
members of the Mission)

Early in the Mission it was agreed among the official members that objectives could best be accomplished in the limited time available by dividing personnel into groups, since each member came with separate objectives. The following breakdown is intended to benefit readers wishing to follow field activities of each member of the Mission. (See Appendix IB for separate itineraries of Bolton, Fernie and Greathead)

October 24 - 28:	Entire Mission together with Ethiopian colleagues, except Monaco, who did not arrive until November 9.
November 1:	Meyer and Narasimhaswamy together.
November 3-7:	Entire Mission together, except Monaco.
November 10-29:	Fernie and Greathead together. (See Appendix IB)
November 10-24:	Meyer, Monaco and Narasimhaswamy together with Ethiopian colleagues on some days.
November 25-26:	Monaco and Narasimhaswamy together.
November 26:	Meyer solo.
November 29 - 3 December:	Meyer, Monaco and Narasimhaswamy together.
November 30 - 5 December:	Bolton and Fernie together. (See Appendix IB)
December 7:	Fernie solo. (See Appendix IB)
December 8-12:	Meyer, Monaco and Narasimhaswamy together with Ethiopian colleagues.
December 17-24:	Meyer and Narasimhaswamy together with Ato Makonnen.
December 27:	Meyer and Narasimhaswamy together.
December 29 - 21 January:	Meyer solo until end of Mission.

APPENDIX IA

ITINERARY OF F.G. MEYER, L.C. MONACO AND R.L. NARASIMHASWAMY AND ETHIOPIAN COLLEAGUES

(Includes itinerary of L.M. Fernie and D.J. Greathead to 9 November)

October 14: Addis Ababa	L.M. Fernie, coffee breeder from Tanzania and D.J. Greathead, entomologist from Uganda, arrived Addis Ababa, as part of the Coffee Mission team.
October 15: Addis Ababa	F.G. Meyer arrived from U.S.A. Visit to Ministry of Agriculture where a small collection of coffee is cultivated in the compound.
October 19: Addis Ababa	R.L. Narasimhaswamy, coffee breeder arrived from India (October 14-23 covers the preparation period in Addis Ababa.)
October 24: Addis Ababa - Debre Marcos	Left Addis Ababa, with two Land Rovers, a Chevrolet pickup truck, and a party of nine, including four members of the Mission, in addition to F. Bolton, an American instructor at Jimma Agricultural Technical School, and four Ethiopian colleagues, Ato Worku Makonnen, Dr. Dagnatchew Yirgou, Ato Abebe Abaya, and Ato Yilma Yomano-Barhan. Our destination was Zeghie Peninsula, Lake Tana, Gojjam province to see coffee cultivated at this place. The all-weather road north from Addis Ababa follows through relatively flat and treeless countryside, typical of the higher parts of the central plateau of Ethiopia, with an average elevation of about 8,000 ft. (2,340 m.). Tef (Eragrostis tef), wheat barley, and broad bean (Vicia faba) are the principal crops in this rich agricultural area. Wheat and barley were still green, with harvest to follow in December-January. Ethiopia is the only country of tropical Africa with sufficient elevation where small grains are grown in abundance. Near the gorge of the Blue Nile River, the road reaches an elevation of 9,100 ft. (2,770 m.) but drops to 7,700 ft. (2,350 m.) at the south rim of the gorge and to 3,000 ft. (910 m.) at the river. The gorge is 18 km. wide from rim to rim. The fine new road in the gorge is a great improvement over the endless hairpin curves of the old tract. The Frankincense tree (Boswellia papyrifera) and Tamarid (Tamarindus indica) occur in some abundance toward the bottom of the gorge. The Blue Nile at this point forms the boundary between Shoa province on the south and Gojjam province on the north. The northern rim of the gorge stands at an elevation of 7,500 ft. (2,290 m.), or 200 ft. (60 m.) lower than the southern rim. After again reaching the plateau the gravel road continues north with only slight deviation in altitude to Debre Marcos, elev. 7,800 ft. (2,380 m.) where the team stayed the night. The town is situated in a forest of planted eucalyptus trees, which is characteristic of many Ethiopian towns on the plateau.

The eucalyptus was introduced to Ethiopia in the 1890's from Australia to alleviate the critical wood shortage which prevails over much of the country.

October 25:

Debre Marcos - Bahar Dar (Lake Tana) (272 km.)

Midmorning stop at Finote Selam, 74 km. north-northwest of Debre Marcos, about 10°42'N., 37°10'E, elev. 5,750 ft. (1,750 m.), to observe cultivated coffee. Coffee plants in this region are grown under the shade of indigenous trees, such as Albizia schimperiana, Cordia africana, Millettia ferruginea, and Ficus lasta. Coffee is planted randomly at intervals of about 6 ft. (2 m.) resulting in a tangle of plants and a low fruit set. Ripe fruit was collected. Plantings in this area are relatively small and of no great importance commercially. A farmer reported that his plants had been grown from seed brought from the Zeghie Peninsula and from Harar province. Arrived Bahar Dar at 5.00 p.m. at the southernmost end of Lake Tana.

October 26:

Zeghie Peninsula (day trip)

Group crossed Lake Tana by motor launch to Zeghie Peninsula where the Arabica coffee plant is cultivated. The Peninsula is almost entirely surrounded by the lake with a higher humidity and greater precipitation than adjacent mainland areas, thus the area is favourable for growing coffee. The Peninsula is completely forested with indigenous vegetation. Coffee is planted under heavy shade of native trees, the most abundant being Albizia schimperiana, Millettia ferruginea, Cordia africana, Ficus sp., and Croton macrostachys. In the shrub understory Coffea arabica is associated with native shrubs, such as Solanum giganteum, Ruttya fruticosa (Acanthaceae), Pavetta aff. oliverana, and Randia urcelliformis both Rubiaceae. Herbaceous weeds include Cardamine trichocarpa (Cruciferae), Solanum nigrum sensu lat., Sida rhombifolia, Impatiens sp., and Drymaria cordata (Caryophyllaceae). Coffee is grown for local consumption only on Zeghie Peninsula. There was no evidence of coffee leaf rust (nor on a later visit in January). Coffee plants were heavily laden with green fruit about two-thirds mature. Ripe fruit was collected on a second trip to Zeghie in January. (See January 13 entry)

October 27:

Gondar

Visited the Tisisat Falls of the Blue Nile River, 32 km. south of Bahar Dar. Now in flood stage, the falls at this period were nearly a mile wide and dropped 150 ft. (45 m.) into a narrow chasm. A hydro-electric power plant recently completed at the falls will be used for the development of industry in this part of Ethiopia.

Group (except Meyer) spent the night at Gondar, and observed coffee cultivated in the town but in small quantities of no commercial importance. James Bruce (1790) reported coffee at Gondar during his long stay in the town during the 18th century.

October 28:
Bahar Dar - Debre Marcos (272 km.)

Entire party reassembled in Bahar Dar for return to Addis Ababa. Stopped for the night at Debre Marcos.

October 29:
Debre Marcos-Addis Ababa (305 km.)

Left Debre Marcos at 8.30 a.m.; arrived Addis Ababa at 5.15 p.m.

November 1:

Debre Zeit (47 km.)

Meyer and Narasimhaswamy visited Central Experiment Station at Debre Zeit, 47 km. south of Addis Ababa, elev. 6,500 ft. (1,980 m.). This research facility is perhaps the most important station of its kind in Ethiopia for trials on cereal crops. Nearby a small field was planted to coffee, grown in rows, mostly in full sun. Damage to the plants and cherries due to sun scorch was evident. A few coffee plants were in better condition under shade of Cordia africana trees. No leaf rust was observed. Fruit was collected under number E-5.

November 2:
Addis Ababa (Entoto Hills)

Addis Ababa. Afternoon field trip to Entoto Hills.

November 3:

Awash (225 km.)

Second field trip left Addis Ababa, 11.30 a.m., with two Land Rovers, a Mercedes truck and a party of nine, for Chercher Hills in Harar Province where coffee is extensively grown. The asphalted road south of Addis Ababa passes through Akaki (25 km.) to Debre Zeit (47 km.), thence to Nazreth. From Nazreth the road continues over a good to not-so-good gravel tract through scrub desert country and a game preserve. Stopped for the night at Awash, a village and refueling stop on the Ethiopian railroad located on the Awash river.

November 4:

Awash - Harar (275 km.)

Left Awash 7.30 a.m. and reached the western end of the Chercher Hills at Asbe Teferi, elev. 5,200 ft. (1,585 m.), 9°5'N., 40°50'E., at 10.30 a.m. A fine new road winds through the cool Chercher Hills east of Asbe Teferi at an elevation mostly over 6,000 ft., at one place reaching 7,800 ft. (2,380 m.). The area is largely deforested, except in deep valleys. In the higher parts the commonest trees are Podocarpus gracilior, Cordia africana, Juniperus procera, and Hagenia abyssinica. Sweet potatoes, Impomoea botatas, are much grown on terraced slopes at an elevation of about 6,000 ft. (1,830 m.), and coffee plantings were observed mostly between 5,000 and 6,000 ft. elevation. Coffee is grown on terraces, mostly without shade but occasionally under Cordia africana and Croton macrostachys, and the plants are sometimes irrigated, as in the Yemen. Coffee leaf rust (Hemileia vastatrix) and the parasite (Verticillium hemileiae) were found together on coffee leaves, but leaf drop observed may not have been entirely due to coffee leaf rust, since other conditions, such as drought, could aggravate leaf drop. Stopped to see College of Agriculture and Mechanical Arts at Alemaya, near Harar. This institution is the leading agricultural school in Ethiopia at the college level. Arrived in Harar city at 6.00 p.m.

November 5:

Harar - Colbolchia - Dire Dawa

Team visited Harar market where coffee is sold in various forms (e.g., unroasted bean; broken leaves for tea infusion (Kuti); broken hulls for tea infusion (Hashara); and unripe green fruit for a kind of cake (Buna Wahbera). Tea infusion made from yellowed (prior to falling) and dried leaves of the coffee plant is widespread in Harar and in some other parts of Ethiopia (see entry for December 23). Visited coffee fields at Combolchia. 17 km. north of Harar city, elev. 6,300 ft. (1,930 m.), where Arabica coffee is cultivated in small plots, 100 ft. by 25 ft. up to an acre in size. No coffee leaf rust observed. The elevation is perhaps a little too high and drought too severe for maximum success in growing coffee at this altitude. Sun scorch affects the leaves and cherries and frost is a threat in November. Without irrigation, coffee growing would hardly be possible, since the long dry season lasts from the end of September until the end of March. Khat or Chat (Catha edulis) is widely cultivated in Harar and competes with coffee as an export product. Visited several small coffee holdings along main road, about 5 km. northwest of Harar on Dire Dawa road. Stayed the night at Dire Dawa, a desert town, elev. 3,400 ft. (1,035 m.). An airport located here serves the Harar area.

November 6:

Dire Dawa - Awash (275 km.)

Left Dire Dawa at 8.00 a.m. for return to Addis Ababa. The eastern end of the Chercher hills is drier than the western end near Asbe Teferi. Stopped at Ehro's coffee farm at Hirna village to observe typical Harar coffee in cultivation, elev. 5,100 ft. (1,560 m.), 143 km. west of Dire Dawa. In Harar province coffee is often grown by Arabs in full sun on terraces and often irrigated by cultural techniques similar to those used in the Yemen (Sylvain, 1956). Coffee leaf rust and the Verticillium parasite were fairly common. Coffee was interplanted with pigeon pea (Cajanus cajan), tree cotton (Gossypium barbadense), tobacco (Nicotiana tabacum), Cayenne pepper (Capsicum annuum), manioc (Manihot esculenta), and fennel (Foeniculum vulgare). Overnight stop at Awash village. A fine plant of Quisqualis indica covered the trellis by the hotel.

November 7:

Awash - Addis Ababa

Left Awash 7.40 a.m. Arrived Addis Ababa 3.00 p.m.

November 8:

Addis Ababa

November 9:

L. Monaco, geneticist from Brazil, arrived in Addis Ababa as the fifth member of the Mission, completing the official party.

November 10:

Addis Ababa - Sidamo (275 km.)

Team (without Fernie and Greathead, see Appendix IB) left Addis Ababa, 1.00 p.m. for Shashemene and Sidamo province east of the Rift Valley, arrived Lake Awasa in Sidamo, 6.00 p.m. The road is asphalted for most of the route, and passes by several rift lakes north of Shashemene.

November 13:

Lake Awasa - Dilla - Yirga-Cheffe - Konga (290 km.)

Lake Awasa, elev. 5,253 ft. (1,610 m.) is one of a series of fresh water lakes in the Rift Valley of Ethiopia. A few of the lakes are saline. The rich coffee-growing area begins inland from the lake and extends 100 km. south at least to Yirga-Cheffe. About 23 percent of the coffee of Ethiopia is produced in Sidamo province with an even greater potential for increased production still undeveloped. Collections were made at Dilla, elev. 5,100 ft. (1,500 m.), at Yirga-Cheffe, elev. 5,900 ft. (1,800 m.), and at Konga village, elev. 6,030 ft. (1,850 m.). The coffee leaf rust and the Verticillium parasite were found in the area with no evidence of leaf drop. Coffee is grown mostly in small fields in rows, in full sun or in open woodland in high shade of common native trees, e.g., Cordia, Albizia, Millettia, Erythrina, Croton. Stopped at Wonago village, 12 km. south of Dilla to see wet processing of coffee by a Mr. Tedini. The wet process is not common in the area on account of insufficient water and apathy of growers to break away from traditional methods of sun-dried coffee. Return to Lake Awasa for the night.

November 14:

Soddu-Walamo (320 km.)

Trip across the Rift Valley to Soddu-Walamo, 90 km. west of Shashemene, elev. 5,250 ft. (1,600 m.) where coffee is grown. Around Soddu, coffee is cultivated in small fields located in wooded areas with high shade. Coffee is planted in the usual way very close together, which results in a tangle of growth and a relatively small harvest. No coffee leaf rust observed. Returned to Lake Awasa for the night.

November 15:

Wondo-Genet (day trip)

Visited coffee plantations at Wondo-Genet, 23 km. southeast of Shashemene, elev. 5,900 ft. (1,800 m.), to witness the coffee harvest in full progress. The first coffee plantation in Sidamo was started here by Belgians about 80 years ago, but the original plantings have been replaced by a planting of scented geranium (Pelargonium sp.) for geranium oil, although a few old dying coffee plants still remain. Mitchell Cotts Ltd. and some other interests now operate coffee plantations in the valley at the foot of the nearby forested escarpment. Coffee leaf rust was observed. In the afternoon a search was made for semi-wild coffee reported to exist in the nearby forest. After cutting through a jungle of vines and undergrowth, a few spontaneous coffee plants with unripe fruit were found, raising hopes that perhaps we had found truly wild coffee east of the Rift Valley. It would be safe to assume, however, that the plants seen in the disturbed forest habitat were waifs spread by monkeys from neighbouring coffee fields.

November 16:

Wondo-Genet - Addis Ababa

Visited for a second time the rain forest area at Wondo-Genet. The composition of this forest resembles areas in Kaffa province, as for example, around Jimma. The very large specimens of Podocarpus gracilior, an indigenous conifer scattered through the forest, probably are older than the other common canopy trees, such as Polyscias fulva (Araliaceae); Kararo Aningeria adolfi-friederici (Sapotaceae); Pygeum africanum (Rosaceae); Mimusops sp. (Sapotaceae); and Schefflera abyssinica (Araliaceae). The relatively small size of the canopy trees, and the entanglement of vines and quick growing shrubs would seem to

indicate a disturbed habitat and a relatively young forest. Certainly, this is not a primary forest, although the remaining specimens of Podocarpus may have been part of an earlier pioneer (primary) forest. With respect to the occurrence of coffee plants in this forest, we know the propensity of coffee to spread into a disturbed habitat in forest areas of Ethiopia. The weedy tendencies of the coffee plant may be observed time and again at the edge of forests near house sites, along trails, as coffee thickets under isolated trees in fields, and in forest clearings. This propensity complicates the problem of identifying truly wild plants. Considerable plant to plant variation exists in all spontaneous coffee plants, but no sure method exists to distinguish plants intentionally cultivated around a house from spontaneous plants in the forest. Incipient domestication is not immediately evident. In forest districts, coffee has not benefited from a long history of domestication, as compared with coffee grown in Harar province and on the Zeghie Peninsula or as compared with some other crop plants of Ethiopian origin

November 17 - 19: Addis Ababa

November 20: Meyer, Monaco, and Narasimhaswamy left Addis Ababa for Jimma, Kaffa province. Spent the night at Waliso, on main road to Jimma.

Waliso (108 km.)

November 21: Left Waliso 8.00 a.m. with one major stop at Welkite, elev. 6,385 ft. (1,950 m.), about 130 km. southwest of Addis Ababa to observe plantings of coffee grown by the Gurage people. The area is bleak and treeless and the elevation would seem to be a little too high for coffee. But coffee grows remarkably well around Welkite. Rainfall in the area averages about 57 ins. (1,425 mm.) per year, concentrated from May to September, with a long dry season the remainder of the year. The coffee leaf rust, but not the Verticillium parasite was found on a few plants. Because of the altitude, the crop is harvested late, usually in January. Although locally grown plants appeared to be quite variable, three named selections were pointed out by the farmer, namely 'Saja' from Kaffa province, 'Chercher' from Harar, and 'Arore' of unknown origin. The 'Arore' selection was interesting on account of the very dark red nearly spherical fruit averaging 16 mm. long by 15 mm. wide when fresh. Coffee at Welkite is usually grown in small plots by individual growers in full sun or between rows of enset or false banana (Ensete ventricosum). The enset is a native Ethiopian plant widely grown by the Gurages at Woli Welkite and in other areas, particularly in Sidamo province, for a kind of fermented bread made from the underground trunk of the plant. From Welkite the road descends sharply to the hot Ghibie River gorge (1,100 m.). On the Kaffa side of the bridge, the road winds quickly to the plateau through mountainous country to Jimma, coffee capital of the region and seat of government of Kaffa province. Arrived Jimma 6.00 p.m.

Welkite - Jimma (227 km.)

November 22:

Jimma - Bada Buna

Jimma, a town of about 10,000 people, is located in a broad fertile valley, at an elevation of 5,750 ft. (1,750 m.), with mountains up to 10,000 ft. (3,050 m.) only a few miles to the east. An average yearly rainfall of about 55 ins. (1,380 mm.) is concentrated from May to September, yet no month is rainless. Frost occasionally injures the tops of coffee plants in November or December. Jimma is barely on the edge of the montane rain forest area of Kaffa province. Only 40 km. to the southwest the road to Bonga passes through the Belleta Forest, elev. about 7,000 ft. (2,135 m.), where coffee is cultivated to a small extent. Jimma ranks as the leading coffee centre of southwestern Ethiopia and supports a newly modernised airport; the Jimma Agricultural Technical School for boys is the leading high school of its kind in the country. Coffee is much planted in all wooded valleys adjacent to Jimma, and in the town huge coffee plants commonly found in dooryards, perform the function of utility as well as for ornament.

Visited Bada Buna forest, about 9 km. northeast of Jimma along the Addis Ababa road to see coffee planted in a secondary forest under indigenous trees of Celtis africana, Pygeum africanum, Rothmannia urcelliformis, Syzygium guineëse, Polyscias fulva, Millettia ferruginea, Cordia africana among the more common. A coarse grass, Setaria candula, up to 6 ft. (2 m.) tall, nearly overtakes the coffee plants and must be cut to the ground before coffee harvest is possible. This grass and a sedge, Cyperus fischerianus, are a plague in many coffee plantings throughout the area. Coffee was definitely introduced to the Bada Buna forest, from material of mixed origin. The plants are highly polymorphic, showing at least two distinct fruit colours, a light and a dark red cherry. Coffee harvest had just started in the area.

November 23:

Doyo (day trip)

Jimma. Prepared collections from Bada Buna. Monaco and Narasimhaswamy visited coffee estate of Ato Teka Egano at Doyo, a few kilometres from Jimma where coffee is cultivated. Coffee plants seen here were of particular interest, because of wide variability found in the ripe fruit and in the leaves, much more than one usually sees in local populations of spontaneous coffee in forest areas. Coffee leaf rust and the Verticillium parasite were observed. Leaf drop not observed.

November 24:

Sapa Forest (102 km.)

Team visited Sapa forest, 49 km. north of Jimma, about 7°57'N., 36°48'E., elev. 5,255 ft. (1,610 m.), to see forest coffee on property of Dejazmatch Johannes Girma, a large land owner. In this area coffee is harvested from semi-wild and naturalised plants growing under common canopy trees, such as Ficus sp., (Wansa) Cordia africana, and Millettia ferruginea. Coffee plants receive very minimal care, but this is typical where no real planting of coffee exists in forest areas. Competing shrubs such as Galiniera coffeoides, Maesa lanceolata, Barleria sp., and Canthium gueinzii, and vines of Impompea spp. are cut out to provide additional light to lessen competition for coffee plants. But very little thinning of coffee plants is practised, as it is felt that a larger crop of coffee will result from many plants,

no matter how close together. While in practice this does not prove to be the case, the small amount of attention given does allow the numerous coffee plants to fruit with some regularity and in some abundance greater than if they had not been tended at all.

November 25:

Saredo (120 km.)

Monaco and Narasimhaswamy left on an overnight trip to Saredo, an area about 50 km. north of Jimma in Limu sub-province. The Limu area enjoys a salubrious climate with more sun and less rainfall than in areas around Jimma. The climate is ideal for coffee. Coffee referred to as Ennarea by Sylvain (1958) comes from the Limu area. Formerly, the area was called Ennarea. Coffee plantations of Ato Shone Seda and Ato Mahari Endale were visited. In this area, coffee is cultivated under indigenous trees, such as Albizia schimperiana, Millettia ferruginea, and Cordia africana, among the more common.

November 26:

Jimma

Monaco and Narasimhaswamy returned to Jimma. Meyer visited a gallery forest along Agaro road, 6 km. from Jimma, to see cultivated coffee planted in a secondary forest along a stream, typical of the area. The high world price of coffee about 1950 encouraged farmers to plant coffee in every available stream valley in the Jimma area. Of course, coffee grows exceedingly well in the area, and now fifteen years later many valleys adjacent to Jimma consist of thickets of overgrown and tangled coffee plants. Weeds, such as Cyperus fischerianus, and a giant grass, Setaria candula, mentioned earlier, both are a scourge. It is not surprising that coffee production is low under such conditions. With a potentially rich genetic stock immediately at hand, it seems highly unwise to continue with primitive methods, when modern cultural techniques and high producing selections might offer greater returns for less effort.

November 27:

Jimma

Narasimhaswamy inoculated leaf discs with coffee rust fungus at the Agricultural School at Jimma. Everyone very busy preparing collections and writing notes.

November 28:

Jimma

Office day with preparations underway for field trip to Gera district.

November 29:

Gera (94 km.)

Meyer, Monaco, and Narasimhaswamy drove to Gera, a town in a rich coffee growing district southwest of Agaro in Kaffa province. Coffee is said to be wild in the area. Agaro is second to Jimma as a centre for coffee and together they form the most concentrated coffee-growing areas in Ethiopia, after Sidamo and Harar. The Agaro area was the source of S.4 'Agaro' and S.6 'Cioccie' selections found by Sylvain (1955) and, since that time, used in Tanzania for breeding purposes.

November 30:

Gera

Gera, Kaffa province. A village in the rain forest area, about 50 km. southwest of Agaro, elev. 6,695 ft. (2,040 m.). Passed the night as guests of Mr. Galanti, the Italian overseer of Galanti-Teka Egano Co. coffee plantation. In Ethiopia the word Buna (or Bunna) applies to the coffee plant and the beverage. The English name coffee and the

Latin Coffea, according to most authorities are derived from variants of the Arabic 'Caova', 'Cova', or 'Kahwah' and are not a corruption of Kaffa, the province of Ethiopia where coffee grows. The method of preparing drinking coffee is fairly standard in most country houses of Ethiopia. First, green coffee beans are roasted over a fire in a clay pot. The roasted beans are then ground to powder in a specially designed mortar. Water is boiled in the traditional way in a narrow-neck, clay pot with a round bottom. The coffee powder is added as the water comes to the boil, and after a few minutes of steeping, coffee is ready for drinking. Coffee is usually sweetened with sugar but the use of spices such as cinnamon, ginger, and Kororima (Aframomum angustifolium) is traditional in many areas.

The highly aromatic 'acid' coffees of Ethiopia with their characteristic piquant flavour are preferred by American buyers who take 80 percent of the Ethiopian crop for blending with mild coffees of Latin America.

The Teka Egano plantation at Gera is one of the most modern in the area, including facilities for wet processing. Coffee is planted in rows on hill slopes, mostly in the open with some light high shade of Wansa (Cordia africana), Bersama abyssinica, and Albizia sp. Two selections of coffee are grown, e.g., 'Ennarea', which probably originated in Limu subprovince of Kaffa (not the same as Ennarea coffee in Eritrea, see entry of January 15) and 'Wobba' of unknown origin. Plants with bronze growing tips predominated among the plantings; coffee leaf rust was observed on a few plants but the infection was light.

Arrangements were made for a trip to the hinterland southwest of Gera, where wild coffee is said to grow near Afallo, in the neighbouring province of Illubabor.

December 1:

Afallo
(25 km.)

Departed from Gera with a string of mules, plus two local police as guides, the secretary of the Gera subprovince, a representative from the Coffee Board, and various assistants, twelve persons in all. After crossing the first river a few kilometers southwest of Gera, coffee plants were abundant along the trail. The terrain was gently rolling, heavily forested, and sparsely settled. Only one clearing and not a single habitation was seen between Gera and Afallo, a distance of about 25 km. Numerous stops were made to collect coffee. Because of the proximity of coffee plants bordering the trail, ripe coffee cherries (kasher) were easy to collect from mule-back. Literally, coffee thickets have developed along the trail as a result of seeds dropped from mules transporting coffee to Gera for market. However, a few hundred yards from the trail, coffee plants diminished significantly in number, yet scattered specimens (one measured 25 ft. (8 m.) tall and slightly over 1 inch (25 mm.) in diameter), were found more than a quarter of a mile away in the forest. Unfortunately, time did not permit an exhaustive search to check on the occurrence of coffee plants farther into the forest. Coffee leaf rust and the Verticillium parasite were found in several sites, mostly in open

places along the trail. The elevation along the trail averaged about 6,000 ft. (1,830 m.). The party had planned to walk as far as Amima and Amballo, where wild coffee was said to grow. But after collecting ripe coffee cherries in Afallo village and coffee leaf rust spores, the guides were reluctant to go farther. Turned back in the direction of Gera, and not too far distant an agreeable camping site was found in the only clearing along this section of the trail.

The following two days were devoted to collecting along the Gera-Afallo trail where coffee plants were abundant, and fully ripe. The area is very sparsely settled, and the forest extends unbroken for long distances. The canopy trees are not large in girth, yet some attain a height of 30 m. Species in the shrub understory consisted of Galiniera coffeoides, Maytenus englerana and M. arguta, and Psychotria orophila, among the more common. A. Liana, Landolphia buchananii (Apocynaceae) was also common. At this period, the weather was agreeable with only brief showers and few insects, except for the terrifying red army ants which plagued the campsite in search of food and flesh.

December 3:
Jimma
(109 km.)

Broke camp at 9.00 a.m. en route to Gera. Coffee plants with fully ripe fruit were common along the trail. Arrived Gera at noon and lunched with Mr. Galanti at the coffee plantation. After paying the guides for services, drove back to Jimma in the afternoon, stopping frequently along the Gera-Agaro road to observe coffee and make further collections. Coffee leaf rust was common in several places. Arrived Jimma at 6.40 p.m.

December 4:
Jimma

Jimma. Despatched coffee leaf rust (Hemileia vastatrix) spores to Dr. d'Oliveira in Portugal. Normally, rust materials were shipped immediately to Portugal by air, after first scraping the spores into gelatin phials and packing these carefully in cork boxes to minimize desiccation. Dried leaves of coffee infected with leaf rust and the Verticillium parasite usually accompanied the spore material. Most of the rust material was prepared by Narasimhaswamy.

December 5:
Jimma

Jimma. Narasimhaswamy visited the Agricultural Technical School to demonstrate leaf rust inoculation on coffee leaf discs. Monaco measured coffee fruit and leaves.

December 6:
Bonga

Monaco and Narasimhaswamy drove to Bonga and 12 km. farther along the road to Wush Wush Plantation to observe spontaneous coffee growing in the forest and in cultivation. Meyer visited coffee farm of Ato Getahoun Birke in Limu subprovince, a place about 50 km. north of Jimma. (See November 25, 26 entry for earlier visit of Monaco and Narasimhaswamy)

December 7:
Jimma

Visited several coffee processing factories in Jimma, with Ato Worku Makonnen of the Ethiopian Coffee Board, to see coffee cleaned, depulped, and bagged prior to being trucked to Addis Ababa. Coffee is brought to Jimma by road from areas in Kaffa province, such as Gera, Agaro, Limu and Bonga, and by air from Teppi and Gore in Illubabor province, from Dembidollo in Wollege province, and from Mizan Teferi in

Kaffa province. The machinery used for dry processing coffee is interesting because much of it is handmade from plans in books of equipment manufactured in Europe. The National Coffee Board is striving to improve methods of growing and handling coffee, since about 60 percent of the gross national production of Ethiopia comes from coffee. The Board is empowered to establish standards and enforce regulations as fast as convention permits. For example, it is now unlawful to dry ripe coffee fruit, except on concrete platforms or on mats off the ground. All cleaned coffee must undergo rigid tests for purity and fitness before leaving Jimma.

December 8:

Teppi

Monaco, Narasimhaswamy, and Meyer with Dr. Dagnatchew Yirgou and Ato Abebe Abaye flew to Teppi in Illubabor province, elev. 4,330 ft. (1,320 m.) about 7°9' N., 35°18'E. Teppi appeared on maps only recently, largely because of coffee which is transported by air to Jimma from this place. The Arabica coffee plant is common in the vicinity of Teppi in the rain forest which extends relatively unbroken for miles in all directions, except for small local areas cleared for crops. The population of the area is widely scattered and villages are few. Shifting agriculture is still in evidence. Primary forest may exist along the Baco and other rivers, but in most areas, the forest is probably of secondary origin. The agricultural potential of the Teppi area has not been tapped as yet, but with roads the region could develop into one of the leading coffee centres of the country.

December 9:

Teppi

Explored area about 8 km. southwest of Teppi where coffee plants are spontaneous and naturalised in the forest. Coffee is usually gathered from the ground in preference to being hand harvested. Plants often are too tall for hand picking, up to 25 ft. (8 m.), and nests of vicious ants on the underside of the leaves deter even the hardiest of native pickers.

The following method of harvesting is typical of the area. In preparation for harvest, all sticks, branches, and herbaceous plants are cleared away to bare earth under coffee plants. The over-ripe fruit is allowed to fall to the ground where it is gathered into baskets. This method, of course, introduces much fermented fruit which lowers market quality. This technique is not approved by the National Coffee Board of Ethiopia. Yet, under existing conditions, the method employed is the most practical for forest people who know coffee primarily as a gathered crop.

Traditionally, Ethiopians living in forest areas of Kaffa and Illubabor, know coffee as a gathered crop of the forest and from plants grown locally around houses. In forest areas, the coffee plant is not a highly sophisticated domesticate, as in some other indigenous crop plants of Ethiopia, such as safflower (Carthamus tinctorius), castor bean (Ricinus communis), tef (Eragrostis tef), enset (Ensete ventricosum), Ethiopian mustard (Brassica carinata), and some others, developed over centuries of crop history from wild stock of Ethiopian origin.

December 10:
Teppi

Explored forest area located about 8 km. due east of Teppi, near the western base of Amoragadel mountain, a prominent landmark on the air route between Teppi and Mizan Teferi. Elevation of the area stands at about 4,000 ft. (1,200 m.). The forest is characterised by large, in fact the largest, canopy trees observed so far. The residents of the area are principally semi-nomadic Shankella (Negro) people who live in small communities at the edge of the forest clearings in round mud and grass huts. These people engage in a simple agriculture, with sorghum as the staple grain crop. Maize is also grown, and a grain amaranth (Amaranthus caudatus), is grown to some extent. The coffee plant is fairly common in some places in association with other native shrubs, such as Acalypha paniculata (Euphorbiaceae), Macrorungia pubinervia (Acanthaceae), Maytenus arguta (Celastraceae), and Argomuellera macrophylla (Euphorbiaceae), among the more common species. It was very interesting to discover coffee leaf rust on seedlings of coffee in the darkest parts of the forest.

December 11:
Teppi

Explored area between Teppi and the Baco river along the Mizan Teferi trail. Coffee plants were found nearly as far as the Baco river, which forms the boundary between Kaffa and Illubabor provinces. The region is sparsely settled, mainly by Shankellas and shifting agriculture is evident. Nearby Amoragadel mountain would have been an excellent place to explore for wild coffee, but time did not permit a visit.

December 12:
Jimma

Departed Teppi by plane at 1.50 p.m. Arrived Jimma 2.35 p.m.

December 13-14:
Jimma

Jimma. Prepared seed samples and notes. Monaco measured coffee leaves and fruit from Teppi trip. Narasimhaswamy prepared coffee leaf rust material for despatch to Portugal.

December 15:
Jimma

Visited a small wooded ravine along main road near Bada Buna where coffee is cultivated. Collected ripe coffee fruit and prepared herbarium specimens of associated flora.

December 16:

Monaco left for Brazil.

December 17:
Mizan Teferi

Meyer, Narasimhaswamy, and Ato Makonnen from the Coffee Board departed Jimma by plane at 10.00 a.m., arrived Mizan Teferi airstrip, Kaffa province at 11.10 a.m. A broad, green valley opens out to the south with verdant mountains up to 8,000 ft. altitude immediately to the east. The soil appears to be fertile and coffee is extensively cultivated locally. Went by Jeep to Mizan Teferi town, located 7 km. east of the airstrip, to see Ato Sayome, the governor, who offered every facility at his command. Discussed plans for a trip to collect coffee on remote Geisha Mountain, south-west of Mizan, a place several days away by foot. Interest in Geisha Mountain was based upon knowledge of an early series of coffee collections made in 1936 by the British Consul then stationed at Maji and sent to Kenya. Since then Geisha coffee has been esteemed as a parent in breeding work for rust resistance at the coffee research station at Lyamungu in Tanzania.

December 18:

Mizan Teferi

Coffee is cultivated up to the edge of the airstrip, elev. 4,600 ft. (1,400 m.). Only a small quantity of ripe coffee was available, as the visit coincided with the end of the coffee harvest in the area. Coffee grows luxuriantly in the Mizan Teferi area, in a climate that appears to be ideal for the plant. Rainfall averages about 70 ins. annually with no month which is rainless. In fact, heavy showers occurred almost daily during the visit, yet December is one of the driest months. January is said to be the driest. Visited coffee farm of Ato Shibeshi, located 3km. south of Mizan airstrip where coffee is grown by modern methods in full sun. Coffee leaf rust was observed in this plantation but leaf drop was not a problem. Semi-wild and naturalised coffee was not found in the Mizan Teferi area, largely because of widespread agriculture and clearing.

December 19:

Mizan Teferi - Benessa

Departed Mizan Teferi airstrip at 10.50 a.m. for Geisha Mountain, with seven mules, two local police, the vice-governor, his son and various helpers, eighteen persons in all. Weather fair and hot at midday. Travelled by trail through farmed and cut-over country along east side of valley. The inhabitants of the area consist of Ghimira people of Galla extraction. The food crops observed were sweet potato (Ipomoea batatas), yam (Dioscorea sp.), taro (Colocasia esculenta), sorghum, maize and enset (Ensete ventricosum). Coffee is grown in small quantities around tukles (round Ethiopian houses), but the crop is of local importance only. Stopped at Debre Werk village, elev. 4,400 ft. (1,340 m.), to observe coffee planted around houses in the village. The topography beyond Debre Werk is more rolling, although the hills are not above an elevation of 6,000 ft. (1,830 m.). Stopped at Bolku to observe and collect material of coffee growing around a single tukle. The man of the house was engaged in smoking a curiously constructed water pipe from a sitting position. Tobacco is grown to some extent around dwellings, but smoking is not common outside the larger towns. Stopped for the night at Benessa in the compound of the local landlord, Shamtit Shashintit, whose domain extends for many miles in all directions. Shortly after our arrival his lordship appeared on horseback with an entourage of servants and gun bearers numbering perhaps 30 persons. The team was welcomed and invited to spend the night as occupants of one of the giant tukles in the compound.

December 20:

Berber Uaha River

Continued toward Geisha Mountain at 11.00 a.m. after the rains had cleared. The trail beyond Benessa was heavily overgrown and barely passable on mule-back. No houses were seen after Benessa. The chief obstacle before Geisha Mountain is the broad valley of the Berber Uaha River. This valley consists mainly of savanna country and is entirely uninhabited. Reached the river at 5.00 p.m., elev. 3,020ft. (920 m.) and camped for the night. A lush gallery forest borders the river, with mostly unfamiliar low elevation species, and with an abundance of Rubiaceae, but no Coffea. Hippos were plentiful in the river, but the area otherwise was desolate. The green hills in the distance beckoned, but to reach them according to our guides, would require a

trek of at least another two days. As Narasimhaswamy was scheduled to leave Ethiopia shortly after 25 December, any plans for reaching Geisha Mountain were abandoned. Two days had already been spent reaching the present position, and only eight days had been allotted to this particular safari. To counter-balance this disappointment, the Mission was presented later with seeds of semi-wild coffee collected by runners sent specially to Geisha Mountain by Bolton and Fernie during their trip to the Maji area in early December. (See Appendix IB)

December 21: At 11.00 a.m. left Berber Uaha River for return to Mizan Teferi. Stopped for the night at Benessa.

December 22:

Ainamba

Left Benessa 10.00 a.m. Took trail to Ainamba village, located on the west side of the valley. The route led through cut-over country, and the only coffee available was found under a giant fig tree (Ficus sp.) about one kilometre Ainamba village. Tents were pitched for the night in the governor's compound, elev. 4,820 ft. (1,500 m.), in the shadow of several large coffee plants, 15 ft. tall, said to be 100 years' old. Also, coffee was planted around several houses in the village. Coffee leaf rust and the Verticillium parasite were observed but no leaf drop was noticed. Some commercial coffee is produced in the environs of Ainamba which is transported by mule to Mizan Teferi and then by plane to Jimma.

December 23:

Tunteta - Mizan Teferi

Ainamba. Two kilometres southwest of the village at a place called Tunteta coffee was found growing near a single tukle. The origin of this coffee was said to be the Sheko forest in the valley below. The Tana Plantation could be seen in the distance. The local residents at Tunteta, according to the guides, ignore the beans for beverage coffee but use the pericarp of ripe coffee cherry for a kind of bread. A drink, prepared from the leaves of coffee just as they turn yellow before dropping from the plant, is said to contain nearly as much caffeine as the coffee bean. Elsewhere in Ethiopia, the leaves of coffee are sometimes used for beverage purposes, especially in Harar province (See entry for November 5). Returned to Ainamba and continued to Mizan Teferi. Coffee was found naturalised under large fig (Ficus sp.) trees at various points along the trail. Arrived Mizan airstrip at 5.00 p.m.

December 24:
Jimma

Departed Mizan Teferi at 1.55 p.m., arrived Jimma at 2.50 p.m.

December 25: Jimma.

December 26: Jimma. Prepared rust samples for shipment to Portugal and began to dry herbarium specimens at Agricultural Technical School.

December 27:

Omonadda (184 km.)

Meyer-Narasimhaswamy field trip to mountains northeast of Jimma. Stopped at Omonadda village on Omo River road to see cultivated coffee. Coffee plants grown here have uniformly very dark bronze leaf tips and in shape and colour the ripe cherries suggest a relatively homozygous population.

The Omonadda coffee plants undoubtedly originated from repeated inbreeding to conform to more or less one genotype. Coffee leaf rust was observed but not the Verticillium parasite. Beyond the village, the road to the Omo River led into the mountains up to 9,000 ft. (2,740 m.) where small grains and pulse plants are extensively grown. Enset or false banana (Ensete ventricosum) was observed at 8,500 ft. (2,600 m.). Returned to Jimma.

December 28: Narasimhaswamy left Jimma for return to India.

December 29: Jimma. Meyer travelled alone from this date to the end of the Mission. Collections of coffee made in the town. Many coffee plants were in flower as a result of nearly two weeks of rain in early December.

December 30:

Bonga

Travelled to Bonga to observe and make further collections of coffee. Bonga is a centre for coffee in the forest region of Kaffa province with a well-distributed precipitation of about 70 inches per year. In the Bonga area, coffee is harvested mostly from semi-wild and spontaneous plants in the forest. The largest modern coffee plantation in the area is at Wush Wush, west of Bonga. The new all weather road to Bonga from Jimma should increase the agricultural potential of the area and bring new coffee planters to the area. Recent surveys show that tea might also be a profitable crop at Bonga because of favourable climatic conditions of temperature and rainfall. Cinchona was introduced at Bonga during the Italian occupation, and a small grove of trees, 20 ft. tall, still survives near the governor's house.

December 31:

Bonga

Bonga. Explored for coffee in the rain forest across the Dentche River. Coffee was found near dwellings, and in the adjacent forest area. Many plants were in full flower on account of recent rains. The spice plant Kororima (Aframomum angustifolium) was abundant. This species is the most valuable indigenous spice plant of Ethiopia, used in nearly every household as an ingredient in wot, the national food dish of the country.

January 1, 1965:

Wush Wush (32 km.)

Travelled to Wush Wush, elev. 6,300 ft. (1,920 m.), located 32 km. west of Bonga. Mr. F. Buckholz, a German planter, manages a successful modern coffee plantation of about 160 acres, with facilities for wet processing. With difficulty the Wush Wush plantation was cleared from dense secondary rain forest about 100 years' old. The closest coffee plantings are at Bonga, but spontaneous coffee occurs in various parts of the forest in the Wush Wush area. The coffee crop of 1966 amounted to about 70 tons at Wush Wush. Seeds to establish the plantation were obtained from the nearby forest, whereby the Wush Wush plantings consist of a variable population with a heterogeneous background. Selections from Kenya have been introduced recently. Cultural techniques at Wush Wush consist of planting coffee in somewhat terraced rows under light shade of the native olive, (Olea welwitschii), African Hackberry (Celtis africana), Pygeum africanum (Rosaceae), and an occasional Elaeodendron buchananii. A pernicious weed grass, Panicum clavum, is

common and difficult to control. Coffee leaf rust has not been reported from Wush Wush.

The nearby forest area is interesting historically. While spontaneous coffee is not uncommon, in view of the history of the area, it would be difficult to pinpoint truly wild coffee. Evidence points to a greater concentration of population for this part of Kaffa province 100 years' ago, before the wars that brought Menelik II to power in 1889.

After the Kingdom of Kaffa was dissolved, the population dispersed and some areas again grew up to forest. Around old dwelling sites in the forest it is possible to find grinding tools and other artifacts, according to Mr. Buckholz. Strenge (1956) also reports finding such artifacts under similar circumstances. Other evidence of former habitation exists in the rows of giant spurge, Euphorbia sp. (E. obovalifolia ?), often 50 ft. tall found in parts of the rain forest. This giant succulent plant seems strangely incongruous in a rain forest environment, although the plant is undoubtedly indigenous. In fact, this spurge is still planted as a living fence around house sites in many parts of the Bonga area.

January 2:

Wush Wush - Jimma

Made observations on coffee growing at Wush Wush and prepared collections of seeds and herbarium specimens. Lack of time prevented investigation of the nearby forest areas where coffee is spontaneous. Started back toward Jimma in mid-morning. Arrived Jimma at 1.10 p.m.

January 3-9:

Jimma

Jimma. Devoted seven days to drying herbarium specimens and preparing nearly 500 seed collections of coffee for shipment to the U.S.A. This task was lightened by help from boys of the Agricultural Technical School and the willing cooperation of Ato Yilma Yomano-Barhan, director of the school. Nearly a full set of the coffee seed collections remained with the school for growing and research purposes.

January 10:

Left Jimma by plane at 4.10 p.m. Arrived Addis Ababa, 5.10 p.m.

January 11:
Addis Ababa

Addis Ababa. Final arrangements made with Mr. J.L. Greig, of F.A.O., for shipping herbarium specimens to U.S.A.

January 13:

Zeghi Peninsula

Departed Addis Ababa by plane at 8.00 a.m. Arrived Bahar Dar, southern end of Lake Tana at 10.15 a.m. At the city dock, a speed boat was hired for the one-and-a-half hour journey to Zeghie Peninsula, to collect ripe coffee fruit. Ripe coffee was found in Bahar Dar, and on Zeghie coffee was about half ripe in the forest near the village, with complete ripening still about three weeks away. Date of ripening on Zeghie Peninsula is at least three months later than in southern Ethiopia, e.g., in Illubabor and parts of Kaffa provinces. Outside of Zeghie, coffee is not grown to any extent elsewhere in the region, except locally around houses in Barhar Dar and neighbouring villages. Although the Zeghie Peninsula receives more rainfall than the adjacent mainland, the entire area is subject to long periods

of drought, extending from October to April. Now, in January, all vegetation, including coffee plants, was wilted, indicating that rain had not fallen for many weeks. Observations on several hundred coffee plants showed that considerable uniformity exists in size, shape, and colour of ripe coffee fruit in Zeghie coffee plants. Half-ripe cherries were nearly round with white flecks and striped and somewhat translucent. Fully ripe cherries were uniformly dark red and nearly round. The growing tips of plant were green to very light bronze. Some plants were obviously more productive than others, but this situation exists wherever coffee grows in Ethiopia. It would be unwise to evaluate productivity as significant under raw field conditions. The apparent uniformity in coffee plants on Zeghie would seem to indicate a relatively long period of domestication of the plant in this locality, going back at least to the end of the 17th century (Sylvain, 1958). One major genotype seems to be involved in Zeghie coffee, although this has not been shown experimentally. Quite the opposite condition exists in forest districts of southwestern Ethiopia where coffee plants often are highly variable and little domesticated and more heterozygous.

Took regular passenger launch from Zeghie dock at 3.30 p.m.; arrived Bahar Dar at 4.50 p.m.

January 14: Departed Bahar Dar by plane at 3.30 p.m.; arrived Asmara at 6.10 p.m.

January 15: Asmara. Visited Faghena Experiment Station, northeast of Asmara, to see coffee growing on the Red Sea escarpment. Dr. Nastasi of the Ethiopian Department of Agriculture kindly provided a Land Rover for the trip, with Dr. Gaetano la Barbera and his Ethiopian assistant as guides. The Red Sea escarpment possesses a most remarkable series of climatic zones, ranging from an elevation of 8,000 ft. (2,340 m.) at Asmara to sea level at Massawa on the Red Sea. The climatic zones are particularly striking in January, when the dry season is still in progress as Asmara, and a few kilometres away on the escarpment, rain and fog often prevail at this period of the year. This results from the fact that the climatic pattern of the Red Sea trough is Mediterranean in character with a winter rainy season (December to February) followed by a long summer drought, while the climate at Asmara on the edge of the escarpment is quite the opposite, with a rainy season concentrated between May and September and rainless or nearly so for the remainder of the year. The trip to Faghena dramatised the climatic differences that exist on the escarpment in January. Left Asmara in clear weather, but soon entered the fog belt a few hundred feet down the escarpment. Abruptly, the slopes changed to green, and fog turned to heavy mist. At the Faghena Experiment Station, elev. 5,575 ft. (1,700 m.), the ditches were full of water, with even heavier mist falling and fog so thick that it was impossible to see ahead more than 300 feet. In this environment, coffee and citrus are grown, only 57 km. from Asmara. Agricultural research at the Faghena Experiment Station covers coffee,

Asmara - Faghena Experiment Station

citrus, and some cereals. Two selections of coffee are grown locally, one called 'Mocha', with ripe cherries, originated from seed brought originally from the Yemen. A second selection, locally called 'Ennarea' (E-622), appears to be totally different from plants grown under the same name in Kaffa province (See November 30 entry). The Ennarea coffee of Eritrea differs from all other coffee plants observed elsewhere in Ethiopia in the colour of the terminal leaves that remain permanently light bronze at maturity, thus permitting an immediate identification of the plant based on leaf colour alone. Ripe cherries were not seen of Ennarea, since they ripen in April.

Coffee has been grown in the Faghena area for over sixty years, according to Mr. Matteoda, a local resident, whose grandfather introduced the plant about 1903 from the Yemen. The production of marketable coffee in this area amounts to about 500 quintals (about 10,000 pounds) annually, grown by about 116 planters. The area is not entirely suited to coffee cultivation, because of low and unpredictable rainfall, averaging 1,050 mm. (40 in.) per annum, and drying winds during July. For these reasons, coffee is usually grown in small plots surrounded by wind breaks. Continued down the escarpment to Massawa on the Red Sea for the night where the climate was warm and humid. The countryside was relatively green from recent light rains.

January 16: Massawa - Asmara — Left Massawa 11.30 a.m., stopping at Ghinda Experiment Station along the main road enroute to Asmara. Arrived Asmara 4.30 p.m.

January 17: Asmara — Departed Asmara International Airport 9.40 a.m., enroute to Rome.

January 18-20: Rome — F.A.O. Headquarters, Rome.

January 21: Lisbon, Portugal. — Departed Rome, arrived Lisbon, 12.15 p.m. Met by Dr. Branquinho d'Oliveira from the Experiment Station, Oeiras, to discuss screening work on the Ethiopian coffee leaf rust material sent by the Mission from Ethiopia.

End of Mission

APPENDIX IB

JOINT ITINERARY OF L.M. FERNIE AND D. GREATHEAD
(10-29 November 1964)

ITINERARY OF L.M. FERNIE (in part with FLOYD BOLTON)
(30 November - 13 December 1964)

November 10:	Left for Sidamo province. Visited coffee plantations near Shashemene at Wondo Genet, Shoa province.
November 11:	Visited coffee plantations at Yorgalem, Biera, and Aleta near Wondo in Sidamo province.
November 12:	Visited coffee plantations at Yirga-Cheffe and Dilla in Sidamo province.
November 13:	Revisited Wondo Genet.
November 14:	Addis Ababa.
November 15:	Visited a small coffee planting at Sabata, elev. 7,800 ft. (2,390 m.) southwest of Addis Ababa on the Jimma Road. The only locality where Antestia (Antestiopsis orbitalis ghesquierei) was found during the Coffee Mission trip.
November 16:	Visited coffee plantations at Welkite in Shoa province on main road to Jimma.
November 17:	Jimma area, Kaffa province. Visited coffee plantings at Jimma Agricultural Technical School and Bada Buna forest near Jimma.
November 18:	Visited Agaro, Kaffa province, with Ato Lemma Frewhywot, Executive Secretary, National Coffee Board of Ethiopia. Examined coffee growing in the area.
November 19:	Visited Limu area north of Jimma. Observed planted coffee.
November 20:	Visited Wush Wush Plantation near Bonga, Kaffa province with Ato Lemma Frewhywot, stopping enroute at Shebe village.
November 21:	Visited coffee plantings along Wush Wush road and at Bonga, Kaffa province.
November 22:	Visited Agaro area with Ato Lemma Frewhywot, and returned to Jimma.
November 23:	Visited Chochi on old road to Agaro, about 7°50' N., 36°45' E., elev. 5,510 ft. (1,680 m.), Kaffa province. Coffee is planted widely in the area under shade of *Albizia schimperiana*, *Cordia africana*, and other native trees.
November 24:	By air to Gore, Illubabor province. Observed coffee growing in area between Gore and Mattu.

November 25: Visited more coffee holdings at Mattu. Returned by air to Jimma.

November 26: Jimma to Waliso by road.

November 27: Waliso to Addis Ababa.

November 29: Greathead left Ethiopia for return home to Uganda.

ITINERARY OF L.M. FERNIE AND FLOYD BOLTON

November 30: Visited Experimental Station at Giren, 5 km. from Jimma.

December 1: By air to Maji, Kaffa province, with Mr. Floyd Bolton, American instructor at Jimma Agricultural Technical School.

December 2: Walked to Balt, elev. 6,800 - 7,000 ft. (2,080 - 2,135 m.), a small largely open settlement on the north side of Maji mountain, Kaffa province. Plantings of coffee in the vicinity of the huts.

December 3: By mule to Kursi, a village about 15 km. west of Maji, elev. about 6,120 ft. (1,870 m.), Kaffa province. Small plantings of coffee were grouped sparsely around the dwellings.

December 4: By mule to Kolu, a village about 35 km. west of Maji, elev. 5,100 ft. (1,550 m.), Kaffa province. This is a very small settlement on the south side of Maji mountain on the road to the Maji airstrip. A few isolated plots of coffee were in flower, although it was possible to collect a few ripe fruits.

December 5: Returned to Jimma by air. Arrangements were made with His Excellency the Governor of Maji and Mr. Harold Kurtz of the American Mission to have messengers sent to some other areas farther afield in the Maji area for the purpose of collecting coffee seeds. Good samples were obtained in this way from Tui, Geisha Mountain, Gorei (Barda), Beru, Giaba, and Gai. (See alphabetical list of collecting localities for details as to location.)

December 6: Jimma.

December 7: Trip to Bore and Gicho villages along Agaro-Gera road, Kaffa province. Coffee is widely planted in the area.

December 8: Jimma.

December 9: Jimma to Addis Ababa by air.

December 10-11: Addis Ababa.

December 12: By air to Shashemene and Wondo Genet, Sidamo province.

December 13: Fernie left Addis Ababa by air for Nairobi, Kenya.

APPENDIX II

ALPHABETICAL LIST OF F.A.O. COFFEE MISSION LOCALITIES IN ETHIOPIA

(with a list of Ethiopian names applied to Coffea arabica)

prepared by

F. G. MEYER

PLACE NAMES

The following is a list of place names in Ethiopia. As no official list of place names is available for the country, spelling has been standardised for uniformity. Place names are spelt phonetically according to English usage in transliterating from the Amaric.

ADDIS ABABA Capital city of Ethiopia with about 450,000 inhabitants. Arabica coffee planted in Ministry of Agriculture compound, elev. 8,000 ft. (2,340 m.). Coffee not commercially profitable at this elevation.

AFALLO Village about 25 km. southwest of Gera, elev. 6,000 ft. (1,830 m.), 7°43' N., 36°17' E., Illubabor province.

AGARO Leading centre for coffee, 44 km. northwest of Jimma, elev. 5,500 ft (1,800 m.), Kaffa province.

AINAMBA Village about 16 km. south of Mizan Teferi airstrip, elev. 4,930 ft. (1,500 m.), Kaffa province.

ALAMA Place near Yirgalem, some 70 km. south of Shashemene, elev. 6,200 ft. (1,890 m.), Sidamo province.

ALETA Coffee plantation a few kilometres southeast of Wondo, Sidamo province.

ALLE Village about 15 km. north of Gore, elev. about 5,000 ft. (1,780 m.) Illubabor province.

ARIRA Place about 8 km. southwest of Teppi, elev. about 3,900 ft. (1,200 m.), Illubabor province.

ASBE TEFERI Town at the western end of the Chercher Hills, elev. 5,200 ft. (1,585 m.), Harar province.

AZOZA Place near Gondar, elev. 6,700 ft. (2,030 m.), Begemdir province. Small quantities of coffee are grown, but no collections were made.

BACO RIVER Flows through rainforest country where coffee is semi-wild. Divides Kaffa and Illubabor provinces.

BADA BUNA Forest 10 km. northeast of Jimma, Kaffa province.

BAHAR DAR Town at southern tip of Lake Tana, elev. 6,200 ft. (1,880 m.), Gojjam province. Coffee cultivated to some extent in the town.

BALT A small largely open settlement on the north side of Maji mountain, elev. 6,800 - 7,000 ft. (2,080-2,135 m.), Kaffa province.

BARDA or BORDE See GOREI.

BELLETA FOREST High montane rainforest, elev. 7,000 ft. (2,135 m.), 40 km. southwest of Jimma, Kaffa province. Coffee grown to a limited extent.

BENESSA Compound of local landlord, about 25 km. southwest of Mizan Teferi airstrip, beyond Debre Werk, elev. about 4,370 ft. (1,330 m.), 6°50' N., 35°30' E., Kaffa province.

BERU Village 30-40 km. westnorthwest of Maji, at 6°15' N., 35°14' E., Maji subprovince, Kaffa province.

BIERA Site of pulpery for production of washed coffee near Yirga-Cheffe, elev. 6,200 ft. (1,880 m.), Sidamo province,

BIO DANGAGO 20 km. northeast of Harar, elev. 6,000 ft. (1,830 m.), Harar province.

BIRA Place near Yirgalem, Sidamo province.

BISHOFTU See DEBRE ZEIT

BOLKU Site of a house along trail southeast of Mizan Teferi airstrip beyond Debre Werk, elev. 4,370 ft. (1,330 m.), 6°50' N., 35°30' E., Kaffa province.

BONGA Leading town and centre for growing coffee, about 120 km. southwest of Jimma, elev. about 5,860 ft. (1,790 m.), Kaffa province.

BORE Village on Agaro-Gera road, elev. 6,200 ft. (1,880 m.), Kaffa province.

CHARA 8 km. west of Bonga on the road to Wush Wush plantation, Kaffa province. A wet process pulpery is located here.

CHERCHER HILLS Region in Harar province with a road between Asbe Teferi and Harar, distance about 188 km., where coffee is grown between elev. 5,000-6,000 ft. (1,520-1,830 m.), Harar province.

CHOCHI Place on old road to Agaro, elev. about 5,510 ft. (1,680 m.), 7°50' N. 36°45' E., Kaffa province. A wet process coffee pulpery is located here.

COMBULCHIA Town 17 km. north of Harar city, elev. 6,300 ft. (1,930 m.), Harar province.

DALLE See YIRGALEM

DEBRE WERK Village, about 16 km. southwest of Mizan Teferi airport, elev. about 5,220 ft. (1,590 m.), Kaffa province.

DEBRE ZEIT Formerly called Bishoftu. Site of Central Experiment Station, 47 km. south of Addis Ababa, elev. 6,500 ft. (1,980 m.). Coffee found cultivated in one place near the station.

DENBI Coffee farm of Getahoun Birke, 62 km. north of Jimma, 7 km. southwest of Suntu, elev. 5,500 ft. (1,760 m.), Limu subprovince, Kaffa province.

DILLA Town 97 km. south of Shashemene, elev. 5,100 ft. (1,550 m.), Sidamo province.

DOYO Modern coffee estate of Ato Teka Egano located a few km. from Jimma, Kaffa province.

ENNAREA Area 50 km. north of Jimma, now Limu subprovince of Kaffa province. Important area for cultivated coffee.

FAGHENA Site of an experiment station on the escarpment, 57 km. northeast of Asmara, elev. 5,650 ft. (1,700 m.), Eritrea. Coffee grown in the vicinity.

FICHI Village 10 km. southwest of Agaro on road to Gera, elev. about 5,890 ft. (1,800 m.), Kaffa province.

FINOTE SELAM Town along main road to Bahar Dar, 74 km. north-northwest of Debre Marcos, elev. 5,750 ft. (1,750 m.), Gojjam province. Coffee grown to a small extent in the area.

GAI Village 40-50 km. west-northwest of Magi, about 6°17' N., 35°11' E., Maji subprovince, Kaffa province.

GEISHA MT. About 50-60 km. north of Maji, elev. 6,000 ft. (1,830 m.), 6°38' N., 35°30' E., Kaffa province.

GERA Town in a rich coffee growing district 50 km. southwest of Agaro, elev. 6,700 ft. (2,040 m.), 7°41' N., 36°24' E., Kaffa province.

GIABA Village about 50 km. west-northwest of Maji, about 6°17' N., 35°11' E., Maji subprovince, Kaffa province.

GICHO Village on Agaro-Gera road, elev. 6,000 ft. (1,830 m.), Kaffa province.

GIMIRA (GHIMIRA) Subprovince of Kaffa province; Mizan Teferi the capital town. Area for coffee.

GIREN Site of experimental farm of Jimma Agricultural Technical School, 5 km. northeast of Jimma along Addis Ababa road, Kaffa province.

GOJJAM PROVINCE Major agricultural area on the Ethiopian plateau north of the Blue Nile River to Lake Tana. Coffee cultivated around Finote Selam and on the Zeghie Peninsula, Lake Tana.

GORE Provincial capital, elev. 6,500 ft. (1,980 m.), Illubabor province.

GOREI Village also called Barda or Borde on the northeastern edge of Geisha Mountain, elev. 5,790 ft. (1,770 m.), 6°42' N., 35°28' E., Maji subprovince, Kaffa province.

HARAR Capital city of Harar province, elev. 6,000 ft. (1,829 m.). Centre of coffee trade. Coffee grown on the edge of the city.

HIRNA Village, 143 km. west of Dire Dawa on main road, elev. 5,090 ft. (1,550 m.), Chercher Hills, Harar province.

ILLUBABOR PROVINCE Southwestern province bounded on the south by Kaffa province. Area of extensive rainforest where wild and naturalised Coffea arabica is found.

JIMMA Provincial capital and leading trade centre for coffee, elev. 5,750 ft. (1,750 m.), Kaffa province.

KABENNA See KOSSA. Ato Kabenna and Ato Mahari Endale operate coffee estates at Kossa.

KAFFA PROVINCE Southwestern province with extensive rainforest where wild and naturalised coffea arabica is found.

KANTHERI Name of a forest adjacent to Wondo-Genet, about 23 km. southeast of Shashemene, Shoa province. Coffee sparingly naturalised.

KOLU (COLU) Village some 35 km. west of Maji, elev. 5,100 ft. (1,550 m.), Kaffa province.

KOMBA Farm of Ato F. Gebre Christos, elev. 5,075 ft. (1,550 m.), Agaro subprovince, Kaffa province.

KONGA Village on main road, 138 km. south of Shashemene, elev. 6,030 ft. (1,850 m.), Sidamo province.

KORCHA Place with two houses on Teppi-Mizan Teferi trail, about 8 km. southwest of Teppi, elev. 3,900 ft. (1,200 m.), Illubabor province.

KOSSA Stopping place 45 km. north of Jimma on Suntu (Limu) road, elev. 6,000 ft. (1,820 m.), Kaffa province.

KURSI (CHERSI) Village about 15 km. west of Maji, elev. 6,120 ft. (1,870 m.), Kaffa province.

LAKE TANA Largest fresh water lake in Ethiopia and source of the Blue Nile river, elev. 6,200 ft. (1,880 m.). Coffee grown on the Zeghie Peninsula across the lake from Bahar Dar.

LIMU See SUNTU. Subprovince of Kaffa province formerly known as Ennarea. Area important for the cultivation of coffee.

MAJI Leading town of Maji subprovince, elev. 7,400 ft. (2,250 m.), in southwestern Kaffa province. Coffee is grown at lower elevations nearby.

MANNA Farm of Ato Gebre Christos Makonnen, near Agaro, elev. 5,000 ft. (1,524 m.), Kaffa province.

MATTU Village 25 km. north of Gore, elev. about 5,500 ft. (1,800 m.) Illubabor province.

MITCHELL COTTS PLANTATION A modern coffee estate at Wondo-Genet, 23 km. southeast of of Shashemene, Shoa province.

MIZAN TEFERI Town on air route southwest of Jimma, elev. at airport 4,600 ft. (1,400 m.), Gimira subprovince, Kaffa province. Coffee is transported by air to Jimma.

OMONADDA (NADDA) Village on Omo River road, 60 km. east-southeast of Jimma, elev. 5,900 ft. (1,800 m.), Kaffa province.

OTA Village about 5 km. west of Agaro on Gera road, elev. about 5,890 ft. (1,900 m.), Kaffa province.

SABATA Village, 15 km. southwest of Addis Ababa on Jimma road, elev. 7,800 ft. (2,390 m.), Shoa province. A few coffee plants grown around the Ghion restaurant.

SAPA Forest area 49 km. north of Jimma, elev. 5,250 ft. (1,610 m.), 7°57' N., 36°48'E., Kaffa province.

SAPA DILDYE Place, 18 km. north of Ghembi village, Agaro road, 53 km. north of Jimma, 8°5' N., 36°54' E., Limu subprovince, Kaffa province.

SAREDO Area 50 km. north of Jimma in Limu subprovince Kaffa province. Formerly the area was know as Ennarea.

SEDECHA Site in forest, 49 km. north of Jimma, elev. 5,300 ft. (1,610 m.), Kaffa province. Coffee extensively naturalised.

SHASHEMENE Town in Shoa province east of Rift Valley and centre for growing coffee.

SHEBE Village along the Bonga road, south end Belleta Forest, about 45 km. west of Jimma, elev. 5,795 ft. (1,830 m.), Kaffa province.

SHEKO FOREST Area adjoining the Tana Plantation, 20 km. south of Mizan Teferi, Kaffa province. Coffee has naturalized and is a source of seed for plantations of the area.

SHOA PROVINCE Coffee cultivated at Welkite and near Shashemene. Generally the province is not suited for growing coffee.

SIDAMO PROVINCE Area largely east of the Rift Valley famed for growing coffee.

SODDU-WALAMO Town in coffee growing area, 90 km. west of Shashemene and the Rift Valley, elev. 5,250 ft. (1,600 m.), Sidamo province.

SUNTU Also called Limu. Village, 70 km. north of Jimma, elev. 5,620 ft. (1,710 m.), Kaffa province. Heart of a rich coffee growing area.

TEPPI Town on air route southwest of Jimma, elev. 4,300 ft. (1,320 m.) 7°9' N., 35°18' E., Illubabor province. Coffee transported by air to Jimma from here.

TUI Village, about 25 km. north of Maji, elev. 5,000 to 6,000 ft. (1,530 - 1,830 m.), 6°22' N., 35°34' E., Maji subprovince, Kaffa province.

TUNTETA Site of a house and planting of coffee near Ainamba, elev. 5,300 ft. (1,620 m.), 6°52' N., 35°27' E., Kaffa province.

WELKITE Town on main Jimma road, 128 km. southwest of Addis Ababa, elev. 6,400 ft. (1,950 m.), Shoa province. The Gurage people cultivate coffee in the area.

WONAGO Village along the main road, 12 km. south of Dilla, elev. 5,800 ft. (1,760 m.), Sidamo province. A wet process coffee pulpery is located here.

WONDO ANBERBER See WONDO-GENET.

WONDO-GENET Area 23 km. southeast of Shashemene, elev. 5,900 ft. (1,800 m.), Shoa province. Coffee is planted and occurs naturalised in a nearby forest.

WUSH WUSH Coffee plantation managed by F. Buckholz, 22 km. west of Bonga, elev. 6,300 ft. (1,920 m.), Kaffa province.

YIRGA-CHEFFE Town, 134 km. south of Shashemene, elev. 5,900 ft. (1,800 m.), Sidamo province.

YIRGALEM Formerly called Dalle. Village, about 64 km. south of Shashemene, elev. 6,000 ft. (1,820 m.), Sidamo province.

ZEGHIE PENINSULA Arm of land projecting into Lake Tana, elev. 6,280 ft. (1,915 m.), Gojjam province. Coffee grown here for a long period of time.

ETHIOPIAN NAMES APPLIED TO COFFEA ARABICA

bun, bunna The whole plant; also the coffee bean and the beverage.

buna wahbera The unripe green fruit for making a kind of cake in Harar.

galaba The hull of the coffee bean.

hashara The broken hulls for tea infusion in Harar.

kasher The cherry of the coffee.

kuti Broken dried leaves for tea infusion in Harar.

APPENDIX III

CONDITION OF COFFEE PLANTS IN FLOWER AND FRUIT DURING THE PERIOD OF THE FAO COFFEE MISSION TO ETHIOPIA, 1964-65

Prepared by F.C. Meyer

October 16:	Addis Ababa, Shoa province. Young green fruit was seen on coffee plants in the compound of the Ministry of Agriculture, elev. about 8,000 ft. (2,340 m.). Addis Ababa is too high for commercial production of coffee although it will ripen about January-February.
October 25:	Finote Selam, elev. 5,750 ft. (1,750 m.), Gojjam province. Some ripe coffee collected but harvesting had not yet begun.
October 26:	Zeghie Peninsula, Lake Tana, elev. 6,280 ft. (1,915 m.), Gojjam province. Coffee fruit still green. Ripe fruit was collected at the beginning of the ripening season on 13 January.
November 1:	Debre Zeit, 47 km. south of Addis Ababa, elev. 6,500 ft. (1,980 m.), Shoa province. Ripe coffee fruit collected in the only field seen in the area. Not really a coffee growing region.
November 5-7:	Chercher Hills, elev. 5-6,000 ft. (1,524-1,830 m.), Harar province. Beginning to middle of the coffee harvest, depending on the elevation.
November 13-16:	Sidamo province: Soddu-Wolamo, Dilla, Yirga-Cheffe, Yirgalem, elev. 5,100-6,000 ft. (1,550-1,820 m.). Middle of the coffee harvest.
November 22:	Jimma, elev. 5,750 ft. (1,750 m.), Kaffa province. Coffee harvest beginning in the area. Lots of ripe coffee in Bada Buna forest.
November 24:	Gore area (Gore, Alle, Mattu), 5,200-6,500 ft. (1,590-1,950 m.), Illubabor province. Coffee harvest underway.
November 24 - December 5:	Agaro district and Gera district, Kaffaprovince. Middle of the coffee harvest.
December 2-5:	Maji subprovince. Geisha mountain, Tui, Kursi, Kolu, Maji vicinity, elev. 5,100-7,000 ft. (1,530-2,020 m.). Ripe coffee available.
December 6:	Limu subprovince, 60 km. north of Jimma, elev. 5,500 ft. (1,675 m.), Kaffa province. Beginning of coffee harvest.

December 8-12: Teppi and vicinity, elev. 4,300 ft. (1,320 m.) and lower, Illubabor province. Coffee harvest finished, with only scattered fruit still on the plants. Peak of the harvest is October but coffee is picked even in June in the area.

December 17-24: Mizan Teferi area (Ainamba, Debre Werk, Bolku, Benessa), elev. 4,365-4,930 ft. (1,330-1,500 m.), Kaffa province. Coffee harvest nearly over.

December 27: Omonadda, 60 km. east-southeast of Jimma, elev. 5,900 ft. (1,800 m.), Kaffa province. Coffee in harvest.

December 29: Jimma, Kaffa province. Most coffee plants in flower due to unseasonable rains during two weeks in December.

December 30 - January 1: Bonga and Wush Wush, elev. 5,860-6,300 ft. (1,790-1,920 m.), Kaffa province. End of the coffee harvest. Plantswere flowering at Bonga.

January 13: Bahar Dar, elev. 6,200 ft. (1,880 m.), Gojjam province. Coffee fully ripe on plants grown in the town.

Zeghie Péninsula, Lake Tana, elev. 6,280 ft. (1,915 m.), Gojjam province. Coffee beginning to ripen but the harvest not yet begun. The red ripe stage was yet another ten days to two weeks away. Seeds germinated from material collected.

January 15: Faghena Experiment Station, elev. 5,650 ft. (1,700 m.), Eritrea. Fruit of C. arabica 'Mocha' was ripe, but the harvest had not yet begun. Another selection, grown as C. arabica 'Ennarea' (not the same as the Ennarea coffee grown in Kaffa province) was still green and would not ripen before April.

APPENDIX IV

OBSERVATIONS ON TIP LEAF COLOUR AND BRANCHING HABIT IN ETHIOPIAN ARABICA COFFEE COLLECTIONS 1/

F.A.O. Coffee Mission 1964-65

by

A. Rama Murthy,
Botany Division, Central Coffee Research Institute,
Coffee Research Station P.O.,
Chikmagalur District, India.

INTRODUCTION

Coffea arabica L. is reported to occur under spontaneous distribution in Ethiopia (1, 5, 8). Arabica coffee collections of Ethiopian origin have been added to the coffee gene bank at the Central Coffee Research Institute from 1953-54 onwards (6). Eighty collections from the FAO expedition to Ethiopia during 1964-65 have also been established. Observations on seedling characters of these collections have been reported (7). The present note contains further observations regarding colour of young unfolding leaves and the nature of the primaries.

OBSERVATIONS

Eighty collections of Arabica coffee material of Ethiopian origin consisting of 2,496 plants were observed for colour of the tip leaf and branching nature of the young primaries. Colour of the tip leaf is scored into four colours - dark bronze or dark brown; light bronze or light brown; light green and copper as recorded in Arabica material elsewhere (2, 4, 6). The angle made by the primaries with the stem is taken into consideration and the growth of the primaries is scored into horizontal, semi-horizontal, erect and semi-erect type. Data from these observations are given in Table 1.

Plants having dark bronze, light bronze, and light green tip leaves are observed in the progenies raised from seed material collected at Shoa, Sidamo, Illubabor and Kaffa provinces. Progenies raised from the collections have shown the following results: Gojjam and Eritrea provinces: plants with light green tip leaves; Harar province: plants with dark bronze and light bronze tip leaves; Shoa and Kaffa provinces: plants showing copper tip leaf colour.

Branching showed the following pattern: Harar and Eritrea provinces: semi-horizontal and semi-erect; Shoa and Sidamo provinces: semi-horizontal, semi-erect and horizontal; Illubabor province: semi-horizontal, semi-erect and erect; Kaffa: horizontal, semi-horizontal, semi-erect, and erect.

1/ Paper submitted in October 1966, based upon observations on seedlings raised from seeds collected during the FAO Coffee Mission.

CONCLUSIONS

Out of the eighty collections observed, six collections - S.2617, S.2628, S.2630, S.2644, S.2655, S.2678-82 - are from individual plants in Kaffa province while the rest are all random collections. This explains the great variation observed in the two characters studied. Of the six collections from individual plants, three - S.2617, S.2628, and S.2630 - show plants with dark bronze, light bronze and light green tip leaves, and S.2644 shows plants with light bronze and light green tip leaves. S.2655 progeny is too small for comment. (Table 1).

Two collections from Shoa show plants with dark bronze tip leaves, two collections from Gojjam, and one from Eritrea show plants with light green tip leaves and all these are uniform as far as the tip leaf colour is concerned. Occurrence of plants with dark bronze or dark brown, light bronze or light brown, and light green tip leaves has been recorded (2, 4). Occurrence of plants with copper tip leaves has also been recorded (6). Only five collections - S.2613, S.2615, S.2645, S.2659, S.2681 - show this character. These are raised from seed collections made in Kaffa and Shoa provinces (6). Further work should throw more light on Ethiopian Arabica coffee.

Many varieties, types and forms have been described in earlier introduction of Arabica coffee (7). But in the Ethiopian material only a few varieties similar to Semperflorens, Typica, Abyssinica, Erecta, and Macrocarpa have been described (3). In the present study, one plant in each of S.2620 and S.2675 which are raised from seed material collected in Kaffa and Illubabor provinces, respectively, show an erect branching habit. Further observations will reveal in what way these plants are similar to the 'Erecta' type described earlier (3).

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TABLE 1

NUMBER OF PLANTS IN EACH COLLECTION HAVING DIFFERENT TIP LEAF COLOUR AND BRANCHING HABIT

CCRI Acc. No.	Dark Bronze				Light Bronze				Light Green				Copper				Total plants observed
	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	
1	2				3				4				5				6
HARAR PROVINCE																	
2599			2	9				2									13
2600			9	15			1	3									28
2601			12	10			3										25
SHOA PROVINCE																	
2602			10	11													21
2605			15	8			1				2						26
2610											3						3
2612			34	8													42
2613			19	19					4		2	1				1	46
2615			38	8											1		47
GOJJAM PROVINCE																	
2707											18	13					31
2709											16	8					24
ERITREA PROVINCE																	
2708											9	4					13
SIDAMO PROVINCE																	
2603			1				3										4
2604	5		33	2			1				2						43
2606	1		16	10							9	3					39
2607	1		9	1	1		1		2		6	6					27
2608			17	5			3	1	1		12	2					41
2609			1	3			2	7			4	4					21
ILLUBABOR PROVINCE																	
2641			1				6	1			1	2					11
2647							7	5			3	5					20
2649				5			5	11			3	2					26
2650							7	8			3	2					20
2652			1	4			9	17									31
2653			2				10	6			18	3					39
2654				4			9	8			12	5					38
2675			2				3			1	3	6					15

TABLE 17 (cont.)

CCRI Acc. No.	Dark Bronze				Light Bronze				Light Green				Copper				Total plants observed
	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	
1	2				3				4				5				6
KAFFA PROVINCE																	
2653			9	2			7	10	3		13	9					53
2614			2	3			10	17				12					44
2616				1			11	20									32
2617			2	4	1		36	22			4						69
2618				1			8	15			8	6					38
2619				1													1
2620			4	4			4	18		1	4	7					42
2621			1	1			9	17			1	7					36
2622							1	1			17	3					22
2623								1			8	33					42
2624							1	3			5	32					41
2625					1		5	5			2	5					18
2626			13	11			2										26
2627			7	32			2	10				1					52
2628				2			5	8				1					16
2629			4	9			2	10			5	8					38
2630				1			1	4			6	10					22
2631			2	2			18	21			6	6					55
2632			5	1			16	4	2		11	5					44
2633			4	4			4	18			4	8					42
2634			2	4			4	11			9	12					42
2635			3	4			7	9			4	15					42
2636			1	2			4	12			3	5					27
2637			4	1			10	5	1		6	13					40
2638	1		25	13			1	5									45
2639			4	1			3	13	1		12	7					41
2640			2				10	12			8	8					40
2642							1	1			21	22					45
2643							1				16	12					29
2644							3	2			25	16					46
2645			9	10			2				2				1		24
2646			1	6													7
2648			2	1			1	1									5
2651								2			4						6
2655								1				1					2
2656							1	3			4	7					15
2657							2	1			21	5					29
2658								1			4	11					16
2659			10	6			6	2			1	9				1	45
2660	4		24	9			8	7	3		5	1					61

TABLE 1 (cont.)

CCRI Acc. No.	Dark Bronze				Light Bronze				Light Green				Copper				Total plants observed
	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	H	E	SH	SE	
1	2				3				4				5				6
KAFFA PROVINCE (cont.)																	
2671							1	8			2	23					34
2672								2			11	16					29
2673				2				1			8	6					17
2674				1							12	8					21
2676			5	7				1			1						14
2677			24	8			5	2		1	12	6					58
2678-82	3		9	1			4										17
2679			8	13			1	1			7	12					42
2680	1		10	8			5				26	8					58
2681			9				6	2	1		21	8			1		48
2683					1		3	2			18	21					45
2684				3			2	14			10	19					48
2706				3							3	6					12
2710											4	15					19

H : Horizontal E : Erect

SH : Semi-horizontal SE : Semi-erect

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APPENDIX V

PRELIMINARY REPORT ON THE COFFEE LEAF RUST (Hemileia vastatrix) MATERIAL RECEIVED FROM THE FAO COFFEE MISSION TO ETHIOPIA 1964-65.

by

A.J. Bettencourt and J. Lopes 1/
Coffee Rust Research Centre,
Oeiras, Lisbon, Portugal.

INTRODUCTION

Between November 1964 and January 1965, the FAO Coffee Mission to Ethiopia sent to the Coffee Rust Research Centre 49 samples (98 accessions) of Hemileia vastatrix Berk. & Br. on Coffea spp., from samples of Hemileia spp. on other Rubiaceae, and 408 accessions of Coffea arabica seed collected in Ethiopia.

Most of the results of the screening of the samples of H. vastatrix for physiologic races have been reported by Bettencourt, Rodrigues and Lopes (1965).

The lack of glasshouse space has considerably delayed the testing of the coffee seedlings, and it is still only possible to report the first results obtained with 228 of the 408 accessions (April 1966).

The techniques used in this work are the same as those described by Oliveira and Rodrigues (1960).

This brief résumé gives some preliminary information on the material collected in Ethiopia.

SCREENING FOR PHYSIOLOGIC RACES OF Hemileia vastatrix Berk. & Br.

From the 49 samples (98 accessions) of Hemileia vastatrix collected by the FAO Coffee Mission to Ethiopia and sent either as infected leaves or as uredospores in gelatin capsules, 46 cultures were established, 44 from rust samples collected on Coffea arabica and two on C. excelsa. Cultures could be established from only about one half of the accessions, as many samples arrived badly damaged by Verticillium hemileiae Bour.

The screening of these 46 cultures led to the characterisation of races II and III, already found on Ethiopian material (Oliveira and Rodrigues 1959), and of race XV, isolated from sample E-10 (Hem. 684), on which it was mixed with race II. Table I summarises these results.

1/ The writers are indebted to Mr. Ilídio Lopes of the Coffee Rust Research Centre for the care taken with the coffee seedlings and the H. vastatrix cultures from Ethiopia; and to Mrs. M. Joaquina Z. Parreira for the great care she has put in the execution of the numerous inoculations performed during the present work.

All the rust samples collected on Rubiaceae of the genera Canthium, Gardenia, Pavetta (aecidia), and Tricalysia gave negative results when inoculated on susceptible coffee plants, such as Coffea racemosa (group F) and C. arabica 'Caturra' (group E).

TABLE 1

Origin of Cultures of Hemileia vastatrix Berk. & Br. and the Physiologic Race to which they belong

Sample No.	Culture No.	Host, if not C. arabica, place of collection and altitude.	Collector	Date	Phys. race
E-10	H. 683	Hirna village (1,550 m.), Chercher Hills, Harar province.	Meyer et al.	6.11.64.	II
do.	H. 684	do.	do.	do.	II & XV
do.	H. 684a	do.	do.	do.	XV
E-13	H. 685	do.	Narasimhaswamy	5.11.64.	II
E-14	H. 686	S of Dilla (1,710 m.), Sidamo province.	Yirgou	13.11.64.	III
E-15	H. 687	SE Shashemene (1,900 m.), Shoa province.	Narasimhaswamy	15.11.64.	II
E-23	H. 695	S of Welkite (1,770 m.), Shoa province.	do.	21.11.64.	II
do.	H. 720	do.	do.	do.	II
E-24	H. 696	Bonga (1,615 m.), Wush-Wush road, Kaffa province.	Fernie	do.	II
do.	H. 721	do.	do.	do.	II
E-28	H. 698	Bada Buna forest (1,750 m.) NE Jimma, Kaffa province.	Fernie & Narasimhaswamy	22.11.64.	*
E-31	H. 700	Agaro, Chochi (1,650 m.), Kaffa province.	Fernie	23.11.64.	III
do.	H. 725	do.	do.	do.	III
E-32	H. 711	Doyo Coffee Plantation, W of Jimma, Kaffa province.	Narasimhaswamy	do.	III
E-33	H. 701	do.	do.	do.	III
do.	H. 726	do.	do.	do.	III

* Rust cultures without indication of race are still under study

TABLE 1 (contd.)

Sample No.	Culture No.	Host, if not C. arabica, place of collection and altitude	Collector	Date	Phys. race
E-34	H. 702	Ghembi village (1,610 m.) N of Jimma, Kaffa province.	Narasimhaswamy	24.11.64	III
do.	H. 727	do.	do.	do.	III
E-40	H. 703	Mattu (1,890 m.), N of Gore, Illubabor province.	Fernie	24.11.64	III
E-41	H. 704	Alle (1,770 m.), N of Gore, Illubabor province.	do.	do.	III
E-62	H. 693	Dildye village (1,630 m.), Sapa region, NW Jimma, Kaffa province.	Narasimhaswamy	26.11.64	III
E-64	H. 694	Saredo village (1,720 m.), SE Limu, Kaffa province.	do.	do.	III
do.	H. 731	do.	do.	do.	III
E-65	H. 713	do.	do.	do.	III
E-73	H. 705	Afallo village (1,820 m.), SE Gera village, Kaffa province.	do.	1.12.64	III
E-74	H. 714	do.	do.	do.	III
E-75	H. 706	Agaro (1,800 m.), Kaffa province.	do.	3.12.64	III
do.	H. 733	do.	do.	do.	III
E-76	H. 715	W of Agaro (1,800 m.), Kaffa province.	do.	do.	III
E-77	H. 707	C. excelsa vel aff. Giren Farm, Jimma Agric. Tech. School, Kaffa province.	Fernie	30.11.64	III
do.	H. 734	do.	do.	do.	III
E-82	H. 708	Chara (1,610 m.) SW of Bonga on Wush-Wush road, Kaffa province.	Narasimhaswamy	6.12.64	III
do.	H. 735	do.	do.	do.	-
E-90	H. 719	Teppi village (1,340 m.) Illubabor province.	do.	9.12.64	II
do.	H. 757	do.	do.	do.	II

TABLE 1 (contd.)

Sample No.	Culture No.	Host, if not C. arabica place of collection and altitude	Collector	Date	Phys. race
E-91	H. 758	SW of Teppi village (1,350 m.), Illubabor province.	Narasimhaswamy	9.12.64	III
E-94	H. 759	E of Teppi village (1,200 m.), Illubabor province.	do.	10.12.64	III
E-95	H. 760	10 km. from Teppi (1,200 m.), Illubabor province.	do.	do.	II
E-99	H. 761	C. excelsa vel aff. Giren Farm, Jimma Agric. Tech. School, Kaffa province.	do.	15.12.64	III
do.	H. 791	do.	do.	do.	III
E-100	H. 762	Bada Buna, NE of Jimma, Kaffa province.	do.	do.	III
E-107	H. 797	Bolku (1,380 m.), W of Benessa, Kaffa province.	do.	20.12.64	Lost
E-119	H. 780	-	-	-	III
E-121	H. 781	-	-	-	III
E-135	H. 808	Bonga village (1,790 m.) Kaffa province.	Meyer	31.12.64	-
E-138	H. 783	do.	do.	do.	III

SCREENING OF *Coffea arabica* L. SEEDLINGS FOR RESISTANCE TO *Hemileia vastatrix* Berk. & Br.

Seedlings of 228 of the 408 accessions of C. arabica seed have been screened to date (April 1966). Many other seedlings of some of these accessions are still awaiting testing.

Of the five coffee groups (C, D, E, I and J) previously found in Ethiopia, and already described in other publications (Oliveira 1958, Oliveira and Rodriques 1959 and 1960, Rodrigues 1960, and Rodrigues and Bettencourt 1965), only groups C and E have so far been detected in the tested material.

Two new groups α and β are however described for the first time:

Group α — This group, typified by clone CIFC. 128/2 (Dilla & Alghe), was separated from group C, on account of its additional susceptibility to race XIX.

Group β — Represented by clone CIFC. 849/1 (Matari), this group includes the most susceptible Arabica coffees ever found in screening at the Oeiras Centre. It was separated from group E to include coffees with susceptibility to race XIX in addition to the other races that attack group E.

Seedlings of both groups need, however, to be further studied in relation to their reaction to races IV, VI, XI, XVIII, XX, and XXI.

Table 2. summarises the reaction of all coffee groups so far found in plant material from Ethiopia. Groups W and γ, although not found in the FAO coffee samples are also referred to here for the first time, since they were recently separated from groups I and J, respectively, on account of their reaction to races XIX and XX.

The screening of the 228 accessions is reported in Table 3.

TABLE 2.

Coffee groups which have been found in Ethiopia and their type clones, according to the reaction they present to the physiologic races of Hemileia vastatrix Berk. & Br. x

Physiologic races of Hemileia vastatrix and number of each type culture	635/3,S. 12 Kaffa	134/4,S. 12 Kaffa	635/2,S. 12 Kaffa	110/5,S. 4 Agaro	32/1, IX 1/6	87/1 Gelaha	128/2 Dilla and Alghe	63/1, Bourbon	849/1, Mutari
	W	I	∝	J	D	C	∝	E	ℬ
I (22)					S			S	S
II (15)								S	S
III (37)						S	S	S	S
IV (32)									?
VI (71)									?
VII (130a)								S	S
VIII (166)					S			S	S
X (137a)	S	S	S	S		S	S	S	S
XI (221)									?
XII (167a)					S	S	S	S	S
XIII (138a)								S	S
XIV (178a)			S	S	S			S	S
XV (70)			S	S				S	S
XVI (178c)	S	S	S	S	S	S	S	S	S
XVII (292)					S	S	S	S	S
XVIII (92)									?
XIX (264) xxx		MR	MR				MR		MR
XX (394)		MR	MR				?		?
XXI (256)									?
XXII (535)								S	S
XXIII (292a)	MS	MS	MS	MS	S	S	S	S	S

x = Blanks correspond to resistant reactions, i.e., reactions where no spores are formed; S = susceptible; MR = moderately resistant; MS = moderately susceptible.

xx = 635/2 and 635/3 initially included in Group I.

xxx = Reactions of this race vary from MR to MS.

? = Reaction needs confirmation.

TABLE 3

Reaction Group of *Coffea arabica* L. Collected by the FAO Coffee Mission to Ethiopia

FAO No.	C.R.R.C. No.	Locality	Collector	Seedling numbers and reaction groups**
E-1*	1669	Finote Selam, Gojjam Prov.	F.G.Meyer	2,3,6 to 9,13 group β; 1,4,5,10,12 group E
E-2*	1670	" " " "	"	1,3 to 8,10,12 to 14,16, 17,20,24 group β; 2,11,15, 19,21 to 23,25 group E
E-3	1671	" " " "	"	3,4,7,11 group β; 1,2,5, 6,8,9,12 to 14 group E
E-4*	1672	" " " "	"	3,5,9,12 group β; 1,2,7, 8,18 group E; 15,16 group C
E-5	1673	Debre Zeit, 47 km S.Addis Ababa	"	1,2,4, to 11 group E; 3 group C
E-6*	1674	Combulchia, Harar Prov.	"	1 to 6,8 group E
E-8	1675	Bio Dangago, " "	"	1 to 4 group E
E-11	1676	Asbe Teferi, " "	"	7 group β; 1,2,5,6,8,10 to 16 group E; 3,4 group C
E-16	1677	23 km SE. of Shashemene, Shoa Prov.		1 to 6,8 to 11 group E; 7 group C
E-17*	1678	Wonago village, Sidamo Prov.	"	5 group E; 1,2,4,6 to 15, 17 to 19 group C
E-18*	1679	7 km N. of Yirga-Cheffe, Sidamo Prov.		2 group β; 1,3 to 8,10,12 group E; 9 group C
E-19*	1680	Konga village, Sidamo Prov.	"	2,4 to 6,8,10 to 14 group E; 1,3,9, group C
E-20	1681	Dilla village, " "	"	1 group C
E-21*	1682	90 km W. of Shashemene, Sidamo Prov.	"	1,3 group E; 4 group C
E-22*	1683	Soddu-Wollamo village, Sidamo Prov.	"	2 to 9,11 to 19 group E

../..

* A few seedlings of this accession not included here have not yet been screened to all the physiologic races

** Some of the seedlings included here in groups C and E were not yet inoculated with race XIX

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-190	1792	Teppi, Illubabor Prov.	F.G.Meyer	12 group E
E-192	1794	" " "	"	2,5 to 7 group E; 1,9 group C
E-200	1802	" " "	"	1,3 to 5,7 group E
E-203	1805	" " "	"	6 group C
E-208*	1810	" " "	"	1,13 to 15 group E
E-209*	1811	" " "	"	2 to 4,9 group E
E-217*	1818	" " "	"	2,5,8 to 14 group E
E-219*	1820	" " "	"	1 to 3,6 group E
E-222	1823	" " "	"	6 to 8,10 group E
E-223	1824	" " "	"	7,8 group E
E-224	1825	Between Teppi village and the Baco River, Illubabor Prov.	"	11,12 group E
E-226*	1827	Sheko Forest, Kaffa Prov.	"	1, to 3,5 to 9 group E; 4 group C
E-227*	1828	" " "	"	2,4 group β; 1,3,5,7,9 group E
E-228*	1829	" " "	"	1 to 4,6,8 to 10,12 to 14 group E
E-229	1830	" " "	"	1,3,5, group E
E-232*	1832	" " "	"	9 group E; 5 group C
E-233a	1834	Mesan Teferi airport, Kaffa Prov.	"	3,7 group E
E-295	1840	Sapa Dildye, Kaffa Prov.	L.Monaco	1,3,4,6 to 8 group E
E-296	1841	" " "	"	1 to 5 group E
E-297	1842	" " "	"	4 group β; 2,3,6 group E
E-300	1845	" " "	"	5 group C
E-301*	1846	Doyo village, "	"	4,9 group β; 1,7 group E; 5 group C
E-303*	1848	" " "	"	1,10 group E; 4,5,9 group C
E-306	1851	" " "	"	5 group β; 4.6 to 8 group E; 2,9 group C

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-307*	1852	Doyo village, Kaffa Prov.	L.Monaco	1,2,7 group E; 5 group C
E-308	1853	" " " "	"	2 group β; 3 to 9 group E
E-310	1855	" " " "	"	5 group β; 1,2,4,6 group E
E-311	1856	Dembi Farm, " "	"	7 group C
E-315*	1860	Saredo, " "	"	1,to 3,5,7,8 group C
E-316	1861	" " "	"	7 group C
E-319	1864	" " "	"	1,2,5,10 group C
E-320*	1865	" " "	"	3,5,7,9 group C
E-321*	1866	" " "	"	7 groups; 1 to 3,4,10 gr C
E-323	1868	Suntu village, Kaffa Prov.	L.Monaco	1,2,5,7,9,10 group E;8 group C
E-324	1869	" " " "	"	1,2,7 group E
E-326*	1871	Gera village, " "	"	4,6 to 8 group E; 1 group C
E-327	1872	" " " "	"	6 group E
E-328*	1873	" " " "	"	3 group E; 1,2,4,5,7,8 group C
E-329*	1874	" " " "	"	3,4,6,7,9, group E; 1 group C
E-330	1875	" " " "	"	1,3,5,7, group E; 6 group C
E-334	1879	" " " "	"	1,2,7,9, group E
E-335*	1880	" " " "	"	1 to 4 group E; 7 group C
E-336	1881	" " " "	"	1 to 7,9 group E
E-337	1882	" " " "	"	6 group β; 1 to 5 group E
E-341*	1885	" " " "	"	1,6 group β; 4,5,7 group E; 2 group C
E-343	1887	" " " "	"	1,2,4 to 7,9, 10 group C
E-344*	1888	" " " "	"	3 to 5 group E; 8 group C
E-345*	1889	" " " "	"	5 to 7,9 group E
E-347	1891	" " " "	"	2 to 6 group E
E-348*	1892	" " " "	"	2 to 7 group E

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-349*	1893	Gera village, Kaffa Prov.	L.Monaco	4,6,8 group E
E-352*	1896	" " "	"	2,5,9 group C
E-353	1897	SW. of Gera, Illubabor Prov.	"	8 group E; 1 to 7,9, 10 group C
E-355	1898	" " " "	"	4 group E; 1 to 3,5 to 7 group C
E-356	1899	" " " "	"	4 group E; 1,2,5 to 7 group C
E-357*	1900	" " " "	"	1,5 group E; 2 to 4 group C
E-358*	1901	" " " "	"	8 group E; 1,4,7,9 group C
E-359*	1902	" " " "	"	2 to 4,6,7 group C
E-360*	1903	" " " "	"	2,3,5,6 group C
E-361*	1904	" " " "	"	3 to 7 group E; 2 group C
E-362*	1905	" " " "	"	1,2,5,6 group E; 4,7, 8 group C
E-363*	1906	" " " "	"	1,4 group C
E-364	1907	" " " "	"	1,4 to 6 group E; 3 group C
E-365*	1908	" " " "	"	1,5 to 8,10 to 12 group E; 3 group C
E-366*	1909	" " " "	"	1 group β; 4,9 group E
E-367	1910	" " " "	"	1 to 4,7,8 group E; 5 group C
E-368*	1911	" " " "	"	1 to 3,5 to 7,9, 10 group C
E-369*	1912	" " " "	"	3 to 5 group E
E-370*	1913	" " " "	"	1 group β; 2 group E; 3,4,6,7,9 group C
E-371*	1914	" " " "	"	3,4,8,10 group E; 7,9, group C
E-372	1915	" " " "	"	1,3 to 5,7,8,10 group E; 2,6, group C

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-373*	1916	SW. of Gera, Illubabor Prov.	L.Monaco	2,3 group E; 1,5 group C
E-374*	1917	" " " "	"	1,5,8,10 group E;
E-376*	1919	5 km N. of Afallo village, Kaffa Prov.	"	3,4 group E; 7 group C
E-377	1920	8 km from Gera,Kaffa Prov.	"	6 group C
E-378	1921	" " "	"	3 group E; 2 group C
E-379	1922	" " "	"	6 group C
E-384	1925	" " "	"	1 to 6,8,9 group C
E-386	1927	5 km N. of Afallo village, Kaffa Prov.	"	6 group E
E-387	1928	" " "	"	6 group C
E-389	1930	" " "	"	1 to 5 group E
E-392	1933	" " "	"	2,6,7 group E
E-393*	1934	30 km NE. of Gera,Kaffa Prov.	"	1,5 group E;2,3,7,9 group C
E-394	1935	17 km NE. of Gera, " "	"	2,5 to 7 group E;4,8 group C
E-395	1936	" " " "	"	1 to 10 group E
E-396	1937	" " " "	"	2,7,8 group E;3,4 group C
E-399*	1940	" " " "	"	1,3 to 5,10 group E
E-400*	1941	" " " "	"	2,4,6 group E; 9 group C
E-401*	1942	Ota village, Kaffa Prov.	L. Monaco	2,3,5 to 7,9 group E; 1,4 group C
E-402*	1943	" " " "	"	4 group C
E-403*	1944	" " " "	"	1 to 3,6 to 8 group E; 5 group C
E-404*	1945	" " " "	"	3,7 group C
E-405*	1946	" " " "	"	9 group E; 7,8 group C
E-406	1947	" " " "	"	6 group C
E-407*	1948	" " " "	"	1 to 3,6 group E
E-408	1949	8 km W. of Bonga, Kaffa Prov.	"	1,4,8,9 group E
E-409	1950	" " " "	"	1 to 3,5 to 10 group E

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-411	1952	8 km W. of Bonga, Kaffa Prov.	L.Monaco	2,6 group E
E-412*	1953	5 km from Bonga, " "	"	1,2,4 group β; 3,7,9 group E
E-413*	1954	" " " "	"	1 to 3,5,7,10 group E
E-415	1955	" " " "	"	2,3,7,8 group E
E-416	1956	" " " "	"	4,7 group C
E-417	1957	" " " "	"	2,5,8 group E
E-418	1958	" " " "	"	3,8,9 group β;2,6 group E; 4,7,10 group C
E-420*	1960	" " " "	"	1,3,5,6 group C
E-423*	1963	8 km SW. of Teppi village, Illubabor Prov.	"	1,3,4,6 group E
E-424*	1964	" " "	"	7,8 group E
E-428*	1968	" " "	"	3,5,7 to 9 group E;1 group C
E-429*	1969	" " "	"	1,5,7 group E
E-432	1972	" " "	"	2 to 4,6 to 9 group E
E-434*	1974	" " "	"	4 group C
E-436	1976	" " "	"	2 group E;1,3 to 6 group C
E-437*	1977	8 km E. of " "	"	10,18 group E; 3,7,9,20 group C
E-438*	1978	" " "	"	1,8,12 group E
E-439*	1979	" " "	"	4,8,9,11,14 group E; 17 group C
E-442	1982	" " "	"	20 group C
E-443*	1983	" " "	"	6,11,17 group C
E-444*	1984	" " "	"	5,16 group C
E-446*	1986	" " "	"	1 group β; 2,5,11,16,17 group E; 10 group ∝; 7,8, 13,14 group C
E-447*	1987	" " "	"	6 group E
E-448*	1988	" " "	"	1 to 3,8,14,20,21 group E; 7,9,10,12,15 group C
E-450*	1990	" " "	"	1 group B; 5 to 7,9,11,13, 15,16 group E; 3,10,12 group C

TABLE 3 (contd.)

FAO No.	C.C.R.C.	Locality	Collector	Seedling numbers and reaction groups
E-451*	1991	8 km E. of Teppi village, Illubabor Prov.	L. Monaco	10 group C
E-452*	1992	" " "	"	3,4,9 to 11,15,19 group E; 1 group ∝
E-453*	1993	" " "	"	5,9,11 group E
E-454*	1994	10 km SE. " "	"	2 to 4,12,13, 16 group E; 5,8, to 10 group C
E-455*	1995	" " "	"	5,7 to 10,12, 14 group E; 2 group C
E-456*	1996	" " "	"	3,5,10 group β; 2,4,6, 8,9,11,14,16,17,19 group E; 13 group C
E-457*	1997	" " "	"	3,5, to 8,11,14 group E; 13,15 group C
E-458*	1998	" " "	"	5,7,8,10,12 group E
E-459*	1999	" " "	"	1 to 6,10,11,13,14,16, 19,21 to 23 group E; 7, 17 group C
E-460*	2000	" " "	"	1,5,6,8,11 to 13,16,18 group E;3,4,10,17,20 group C
E-461*	2001	" " "	"	1 to 3,7,13,15,16,18 group E
E-462*	2002	" " "	"	1 to 3,5 to 7,9 to 12, 14,16 group E;4,15 group C
E-463*	2003	7 km SE. of " "	"	1 to 6,8,10,11,13 to 15 group E; 9 group C
E-464*	2004	" " "	"	12 group β;1 to 3,5,8 to 12,15 to 18 group E; 6 group C
E-465	2005	" " "	"	1,3 to 10 group E
E-466*	2006	" " "	"	1 to 4,6 to 8,10 group E; 5 group C
E-467*	2007	Fichi village, Kaffa Province	"	1,2,4 group E; 3,6 to 8 group C
E-468*	2008	" " "	"	4,5,7 group C
E-469*	2009	" " "	"	1,3,4,8 group E
E-470*	2010	" " "	"	1 to 5,8,9 group E; 6 group C
E-471*	2011	" " "	"	2 to 4,10 group E; 1,6 group C

TABLE 3 (contd.)

FAO No.	C.C.R.C. No.	Locality	Collector	Seedling numbers and reaction groups
E-472*	2012	Fichi village, Kaffa Prov.	L.Monaco	1,3 to 5 group E
E-473*	2013	" " "	"	2 to 5 group E
E-474*	2014	Sapa Dildye, "	"	1,2 group E;4 group C
E-475*	2015	" " "	"	2,3,6,8 group C
E-476	2016	" " "	"	4,5 group C
E-477	2017	" " "	"	2 group E; 4,7,9 group C
E-478	2018	" " "	"	1,2 group C
E-479	2019	" " "	"	1,2 group E
E-480*	2020	" " "	"	3 group C
E-481*	2021	" " "	"	1,5,7 group C
E-482	2022	" " "	"	1 group C
E-483*	2023	" " "	"	2,3,5 to 7,9,24 group E; 8 group C
E-484*	2024	" " "	"	1 group E
E-485	2025	" " "	"	1,2 group E; 5,10 group C
E-486*	2026	" " "	"	10 group E; 3 to 5,7 to 9 group C
E-487	2027	" " "	"	1 to 4,6 group C
E-488*	2028	" " "	"	2 to 10 group E
E-489	2029	" " "	"	1 to 8 group E
E-490*	2030	" " "	"	1,6 to 8 group C
E-491	2031	" " "	"	1,3,6 group E; 2,4,5 group C
E-492*	2032	" " "	"	4 group C
E-493*	2033	Kossa-Kabenna, "	"	3 group E; 8 group α; 1, 2, 5 group C
E-494	2034	" " "	"	1 to 6,8,9 group C
E-495*	2035	" " "	"	9 group β; 4 to 8 group E
E-496*	2036	" " "	"	2,4 to 9 group E
E-497	2037	" " "	"	1 to 6 group C
E-498*	2038	Ato Shibeshi, "	F.G.Meyer	2,4 to 6 group E; 1,7,8, 10 group C
E-499*	2039	Bolku "	"	6,7 group β; 2,3,10 to 15 group E

TABLE 3 (contd.)

FAO No.	C.C.R.C. No.	Locality	Collector	Seedling numbers and reaction groups
E-500*	2040	Debre Werk village, Kaffa Prov.	F.G.Meyer	10 group E; 12 group C
E-501	2041	" " " "	"	2 to 13 group E
E-502	2042	Bolku, Kaffa Province	"	1,2 group E
E-503	2043	" "	"	1,2,4,5 group E; 3 group C
E-504*	2044	" "	"	1 to 6,9 to 11,13 group E; 8, 12 group C
E-505	2045	" "	"	3,5,11 group β; 1,2,4,6 to 9 group E; 10 group C
E-507*	2047	" "	"	6 group β; 1 to 5,7,9, 13,14 group E;15 group C
E-508*	2048	" "	"	1 to 6,8 group E
E-509*	2049	" "	"	2 to 5,9,10 group E
E-510*	2050	" "	"	1 to 3,5 group E
E-511	2051	" "	"	1 to 8 group E
E-512*	2052	" "	"	1,2,4,6 to 10 group E
E-513*	2053	" "	"	2 to 4,7,8 group E; 1, 5 group C
E-514*	2054	" "	"	1 to 10 group E
E-515	2055	" "	"	1 to 9 group E
E-516*	2056	Tunteta, Kaffa Province	"	1 to 3,5,6 group E
E-517*	2057	" "	"	2,4 group E; 9 group C
E-518	2058	" "	"	1 to 9 group E
E-519*	2059	" "	"	3 group β; 1, 4 to 9 group E
E-520*	2060	" "	"	6 group β; 1,2,4,5,8 to 13 group E
E-521*	2061	" "	"	4 group β; 2,3,5,7 to 9 group E; 6 group C
E-522	2062	" "	"	1 to 9 group E
E-524*	2064	Omonnada village, Kaffa Prov.	"	3,5,10,13 to 15 group β; 1,4,6 to 9,11,12 group E
E-525	2065	Jimma, Kaffa Province	"	12 group β; 1 to 6,8 to 11
E-526*	2066	" "	"	1,2,4, to 6,8 to 10,13 group E;3,14 group C
E-557	2067	Zeghie village, Gojjam Prov.	"	1 to 3,5 to 7,9 to 15 group E; 4,8 group C
E-558	2068	" " "	"	3,7 group β; 1,2,4 to 6,8 to 10 group E

TABLE 3 (contd.)

FAO No.	C.C.R.C. No.	Locality	Collector	Seedling numbers and reaction groups
E-559*	2069	Zeghie village, Gojjam Prov.	F.G.Meyer	5,6 group β; 1 to 4,7 to 10 group E
E-560*	2070	" "	"	3,5,8,12 group β; 1,2,6, 9 to 11 group E; 4 group C
E-561	2071	" "	"	2 to 4,7,10,11 group β; 5,6,8,9 group E
E-562	2072	" "	"	2,5,7,9,10,12 group β; 1,3,4,6,11 group E
E-563	2073	" "	"	1,2,5,7 group β; 3,4,6, 8 to 13 group E
E-564	2074	" "	"	2 to 4,8 group β; 1,6,9 group E; 5 group ϰ
E-565*	2075	" "	"	1,2,4,5,12,13 group β; 6 to 11,15 to 17 group E
E-566*	2076	" "	"	2 to 4,6 to 8,12,13 group β; 1,5,9 to 11 group E
E-567	2077	" "	"	4 to 7 group β; 2,3,8 to 11 group E
E-568*	2078	" "	"	2,6 to 8,12,13,15 group β; 1,4,5,9,11,14 group E
E-569*	2079	" "	"	1,2 group β; 3 to 7,9 to 11 group E
E-570	2080	" "	"	3,5,9 group β; 1,4,6 to 8 group E
E-574	2083	" "	"	3,5,8,9 group E
E-576	2085	Bahar Dar, "	"	2,3,5,7 to 9 group E
E-578	2086	" " "	"	4,9,12,14,15,20,22,23, 25,28 group E

DISCUSSION

Of the 408 coffee samples collected by the FAO Coffee Mission to Ethiopia, 228 have been screened and some reactions of the seedlings reported here still need to be confirmed. It is impossible, therefore, to give a detailed discussion of such preliminary results. It may be legitimate, however, to indicate here briefly, although with all the necessary restrictions, some pertinent aspects of the results already available.

Groups D,I,J.W. and γ , formerly characterized in accessions collected in Ethiopia by Bechte, Buckholz, Siengenthaler, and Sylvain, have not been detected so far in the material under study. On the other hand, two new groups, ∝ and β, were defined by means of race XIX. Unfortunately, it is not possible to state whether or not there were seedlings of these groups in the Ethiopian coffees previously screened, as at that time race XIX had not yet been differentiated. For the same reason it is not possible to know whether seedlings previously included in groups C,E,I, and J did in fact belong to these groups or should rather be included in groups ∝ , β, W, and ϰ , respectively,

The behaviour of coffee seedlings included in groups α, β, γ, and I towards race XIX leads us to admit that a new factor for host resistance $Subscryst_H5$ might be present in the coffee plants not attacked by this race, i.e., plants of groups E, D, C, J, and W, which is now under study.

The screening of the 46 rust cultures established from the samples received lead to the identification of the two most common physiologic races in Ethiopia, i.e. races II and III. Race XV was found for the first time in material from Ethiopia in a mixed sample collected at the Hirna village in the Harar Province. It is interesting to note that the presence of this race in Ethiopia had already been predicted by the Oeiras Center, on account of the existence in that country of coffees belonging to groups J and I, which carry the factor $Subscryst_H4$ for resistance to H. vastatrix.

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APPENDIX VI

LIST OF PESTS AND OTHER INSECTS COLLECTED ON THE ARABICA COFFEE PLANT (COFFEA ARABICA) COLLECTED IN ETHIOPIA BY D.J. GREATHEAD, FAO COFFEE MISSION, 1964-65

A. INSECTS

Achrysocharis richiei Ferr. (parasite on Leucoptera caffeina)

Acrocercops sp. (moth Miner)

Ant (Monomorium sp.)

Antestia Bug (Antestiopsis intricata and A. orbitalis ghesquierei)

Antestiopsis intricata (Ghesq. and Car.) (Hemiptera : Pentatomidae) - Antestia Bug

Antestiopsis orbitalis ghesquieri Car. - Antestia Bug

Apanteles bordagei Gir. (Parasite on Leucoptera caffeina)

Aphytis sp. (Hymenoptera : Aphelinidae) - (parasite of scale Coccus alpinus)

Berry Boring Moth (Olethreutes sp.)

Blotch Leaf Miner (Leucoptera caffeina)

Bogosia sp (Tachinid)

Braconid parasites: Opius (Biosteres) sp. near O. desideratus and Opius sp. of the africanus group

Ceratitis rosa Karsch (Trypetidae) - Natal Fruit Fly

Ceroplastes sp. - White Waxy Scale

Chrysocaris lepelleyi Ferr. (parasite on Leucoptera caffeina)

Cirrospilus sp. (parasite on Acrocercops sp.)

Coccidioxenos sp. (Hymenoptera : Encyrtidae) - (parasite of scale Shitococcus formicarius)

Coccophagus sp. (Hymenoptera : Aphelinidae) - (parasite of scale Coccus alpinus)

Coccus alpinus de Lotto (Hemiptera : Coccidae) - Green Scale

Corioxenos antestiae Blair - (Parasite on Antestiopsis)

Crematogaster ?africanus Mayr - ant

Ctenochiton arborescens Laing - Scale

Derostenus coffeae (parasite on Acrocercops sp.)

Elasmus sp. ?johnstoni Ferr. (parasite on Leucoptera caffeina)

Epiplema sp. near dohertyi Warr. (Lepidoptera : Uraniidae) - Leaf Skeletonizer

Fruit Fly: Ceratitis rosa
Trirhithrum coffeae

Green Fly (Toxoptera aurantii)

Green Scale (Coccus alpinus)

Leaf Skeletonizer (Epiplema sp. near dohertyi)

Leucoptera caffeina Washbn. (Lepidoptera : Lyonetidae) - Blotch Leaf Miner

Lygus coffeae China (Hemiptera : Miridae) - Mirid Bug

Mealy Bug - (Pseudococcus sp.)

Melanagromyza coffeae Hering = M. coffeeae

Melanagromyza coffeeae Konigsb. (Diptera : Agromyzidae) - Serpentine Miner

Metaphycus sp. (Hymenoptera : Encyrtidae) - (parasite of scale Coccus alpinus)

Mirid Bug (Lygus coffeae)

Monomorium sp. - Ant

Moth Borer (Lepidoptera : Cossidae)

Moth Miner (Acrocercops sp.)

Myrmecaria eumenoides Gerst. - Ant

Natal Fruit Fly (Ceratitis rosa)

Olethreutes sp. (Lepidoptera : Tortricidae) - Berry Boring Moth

Opius sp. aff. africanus Szepl. - Braconid parasite on Ceratitis rosa and Trirhithrum coffeae

Opius (Biosteres) sp. near O. desideratus Bridw. - Braconid parasite on fruit flies Ceratitis rosa and Trirhithrum coffeae

Pediobius coffeicola Ferr. (parasite on Leucoptera caffeina)

Plusia sp. (Agrotidae)

Pseudococcus sp. - Mealy Bug

Rolaspis sp. Mussel-like Scale

Scale: Ceroplastes sp.
Ctenochiton arborescens
Rolaspis sp.
Selenaspidus articulatus
Stictococcus formicarius

Selenaspidus articulatus Morgan - Scale

Serpentine Miner (Melanagromyza coffeeae)

Shitococcus formicarius Newst - Scale

Toxoptera aurantii Boy (Aphididae) - Green Fly

Toxoptera cammeliae Kalt. = T. aurantii

Trirhithrum coffeae Bezzi - Fruit Fly

White Waxy Scale (Ceroplastes sp.)

B. SNAILS

Africarion (Urocyclidae)

APPENDIX VII

LIST OF PARASITIC LEAF FUNGI ON COFFEA ARABICA, AND OTHER RUBIACEAE

Prepared by F.G. Meyer

Species recorded: C.arabica:

Aschersonia goldiana Sacc. and Ell.
Cercospora coffeicola Berk. and Cke.
Hemileia vastatrix Berk. and Br.
Meliola coffeae Hansf.
Trichothyrium reptans (Berk. and Curt.) Hughes
Verticillium hemileiae Bouriquet

Species recorded on other Rubiaceae:

Hemileia gardeniae-thunbergiae (P.Henn.) Maubl. and Roger (Host Gardenia lutea Fresen.)
Hemileia holstii Syd. (Host Psychotria orophila Petit)
Hemileia pavetticola Maubl. and Roger (Host Pavetta sp.)
Unknown Ascomycete (Host Canthium ruwenzoriense Bullock)

Determinations on all fungus materials were kindly made by John A. Stevenson, collaborator, Mycology Investigations, Beltsville, Maryland. Documented specimens are on permanent deposit in the herbarium of the National Fungus Collections, Beltsville. Spore material for most of the collections was sent to Dr. Branquinho d'Olivera, Estaçao Agronómica Nacional, Oeiras, Portugal for rust screening and other studies. (Preliminary report, Appendix V)

A. Leaf fungi on Coffea arabica

E-10.....Hemileia vastatrix Berk. and Br.

On host cultivated in a small field belonging to Ato Ebro near Hirna village, 143 km west of Dire Dawa, Chercher Hills, elev. 1,155 m 9°12' N, 41°7.5' E, Harar Prov. Coll. R.L. Narawimhaswamy. 6 November 1964.

E-13.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-10. Coll. R.L. Narasimhaswamy

E-14.....Hemileia vastatrix Berk. and Br.

On host cultivated just south of Dilla, elev. 1,700 m, 6°25' N, 38°18' E, Sidamo Prov. Coll. Dagnatchew Yirgou. Nov. 13, 1964.

E-15.....Hemileia vastatrix Berk. and Br.

Fairly common on host cultivated in Mitchell Cotts plantation, 25 km. SE. of Shashemene, elev. 1,900 m, ca 7°7' N, 38°40' E, Shoa Prov. Coll. F.G. Meyer. Nov. 15, 1964.

E-23.....Hemileia vastatrix Berk. and Br.

Rare at this locality; found on 8 plants only 4 to 6 years old, cultivated in a field of several hectares, in full sun and interplanted between Ensete ventricosum 5 km south of Welkite, elev. 1,950 m, 8°15' N, 38°10' E, Shoa Prov. Coll. R.L. Narawimhaswamy 21 November 1964.

E-24.....Hemileia vastatrix Berk. and Br.

Found on one plant only in an open situation along Bonga Wush-Wush road, elev. 1,615 m, Kaffa Prov. Coll. L.M. Fernie. 21 November 1964.

E-25.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-23. Coll. R.L. Narasimhaswamy

E-26.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-24. Coll. L.M. Fernie

E-27.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On spontaneous host plants in woodland near village of Sedecha, elev. 1,500 m, Limi subprovince, Kaffa Prov. Coll. L.M. Fernie. 21 November 1964.

E-28.....Hemileia vastatrix Berk. and Br.

Occasional on host grown in high shade of secondary forest trees consisting of Celtis africana, Pygium africana, Rothmannia urcelliformis, Syzgium guineense, Croton macrostachys, and Schefflera abyssinica as dominants of the upper story; Bada Buna forest, 10 km NE. of Jimma, elev. 1,750 m, 7°40' N, 36°52' E, Kaffa Prov. Coll. L.M. Fernie and R.L. Narasimhaswamy. 22 November 1964.

E-31.....Hemileia vastatrix Berk. and Br.

Occasional on host growing spontaneously in secondary woodland near Chochi, on old Agaro road, elev. 1,620 m, Kaffa Prov. Coll. L.M. Fernie. 23 November 1964.

E-32.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Parasitized rust common on host grown in a field with light shade, Doyo coffee plantation, owned by Ato Teka Egano, ca 8 km west of Jimma, ca 7°40' N, 36°50' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 23 November 1964.

E-33.....Hemileia vastatrix Berk. and Br.

On host cultivated under shade of Albizia schimperiana and Cordia africana. Some host plants with unparasitized rust. Same locality as E-32. Coll. R.L. Narasimhaswamy. 23 November 1964.

E-34.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Occasional on host growing at edge of woodland in small clearings, 49 km N of Jimma, via Agaro road, turning right at Ghembo village, thence to coffee holding of Dedjazmatch Johannes Girma, elev. 1,610 m, ca 7°57' N, 36°48' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 24 November 1964.

E-40.....Hemileia vastatrix Berk. and Br.

Occasional on host plants by Sur River bridge, near Mattu, 20 km north of Gore, elev. 1,890 m, 8°18' N, 35°33' E, Illubabor Prov. Coll. L.M. Fernie. 24 November 1964.

E-41.....Hemileia vastatrix Berk. and Br.

On host along roadside at Alle, about 10 km north of Gore, elev. 1,568 m, 8°15' N, 35°33' E, Illubabor Prov. Coll. L.M. Fernie. 24 November 1964.

E-62.....Hemileia vastatrix Berk. and Br.

On host growing spontaneously, Sapa Dildye, 53 km NW. of Jimma, property of Ato Shone Seda, elev. 1,630 m, Kaffa Prov. Coll. R.L. Narasimhaswamy. 26 November 1964.

E-63.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-62. Coll. R.L. Narasimhaswamy.

E-64.....Hemileia vastatrix Berk. and Br.

Occasional on host planted under light shade, 20 km southeast of Suntu (Limu), property of Ato Getahoun Birke, elev. 1,720 m, Kaffa Prov. Coll. R.L. Narasimhaswamy. 26 November 1964.

E-65.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On host plants cultivated on property of Ato Getahoun Birke at Saredo, 20 km SE. of Suntu (Limu), elev. 1,720 m, Limu sub-province, Kaffa Province. Coll. R.L. Narasimhaswamy. 26 November 1964.

E-73.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On host growing in an abandoned field in full sun at Afallo, 15 km southwest of Gera village, elev. ca 1,820 m, 7°43' N, 36°17' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 1 December 1964.

E-74.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Collected from eight plants. Same locality and date as E-73. Coll. R.L. Narasimhaswamy.

E-75.....Hemileia vastatrix Berk. and Br.

Abundant on host planted along main road, 2 km west of Agaro, elev. 1,800 m, 7°5' N, 36°37' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 3 December 1964.

E-76.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

The parasitized rust is abundant on the host at the same locality as E-75. Coll. R.L. Narasimhaswamy. 3 December 1964.

E-77.....Hemileia vastatrix Berk. and Br.

On Coffea excelsa vel aff. planted on experimental farm of Jimma Agricultural Technical School at Giren, 5 km NE. of Jimma, 7°35' N, 36°50' E, Kaffa Prov. Coll. L.M. Fernie. 30 November 1964.

E-82.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Abundant on plants in open situation growing spontaneously, not in a plantation, 8 km SW. of Bonga on Wush-Wush Road at Chara, elev. ca 1,610 m, ca 7°15' N, 36°12' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 6 December 1964.

E-90.....Hemileia vastatrix Berk. and Br.

Abundant on host planted in Teppi village, elev. 1,340 m, 7°8' N, 35°18' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 9 December 1964.

E-91.....Hemileia vastatrix Berk. and Br.

On host plants growing spontaneously in deep rain-forest, 7 km SW. of Teppi village, elev. 1,350 m, 7°9' N, 35°18' E, Illubabor Prov. Spores very light yellow. Coll. R.L. Narasimhaswamy. 9 December 1964.

E-92.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Occurs with the unparasitized rust on cultivated coffee growing in Teppi village, elev. 1,340 m, 7°8' N, 35°18' E, Illubabor Prov. Coll. R.L. Narasimhaswamy 9 December 1964.

E-93.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Occurs with the unparasitized rust on spontaneous seedling and mature coffee plants in rain-forest, 7 km SW. of Teppi village, elev. 1,350 m, 7°9' N, 35°18' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 9 December 1964.

E-94.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On seedlings and mature host plants growing spontaneously about 8 km due east of Teppi village via trail that crosses the Baco River near the village leading into rain-forest country, elev. 1,200 m, 7°8' N, 35°19' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 10 December 1964.

E-95.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

The parasitized rust common the the host in rain-forest, Teppi-Mizan Teferi trail, ca 10 km from Teppi, elev. ca 1,200 m, ca 7°8' N, 35°20' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 11 December 1964. Spores light yellow.

E-96.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

The parasitized rust common on host in rain-forest, Teppi-Mizan Teferi trail, ca 10 km from Teppi, elev. ca 1,200 m, ca 7°8' N, 35°20' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 11 December 1964.

E-97.....Aschersonia goldiana Sacc. and Ell.

Parasitic on scale insect infecting C. arabica, occasional on plants growing spontaneously in rain-forest, along Teppi-Mizan Teferi trail, ca 10 km from Teppi, elev. ca 1,200 m, ca 7°8' N, 35°20' E, Illubabor Prov. Coll. F.G. Meyer and R.L. Narasimhaswamy. 11 December 1964.

E-98.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On host plants cultivated in open situation, 35 km SW of Agaro town at Gicho on road to Gera, elev. 1,800 m, Kaffa Prov. Coll. L.M. Fernie. 4 December 1964.

E-99.....Hemileia vastatrix Berk. and Br.

Abundant on one host plant of Coffea excelsa vel aff. growing on experimental farm of Jimma Agricultural Technical School at Giren, 5 km northeast of Jimma along the Addis Ababa Road, Kaffa Prov.

E-100.....Hemileia vastatrix Berk. and Br.

Common on host cultivated in thin shade, about 7 km NE. of Jimma in valley on left side of main road to Addis Ababa near Bada Buna forest, Kaffa Prov. Coll. R.L. Narawimhaswamy. 15 December 1964.

E-101.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-100. Coll. R.L. Narasimhaswamy.

E-102.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet
+ Trichothyrium reptans (Berk. and Curt.) Hughes on Meliola sp. (?) cf. M. coffeae Hansf.

Same locality and date as E-103. Coll. R.L. Narasimhaswamy.

E-103.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet
+ Trichothyrium reptans (Berk and Curt.) Hughes on Meliola sp. (?) cf. M. coffeae Hansf.

The parasitized rust was more common than unparasitized at this locality on host planted in open by a stream, edge of Mizan Teferi air-strip, elev. 1,400 m, 6°55' N, 35°25' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 17 December 1964.

E-104.....Hemileia vastatrix Berk. and Br.
+ Trichothryium reptans (Berk. and Curt.) Hughes on Meliola coffeae Hansf.
Trace of Cerospora coffeicola Berk. and Cke.

Same locality and date as E-105. Coll. R.L. Narasimhaswamy.

E-105.....Hemileia vastatrix Berk. and Br.

Trace of Cercospora coffeicola Berk. and Cke.
+ Trichothryium reptans (Berk. and Curt.) Hughes on Meliola coffeae Hansf.

The parasitized rust was more common than unparasitized at this locality on host planted in plantation, 2½ km south Mizan Teferi air-strip, elev. 1,400 m, 6°55' N, 35°25' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 18 December 1964.

E-106.....Hemileia vastatrix Berk. and Br.

Common on planted coffee near a house in Bolku village, 6 km south of Benessa, elev. 1,380 m, ca 6°50' N, 35°30' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 20 December 1964.

E-107.....Hemileia vastatrix Berk. and Br.
+ Trace Verticillium hemileiae Bouriquet

The parasitized rust rare at this station. Same locality and date as E-106. Coll. R.L. Narasimhaswamy.

E-109.....Hemileia vastatrix Berk. and Br.

On naturalized and cultivated host plants, 2 km east of Ainamba village, elev. 1,500 m, 6°53' N, 35°28' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 22 December 1964. Spores light yellow and sporulation sparse.

E-110.....Hemileia vastatrix Berk. and Br.

On host cultivated at a dwelling called Tunteta, on steep slopes, ca 2½ km SW. of Ainamba village just over crest of ridge overlooking the Tana Plantation and the Sheko valley to the SW., elev. 1,620 m, ca 6°52' N, 35°27' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 23 December 1964. Sporulation sparse and the spores light yellow.

E-111.....Hemileia vastatrix Berk. and Br.
+ Trace Verticillium hemileiae Bouriquet

The parasitized rust was more common than unparasitized, same locality and date as E-110. Coll. R.L. Narasimhaswamy.

E-112.....Hemileia vastatrix Berk. and Br.
+ Trace Verticillium hemileiae Bouriquet

The parasitized rust was more common than unparasitized on host cultivated 2 km east of Ainamba village, elev. 1,500 m, 6°53' N, 35°28' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 23 December 1964.

E-119.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Fairly common on host cultivated around a house in Omonadda (Nada) village, ca 72 km NE. of Jimma on old Italian road to the Omo River, elev. 1,820 m, ca 7°37' N, 37°14' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 27 December 1964.

E-120.....Hemileia vastatrix Berk. and Br.
Verticillium hemileiae Bouriquet

Same locality and date as E-119. Coll. R.L. Narasimhaswamy.

E-121.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

On an old host plant grown in front of a dwelling house in Jimma, elev. 1,720 m, Kaffa Prov. Coll. R.L. Narasimhaswamy. 27 December 1964.

E-122.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Same locality and date as E-121. Coll. R.L. Narasimhaswamy.

E-135.....Hemileia vastatrix Berk. and Br.

On host plants cultivated along main street in Bonga town in front of a house, elev. 1,790 m, Kaffa Prov. Coll. F.G. Meyer. 31 December 1964.

E-136.....Aschersonia goldiana Sacc. and Ell.

Parasitic on scale insects, abundant on one plant of C. arabica, 7 km SW. of Bonga on road to Wush Wush plantation, elev. 1,620 m, ca. 7°15' N, 36°12' E, Kaffa Prov. Coll. F.G. Meyer. 31 December 1964.

E-137.....Trichothyrium reptans (Berk. and Curt.) Hughes on Meliola coffeae Hansf.

Abundant on host growing spontaneously in rain-forest, 7 km SW. of Bonga on road to Wush Wush plantation, elev. 1,620 m, ca 7°15' N, 36°12' E, Kaffa Prov. Coll. F.G. Meyer. 31 December 1964.

E-138.....Hemileia vastatrix Berk. and Br.
+ Meliola coffeae Hansf. heavily parasitized by Trichothyrium reptans

On the host cultivated in Bonga town, elev. 1,790 m, ca 7°15' N, 36°13' E, Kaffa Prov. Coll. F.G. Meyer. 31 December 1964.

8736.....Hemileia vastatrix Berk. and Br.
+ Verticillium hemileiae Bouriquet

Common on host cultivated at edge of Asbe Teferi village, elev. 1,590 m, 8°5' N, 40°51.5' E, Harar Prov. Coll. F.G. Meyer. 6 November 1964.

B. Leaf fungi on other Rubiaceae

E-29.....Hemileia gardeniae-thunbergiae (P.Henn.) Maubl. and Roger

On Gardenia lutea Fresen. in savanna on slopes west side of Bada Buna hill, elev. 1,750 m, 7°40' N, 36°52' E, Kaffa Prov. This rust is extremely abundant on some host plants here and elsewhere this plant occurs. Coll. L.M. Fernie. 22 November 1964.

E-79.....Ascomycete of unknown identity

Common on Canthium ruwenzoriense Bullock (Meyer, 8881), an understory tree of the rain-forest, 15 km SW. of Gera along trail to Afallo, elev.1,900 m, 7°45' N, 36°18' E, Illubabor Prov. Coll. R.L. Narasimhaswamy. 2 December 1964.

E-83.....Hemileia holstii Syd.

Host Phychotria orophila Petit in forest, ca 8 mi. south of Maji, elev. ca 2,230 m, ca 6°8' N, 35°36' E, Kaffa Prov. Coll. L.M. Fernie. 4 December 1964.

E-108.....Hemileia gardeniae-thunbergiae (P. Henn.) Maubl. and Roger

Abundant on the host, Gardenia lutea Fresen. in savanna area, about 3 km N. of Berber Uaha River, elev. 1,200 m, ca 6°45' N, 35°30' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 20 December 1964

8751.....Hemileia pavetticola Maubl. and Roger

On Pavetta sp. in a field of cultivated Coffea arabica at Konga village, 4 km south Yirga-Cheffe, which is 37 km south of Dilla, Sidamo Prov. Coll. F.G. Meyer. 13 November 1964.

APPENDIX VIII

INVENTORY OF COFFEA ARABICA SEED COLLECTION PROCURED IN ETHIOPIA BY THE FAO COFFEE MISSION, 1964-1965

The seed collections of C. arabica listed in the inventory represent the efforts of F. Bolton, L.M. Fernie, Worku Makonnen, F.G. Meyer, L. Monaco, and R.L. Narasimhaswamy during the period 25 October 1964 to 14 January 1965. While the collection of 621 seed samples is the largest from Ethiopia to date, only a very small part of the total area was visited within the short time limit of the Mission. Field work in such areas is always slow. The various areas were visited by Land Rover, boat, airplane, mule back, and by foot. Roads are few and access to some of the most interesting areas is off the beaten track over trails.

Collections were carefully documented and for research purposes this is a critical point. Within a few years, the seedlings now being nurtured in India, Tanzania, Ethiopia, Costa Rica, and Peru will come to maturity offering valuable material for study.

Field work in Ethiopia consisted largely of first hand observations backed by documentary material, including herbarium specimens and seed collections, and photographs, for follow-up studies on origin and variation, for breeding and selection work, and for screening against the coffee leaf rust (Hemileia vastatrix).

Seed samples were collected largely from individual coffee plants within populations without regard to specific characteristics. Seeds from up to 175 plants were collected at some localities. Messrs. Fernie and Narasimhaswamy followed slightly different techniques in sampling, both of whom concentrated more on plants with potential commercial possibilities, e.g. as to habit, size and quantity of fruit, etc.

Collections listed as random samples in the inventory were a mixture of seeds from several plants taken within a population at a given place without regard for specific characteristics.

Field processing of seed collections followed simple techniques. The fresh fruit after being collected was hand pulped, washed, and air dried out of the sun. The dried seeds in parchment were stored in paper envelopes in a cool place at Jimma. Upon leaving Ethiopia, Meyer hand-carried 488 seed collections by air to Washington, D.C. All seeds were taken to the Plant Introduction Station, Glenn Dale, Maryland, for germinating. Most of the samples from individual plants consisted of twenty to fifty seeds; in random samples perhaps three times that amount. Seeds were sown in milled sphagnum moss in metal flats in a greenhouse and germinated within a period of thirty to fifty days after planting. Although the oldest seeds were sixty days old from time of collection, all collections germinated, and in most instances, germination was well above 90 percent at Glenn Dale. Fernie and Narasimhaswamy each handled his share of the collections separately for planting on home grounds.

The summary report below shows the survival of coffee seedling since the seeds were initially planted on 1 February 1965. On 2 June 1965, over 11,000 seedlings representing 488 collections were sent from Glenn Dale to three cooperators in Ethiopia, Peru, and Costa Rica. Certain collections made by Fernie and Narasimhaswamy, in their possession only, are included in the survival report. Seedlings grown by Dr. d'Oliveira in Portugal for rust screening are not reported here.

During a visit to the Institute at Turrialba, Costa Rica in December, 1966, the team leader, F.G. Meyer, saw the coffee seedlings growing from the 1964-65 collections. Already, some plants had begun to bear fruit and were over two feet high in less than two years from seed.

Survival record of C. arabica seed introductions by FAO Coffee Mission to Ethiopia as of June, 1966

Institution reporting	Number of introductions	Surviving introductions
Jimma, Ethiopia	433	228
Lyamungu, Tanzania	196	191
Balehonnur, India	81	81
Tingo Maria, Peru	455	ca. 434
Turrialba, Costa Rica	485	485

Cooperators in possession of C. arabica germ plasm material are indicated below by code letter at the end of each introduction as follows:

E - Jimma Agricultural Technical School, Ethiopia
I - Central Coffee Research Institute, India.
M - Coffee Research Station, Lyamungu, Tanzania.
O - Estacao Agronómica Nacional, Oeiras, Portugal.
P - Instituto Interamericana de Ciencias Agricolas de la Oea, Zona Andina, Lima, Peru.
T - Instituto Interamericana de Ciencias Agricolas de la Oea, Turrialba, Costa Rica.

Expedition No. - The letter "E" precedes each field number followed by field notes and cooperators who recieved seed.

Seed collections -

Single plants - Collections so designated were from single individuals, with or without regard for specific traits exhibited in the field.

(Rep.) Representative samples - Collections so designated were from several individual plants exhibiting obvious morphological differences as well as from the dominant type (collections of Fernie and Bolton).

Random samples - Collections so designated were from several or many (up to 175) individual plants within a population without regard to specific traits exhibited in the field.

Herbarium specimens - Voucher herbarium specimens were prepared by Meyer for 52 collections at different localities. All material was prepared with fruit, since the visit coincided with the fruiting season. Some flowering material was available due to unseasonable rains in December. A large series of leaf samples and fruit samples were taken at each locality for an analysis of variability. At a later date representative sets of specimens will be deposited in leading herbaria in the United States and Europe with additional sets going to the herbarium of the Botany Department at Haile Selassie I University in Addis Ababa and another to the East African Herbarium at Nairobi, Kenya. The first set of all materials will be on deposit at the U.S. National Herbarium, Washington, D.C.

E-1.....Random sample from several plants. Cultivated in a small farm under shade of Albizia schimperiana, Cordia africana, and Millettia ferruginea, at Finote Selam, about 1 km left of the main road going north elev. 1,750 m, 74 km north north west of Debre Marcos, ca 10°42' N, 37°10' E, Gojjam Prov. No leaf rust observed. Herbarium voucher, Meyer 8627. 25 October 1964. (E, O, P, T.)

E-2.....From a single plant. Same locality as E-1. Coll. F.G. Meyer. 25 October 1964. (O)

E-3.....From a single plant. Same locality as E-1. Coll. F.G. Meyer. 25 October 1964. (O)

E-4.....From a single plant. Same locality as E-1. Coll. F.G. Meyer. 25 October 1964 (O)

E-5.....Random sample from plants cultivated in an open field, 3 to 4 years old, untopped; near second crater lake beyond Agricultural Experiment Station, Debre Zeit, elev. 1,900 m, 8°45' N, 38°58' E, about 50 km south of Addis Ababa, Shoa Prov. Planting consisted of a few hundred plants, many doing poorly with sun scorched leaves and fruit, but some plants doing well under Wansa trees (Cordia africana). Tip leaves dark brown; fruits large, oblong and ripening deep red. No leaf rust observed. Coll. R.L. Narasimhaswamy and F.G.Meyer. 1 November 1964 (E,I,O,P,T.)

E-6.....From a single plant. Cultivated in open in small field of about 100 plants, ca 2 m tall, suffering from die back shoots bronze tipped. 1 km north of Combulchia, right side of road, 17 km north of Harar city, 9°27' N, 46°6' E, elev. 1,930 m, Harar Prov. No leaf rust observed. Herbarium voucher, Meyer 8719. 5 November 1964. (O)

E-7.....Random sample from Janab Ismail Hassan's holding. Same locality as E-6. One or more plants are planted together and untopped in an open field; tip leaves dark brown; leaves thick and leathery, showing resemblance to S.353 of CCRI India; fruits big and flat on two sides, with small navel and ripening red; beans rounded at both ends; about 5 percent empty beans noticed. No leaf rust observed. Coll. R.L. Narasimhaswamy and F.G. Meyer. 5 November 1964. (E,I,M,O,P,T)

E-8.....From a single plant. Cultivated on terraced slopes, occasionally irrigated from springs at Bio Dangago, 20 km north east of Harar, elev. 1,830 m, 9°28' N, 41°56' E, Harar Prov. Shoots bronze-tipped. No leaf rust observed. Herbarium voucher, Meyer 8724. 5 November 1964 (O)

E-9.....Random sample from 5 to 6 year old plants cultivated by Mr. Ebro, in the open with occasional shade of Wansa (Cordia africana) trees, near Hirna village, elev. 1,557 m, 143 km west of Dire Dawa on main road, Chercher Hills, ca 9°12' N, 41°7.5' E, Harar Prov. Tip leaves dark brown; fruits longish with small navel and small persistent calyx lobes on some and ripening red. Hemileia vastatrix observed. Coll. R.L. Narasimhaswamy and F.G. Meyer. 6 November 1964. (E,I,O,P,T)

E-10.....Leaf fungus (see Appendix VII).

E-11.....Random sample from plants cultivated on slopes, mostly without shade, but some native trees, i.e. Cordia africana and Ficus sp. are permitted to grow for shade. Asbe Teferi, elev. 1,590 m, ca 80 km east of Awash village on Harar road, 9°5' N, 40°51.5' E, Harar Prov. Shoots bronze-tipped. Hemileia vastatrix observed. Coll. F.G. Meyer. 6 November 1964. (E,O,P,T)

E-12.....Random sample from plants cultivated without shade in a small field by roadside, 5 km north west of Harar city on Dire Dawa road, 9°19' N, 42°6' E, Harar Prov. Plants probably 60 to 70 years old, untopped; tip leaves dark brown; leaves thick and leathery, dark green; fruits big and oblong and small navel. One plant had long and broad fruits with broad bulging navel; fruits ripening red with high bean abnormality evident. No leaf rust observed. Coll. R.L. Narasimhaswamy, 5 November 1964. (E,I,P,T)

E-13....
to
E-15 ....Leaf fungi (See Appendix VII)

E-16.....Random sample from plants cultivated at Mitchell Cotts Plantation, 23 km south east of Shashemene, elev. 1,800 m, ca 7°7' N, 38°40' E, Shoa Prov. Shoots bronze-tipped. Origin of plants from Harar seed. Hemileia vastatrix observed. Herbarium voucher, Meyer 8781. 15 November 1964. (E,M,O,P,T)

E-17.....Random sample from wet processed fruit obtained from Mr. Tedini, Wonago (Wanago) village, 12 km south of Dilla, elev. 1,760 m, 6°20' N, 38°15' E, Sidamo Prov. Coll. R.L. Narasimhaswamy and F.G. Meyer. 13 November 1964. (E,I,M,O,P,T)

E-18.....Random sample from plants cultivated under Ensete ventricosum, 4 km north Yirga-Cheffe (Irga Chafe), elev. 1,808 m 6°12' N, 38°13' E, Sidamo Prov. No leaf rust observed. Coll. R.L. Narasimhaswamy and F.G. Meyer. Herbarium voucher, Meyer 8747. 13 November 1964. (E,I,M,O,P,T,)

E-19.....Random sample cultivated in shade of Ensete ventricosum, Cordia africana, and Millettia ferruginea at Konga village, 4 km south of Yirga-Cheffe, elev. 1,850 m, 37 km south of Dilla, ca 6°12' N, 38°13' E, Sidamo Prov. Plants multi-stemmed and untopped; tip leaves green and bronze; fruits resemble Kents and ripen red. No leaf rust observed. Coll. R.L. Narasimhaswamy and F.G. Meyer. Herbarium voucher, Meyer 8748. 13 November 1964. (E,I,M,O,P,T)

E-20.....From a single plant, cultivated in Dilla village, elev. 1,550 m, 6°25' N, 38°18' E, Sidamo Prov. Fruit nearly spherical. No leaf rust observed. Herbarium voucher, Meyer 8749. 13 November 1964. (E,I,O,P,T).

E-20a....Random sample from a few plants growing near the sub-office of the National Coffee Board, Dilla village, elev. 1,550 m, 6°25' N, 38°18' E, Sidamo Prov. Plants tall and multi-stemmed, with small, broad leaves and short internodes; fruits in small clusters, small, and round. No leaf rust observed. Coll. R.L. Narasimhaswamy. 13 November 1964. (I) Grown in India under CCRI 2603

E-21.....Random sample from a field consisting of about 200-300 plants along main road to Soddu-Wollamo, 90 km west of Shashemene, elev. 5,250 ft (1,600 m), 7°8' N, 37°58' E, Sidamo Prov. Planted in full sun without irrigation in an area of relatively low rainfall barely west of the Rift Valley. Plants suffer from dieback, are multi-stemmed and untopped; tip leaves bronze to dark bronze and some green; fruits long and narrow; ripening red. No leaf rust observed. Coll. R.L. Narasimhaswamy and F.G. Meyer. 14 November 1964. (E,I,M,O,P,T,)

E-22.....Random sample from plants cultivated in open situations south edge of Soddu-Wolamo village, 6°52' N, 37°46' E, Sidamo Prov. No leaf rust observed. Both green and bronze-tipped plants observed. Herbarium voucher, Meyer 8772. 14 November 1964. (E,M,O,P,T)

E-23 - E-28.....Leaf fungi (See Appendix VII)

E-30.....From a single plant cultivated by Ato Teka Egano, Doyo village, 15 km southwest of Jimma, elev. about 1,770 m, ca 7°37' N, 36°46' E, Kaffa Prov. Plant resembles S.31 at the CCRI, India, with linear-oblong, thick, dark green leaves; fruits and beans roundish; plant very vigorous; bean abnormality appeared to be very little. Much variability in the plants at this place was noticed, the material having originally come from the Jimma Agricultural Technical School. Hemileia vastatrix observed on a few plants. Coll. R.L. Narasimhaswamy. 23 November 1964. (E,I,N,O,P,T)

E-31 - E-34.....Leaf fungi (See Appendix VII)

E-35.....Random sample from naturalized and spontaneous plants in a secondary forest area, 49 km north of Jimma, via Agaro road, turning right at Ghembi village and proceeding generally north to second bridge over branch of Awetu river, thence about 5 km across country to Sedecha, property of Dejazmatch Johannes Girma, elev. 1,610 m, about 7°57'N, 36°48' E, Kaffa Prov. The plants at this place consist of three recognizable fruit shapes. The coffee leaf rust Hemileia vastatrix observed at edge of clearings, but not in dense shade. On north slopes, C. arabica occurs almost to the exclusion of other woody vegetation, except for occasional old specimens of Ficus sp., Millettia ferruginea, Cordia africana, and Albizia schimperiana, all of which tower well above the coffee understory. Herbarium voucher, Meyer 8822. 24 November 1964. (E,M,O,P,T)

E-36.....Random sample from plants cultivated in the open and in shade of Ensete ventricosum, 5 km south of Welkite, elev. ca 1,950 m, 8°15' N, 38°10' E, Shoa Prov. Plants belong to Ato Alamu Sherag and were multi-stemmed with narrow linear-oblong leaves and small roundish fruits ripening red. A high percentage of defective beans were observed. Hemileia vastatrix observed on a few plants. The planting consisted of three cultivars, namely 'Arore', 'Saja', and 'Chercher'. The plants called 'Arore' are distinctive in having nearly spherical fruit. This and 'Chercher' were described earlier by Meyer (1965). The plantings in this locality clearly are of mixed origin. Coll. R.L. Narasimhaswamy and F.G. Meyer. 21 November 1964. (E,I,M,O,P,T)

E-37.....Random sample from plants cultivated in a field with no shade, ca 15 km south west of Shashemene at Wondo-Genet, elev. ca 1,950 m, ca 7°7' N, 38°40' E, Shoa Prov. Plants bronze-tipped. Hemileia vastatrix observed on a few plants. Planted originally ca 80 years ago, but plantings now abandoned. Coll. F. G. Meyer. 16 November 1964. (E,M,O,P,T)

E-38.....Random sample from plants originally introduced and now naturalized, Bada Buna forest, 7 km north east Jimma, elev. 1,750 m, 7°40' N, 38°52' E, Kaffa Prov. Hemileia vastatrix observed on a few plants. Both light red and dark red cherries observed. Herbarium voucher, Meyer 8818. 22 November 1964. (E,M,O,P,T)

E-39.....Random sample of wet processed cherries harvested from plantings grown in nearby secondary forest at Chochi on old road to Agaro, ca 7°50' N, 36°45' E, elev. 1,680 m, Kaffa Prov. Coll. F.G. Meyer. 24 November 1964. (E,M,O,P,T)

E-40.....Leaf fungus (See Appendix VII)

E-41 to E-48....From single plants naturalized in same locality as E-35. Coll. F.G. Meyer. 24 November 1964.

(E-41).....(O, P, T)
(E-42).....(O, P, T)
(E-43).....(O, P, T)
(E-44).....(E, O, P, T)

(E-45).....(E, O, P, T)
(E-46).....(O, P, T)
(E-47).....(E, O, P, T)
(E-48).....(E, O, P, T)

E-49 to E-51.....No collections.

E-52 to E-60.....From single plants. Same locality as E-38. Coll. F.G. Meyer 22 November 1964. (E,O,P,T) and E-52, E-58 also to (M)

E-61.....From a single plant with narrowly elliptic leaves not unlike those of C. arabica 'Angustifolia'. Same locality as E-38. Coll. F.G. Meyer. 22 November 1964. (E,M,O,P,T)

E-62 to E-65.....Leaf fungi (See Appendix VII)

E-66.....From a single plant with light red cherries (a dark red cherry also occurs in the populations at this locality). Same locality as E-38. Herbarium voucher, Meyer 8818. 22 November 1964. (E,M,O,P,T)

E-67.....From a single plant with larger fruit than in other plants observed at this locality. Same locality as E-35. Herbarium voucher, Meyer 8822. 24 November 1964. (E,M,O,P,T)

E-68.....Random sample from plants grown under shade, farm of Ato Getahoun Birke, at Saredo, about 20 km southeast of his Denbi farm, ca 8°05' N, 36°53' E, elev. 1,720 m, Kaffa Prov. Coll. L. Monaco. 26 November 1964. (E,M,O,P,T).

E-69.....From a single plant, cultivated in high shade of secondary forest, on west slope of small valley with stream, 6 km northwest of Jimma, on Agaro road, left side of road going northwest, 7°41' N, 36°47' E, elev. 1,750 m, Kaffa Prov. No leaf rust observed. Coll. F.G. Meyer. 26 November 1964. (E,M,O,P,T)

E-70.....From a single plant, cultivated in high shade of Albizia schimperiana and Cordia africana, 20 km northwest of Jimma on Agaro road, ca 7°45' N, 36°46' E, Kaffa Prov. No leaf rust observed. Coll. F.G. Meyer. 26 November 1964. (O,P,T)

E-71.....Random sample from same locality as E-35. Hemileia vastatrix on a few plants. Coll. R.L. Narasimhaswamy. 24 November 1964. (E,I,M,O,P,T)

E-72.....Random sample from same locality as E-38. Leaves linear-oblong with cuneate base and drawn out drip tip; tip leaves light bronze; fruits large squat-shaped, flat on two sides with small navel and ripening red. Very little bean abnormality observed. Hemileia vastatrix observed on a few plants. Coll. R.L. Narasimhaswamy. 22 November 1964. (E,I,M,O,P,T)

E-73 to E-77.....Leaf fungi (See Appendix VII)

E-80.....Random sample from cultivated plants belonging to Ato Mahari Endale, at (Kossa) Cosa-Kabenna, 45 km north of Jimma, on Suntu road, ca 7°58' N, 36°53' E, Limu sub-province, Kaffa Prov. No leaf rust observed. Coll. R.L. Narasimhaswamy. (E,I,M,O,P,T)

E-81.....Random sample from naturalized plants belonging to Ato Shone Seda, Sapa Dildye, 18 km north of Ghembi village, Agaro road, 53 km north of Jimma, ca 8°5' N, 36°54' E, Limu sub-province, Kaffa Prov. Hemileia vastatrix on a few plants. Coll. R.L. Narasimhaswamy. 26 November 1964. (E,I,M,O,P,T)

E-82.....Leaf fungi (See Appendix VII).

E-84.....Random sample from wet processed cherries harvested in nearby secondary forest. Same locality as E-80. No leaf rust observed. Coll. F.G. Meyer. 6 December 1962. (E,M,O,P,T)

E-85.....Random sample from plants obviously planted, in open situation along trail, 5 km southwest of Gera on trail to Afallo, elev. ca 1,900 m, 7°45' N, 36°18' E, Illubabor Prov. No leaf rust observed. Coll. L. Monaco. 2 December 1964. (E,M,O,P,T)

E-86.....Random sample from many plants cultivated along a 30 km stretch of road between town of Agaro and village of Gera, elev. ca 1,800 m, ca 7°50' N, 36°30' E, Kaffa Prov. Coll. F.G. Meyer. 3 December 1964 (O).

E-87.....Random sample from many plants, cultivated in Galanti-Teka Egano Co. coffee farm, edge of Gera village, 50 km southwest of Agaro, elev. 2,040 m, ca 7°14' N, 36°24' E, Kaffa Prov. Plants are called Ennarea, the name of a former district in Kaffa Province now the Limu sub-province. Hemileia vastatrix on a few plants. Coll. R.L. Narasimhaswamy. 30 November 1964. (E,M,O,P,T)

E-88.....Random sample from plants naturalized along forest trail, ca 5 km north of Afallo village, a place ca 20 km southwest of Gera, elev. 1,900 m, ca 7°43' N, 36°18' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 2 December 1964. (E,I,M,O,P,T)

E-89.....Random sample from same segment of road as E-86. Hemileia vastatrix observed. Coll. R.L. Narasimhaswamy. 3 December 1964. (E,I,M,O,P,T)

E-90 to E-112.....Leaf fungi (See Appendix VII)

E-114.....Random sample from many plants in coffee farm called Minch of Ato Shibeshi, 2½ km south of Mizan Teferi airport, elev. 1,400 m, about 6°55' N, 35°25' E, Kaffa Prov. Hemileia vastatrix observed. Coll. R.L. Narasimhaswamy. 18 December 1964. (E,I,M,O,P,T)

E-115.....Random sample from plants cultivated around houses at Debre Werk village, ca 16 km southwest of Mizan Teferi airport, elev. ca 1,590 m, ca 6°53' N, 35°30' E, Kaffa Prov. Coll. R.L. Narasimhaswamy. 19 December 1964. (E,M,O,P,T)

E-116.....Random sample from plants naturalized under a large Ficus tree, 1 km east of Ainamba village, elev. 1,500 m, 6°53' N, 35°28' E, Kaffa Prov. Plants very large leaved. Hemileia vastatrix observed. Coll. R.L. Narasimhaswamy. 22 December 1964. (E,I,M,O,P,T)

E-117.....Coffea arabica L. 'Purpurascens'. Leaves deep purplish. Planted in collection at Experimental farm of Jimma Agricultural Technical School, Giren, 5 km northeast of Jimma, Kaffa Prov. Coll. F.G. Meyer. 15 December 1964. (M)

E-118.....Random sample from plants growing spontaneously in rain forest, near Korcha village on Teppi-Mizan Teferi trail, elev. 1,200 m, about 8 km southwest of Teppi, ca 7°8' N, 35°24' E, Illubabor Prov. Hemileia vastatrix observed in the area. Coll. R.L. Narasimhaswamy. 11 December 1964. (E,I,N,O,P,T)

E-119 to E-122.....Leaf fungus (See Appendix VII)

E-123a...(Small bean). Random sample from plants allegedly spontaneous in the forest. Beru village about 6°15' N, 35°14' E, Maji sub-province, Kaffa Province. Sample obtained by runners employed to collect seeds from this place. 10 December 1964. (E,I,M,O,P,T)

E-123b...(Large bean). Random sample of bean larger than the preceding. Same locality as E-123a. (E,I,M,O,P,T)

E-124 ....Random sample from plants allegedly spontaneous in the forest. Geisha Mountain, elev. about 1,830 m, ca 6°38' N, 35°30' E, ca 50 - 60 km north of Maji, Maji sub-province, Kaffa Prov. Sample obtained by runners employed to collect seeds from this place. 10 December 1964. (E,I,M,O,P,T)

E-125.....Random sample from plants allegedly spontaneous in the forest. Tui village, a place ca 20 - 30 km north of Maki, elev. 1,530 - 1,830 m, about 6°22' N, 35°34' E, Maji sub-province, Kaffa Prov. Sample obtained by runners employed to collect seeds from this place. Coll. 10 December 1964. (E,I,M,O,P,T)

E-126.....Random sample from vicinity of Gorei village (also called Bardo or Borde) on the northeastern edge of Geisha Mountain, elev. about 1,770 m, ca 6°42' N, 35°28' E, Maji sub-province, Kaffa Prov. Sample obtained by runners employed to collect seeds from this place. Coll. 10 December 1964. (E,I,M,O,P,T)

E-128.....Random sample from many plants, along trail to Afallo, 6-8 km southwest of Gera, elev. about 1,900 m, ca. 7°45' N, 36°18' E, Illubabor Prov. Coll. F.G. Meyer, 2 December 1964. (E,M,O,P,T)

E-129.....Random sample from many plants cultivated along a 40 km segment of Gera-Agaro road, elev. about 1,800 m, about 7°51' N, 36°37' E, Kaffa Prov. Hemileia vastatrix observed in the area. Coll. F.G. Meyer, 3 December 1964. (E,M,O,P,T)

E-130
to
E-133....From single plants cultivated at Ota village, about 5 km west of Agaro town, elev. about 1,800 m, about 7°51' N, 36°37' E, Kaffa Prov. Hemileia vastatrix is common in the area. Coll. F.G. Meyer, 3 December 1964. (E,O,P,T)

E-134....Random sample from plants selected by the owner for seed purposes, at Galanti-Teke Egano Co. coffee farm. Same locality as E-87. Coll. F.G. Meyer, 30 November 1964. (E,M,P,T)

E-135 to E-138.....Leaf fungi (See Appendix VII)

E-139
to
E-145....From single plants growing spontaneously in the forest and along trail, about 15 km southwest of Gera on trail to Afallo, elev. 1,900 m, about 7°45' N, 36°18' E, Kaffa Prov. Herbarium voucher, Meyer 8879. 1 December 1964. (E,O,P,T); E-139 and E-141 also to (M)

E-146
to
E-159....Samples from single plants cultivated at Galanti-Teke Egano Coffee Co. farm. Same locality as E-87. Hemileia vastatrix observed in the plantation. From plants called Ennarea. (See entry under E-87). Coll. F.G. Meyer. 1 December 1964.

(E-146).....(E, O, T)
(E-147).....(O, T)
(E-148).....(O, T)
(E-149).....(O, T)
(E-150).....(E, O, P, T)
(E-151).....(E, O, P, T)
(E-152).....(E, O, P, T)
(E-153).....(E, O, T)
(E-154).....(O, T)
(E-155).....(E, M, O, P, T)
(E-156).....(E, O)
(E-157).....(O, T)
(E-158).....(E, M, O, P, T)
(E-159).....(E, M, O, T)

E-160
to
E-162.....From single plants cultivated at Fichi village, about 10 km. southwest of Agaro on Gera road, elev. about 1,800 m, about 7°39' N, 36°33' E, Kaffa Prov. Hemileia vastatrix in the area. Coll. F.G. Meyer. 3 December 1964. (E,O,P,T)

E-163
to
E-165....Samples from individual plants cultivated in coffee farm of Ato Kabenna, about 36 km north of Jimma and about 1 km south of Kossa (Cossa) village, about 7°52' N, 36°52' E, Kaffa Prov. Herbarium voucher, Meyer 8887. 6 December 1964. (E,O,P,T); E-163 and E-165 also to (M)

E-166
to
E-177....From single plants cultivated by Ato Getahoun Birke, at his Denbi Farm, 62 km north of Jimma and 7 km southwest of Suntu, elev. 1710 m, about 8°8' N, 36°53' E, Limu sub-province, Kaffa Prov. The plants grown in this district are referred to loosely as Limu coffee after the name of the sub-province (old name Ennarea); plants predominently bronze-tipped. No Hemileia vastatrix observed. Herbarium voucher, Meyer 8888. 6 December 1964. (E,O,P,T); E-167 E-169 E-173 E-174 E-176 E-177 also to (M)

E-178....Random sample from 175 plants. Same locality as E-166. Herbarium voucher, Meyer 8888. 6 December 1964. (E,M,O,P,T)

E-179
to
E-183....Samples from single plants cultivated and sometimes naturalized along Agaro-Gera road, elev. 1800-2000 m, Kaffa Prov. Hemileia vastatrix observed in the area. Herbarium voucher, Meyer 8885. 3 December 1964. (E,O,P,T); E-179 and E-180 also to (M)

E-184
to
E-187....From single plants cultivated in small valley, left side of road some 7 km. northeast of Jimma on Addis Ababa road, just before Bada Buna, elev. about 1750 m, Kaffa Prov. Coll. F.G. Meyer. 15 December 1964. (E,O,P,T); E-184 (O,P,T) only.

E-188....Coffea arabica L. 'Variegata'. Two plants observed with white variegated leaves in planting near owner's house. Same locality as E-166. Coll. F.G. Meyer. 6 December 1964. (E,O,P,T)

E-189
to
E-223....From single plants growing spontaneously and naturalized in forest area near Teppi village, e.g. from 8 km. east of Teppi; 8 km southwest of Teppi; and along the Mizan Teferi trail between Teppi and the Baco River, elev. 1200-1320 m, about 7°9' N, 35°18' E, Illubabor Prov. Hemileia vastatrix is common throughout the area but is heavily parasitized. Herbarium voucher, Meyer 8913. 9, 10, 11, December 1964. (E,O,P,T); E-197, E-204, E-208, E-212 also to (M)

E-224....Random sample from many plants growing spontaneously and naturalized along Mizan Teferi trail between Teppi village and the Baco River, elev. 1,200 - 1,300 m, about 7°09' N, 35°18' E, Illubabor Prov. Hemileia vastatrix is common and heavily parasitized with Verticillium hemileiae. Coll. F.G. Meyer. 11 December 1964. (E,M,O,P,T)

E-225....Random sample from Ato Shibeshi's coffee farm, 2½ km south of Mizan Teferi airport, elev. about 1,400 m, 6°55' N, 35°25' E, Kaffa Prov. Plants grown from seed obtained from the Sheko forest, about 20 km to the south toward the Tana Plantation. Coll. F.G. Meyer. 17 December 1964. (E,M,P,T)

E-226 to E-232....From single plants. Same locality as E-225. Herbarium voucher, Meyer 8974. 18 December 1964. (E,O,P,T); E-225 and E-229 also to (M)

E-233 and E-233a....From single plants. Edge of Mizan Teferi airport, elev. 1,400 m 6°55' N, 35°25' E, Kaffa Prov. Pericarp of the ripe fruit relatively thick. Herbarium voucher, Meyer 8969. 17 December 1964. (E,O,P,T)

E-234....Rep. sample consisting of 22 fruits. Bronze shoots. Hemileia vastatrix present. Same locality as E-9. Coll. L.M. Fernie, 1. 6 November 1964. (M)

E-235....Rep. sample consisting of 79 fruits. Cultivated at Wondo Anberber, about 15 km southwest of Shashemene, elev. about 1,900 m, about 7°7' N, 38°40' E, Shoa Prov. Hemileia vastatrix present. Coll. L.M. Fernie, 2. 10 November 1964 (M)

E-236....Rep. sample consisting of 11 fruits. Cultivated at Alamo, Sidamo Prov. Coll. L.M. Fernie, 3. 11 November 1964. (E,M,P,T)

E-237....Rep. sample consisting of 19 fruits. Cultivated at Yirgalem and Bira, Sidamo Prov. Hemileia vastatrix present. Coll. L.M. Fernie, 4. 11 November 1964. (E,M,P,T)

E-238....Rep. sample consisting of 25 fruits. Cultivated at Aleta Wondo - Colla, Sidamo Prov. Coll. L.M. Fernie, 5. 11 November 1964. (M)

E-239....Rep. sample consisting of 28 fruits. Cultivated at Dilla (same locality data as E-20). Hemileia vastatrix present. Coll. L.M. Fernie, 6. 12 November 1964. (M)

E-240....Rep. sample consisting of 56 fruits. Cultivated at Yirga Cheffe, elev. about 1,800 m, about 6°12' N, 38°13' E, Sidamo Prov. Coll. L.M. Fernie, 7. 12 November 1964. (M)

E-241....Rep. sample consisting of 32 fruits. Cultivated at Welkite (same locality data as E-36). Hemileia vastatrix very slight. Coll. L.M. Fernie, 8. 16 November 1964. (M)

E-242....Rep. sample consisting of 62 fruits from Bada Buna forest near Jimma (same locality as E-38). Hemileia vastatrix present. Coll. L.M. Fernie, 9. 17 November 1964. (M)

E-243....From a single plant consisting of 11 fruits from a single plant number 1-7 Jimma (S.2 Ennarea). Jimma, Kaffa Prov. Coll. L.M. Fernie, 10. 17 November 1964. (M)

E-244....Rep. sample consisting of 28 fruits. Same locality as E-35. Coll. L.M. Fernie and Floyd Bolton, 11. 18 November 1964. (M,P,T)

E-245....Rep. sample consisting of 37 fruits. Same locality as E-80. Coll. L.M. Fernie, 12. 19 November 1964. (M)

E-246....Rep. sample consisting of 23 fruits. Same locality as E-166. Coll. L.M. Fernie and Floyd Bolton, 13. 19 November 1964. Long flat bean. (E,M,P,T)

E-247....From a single plant consisting of 47 fruits. Same locality as E-166. Long round bean; green-tipped plants; long cherry. Coll. L.M. Fernie and Floyd Bolton,14. 19 November 1964. (E,M,P,T)

E-248....Rep. sample consisting of 59 fruits. Wush Wush Plantation. elev. 1,920 m, 22 km west of Bonga, about 7°15' N, 36°8' E, Kaffa Prov. Coll. L.M. Fernie, 15. 21 November 1964. (M)

E-249....From a single plant consisting of 41 fruits. Same locality as E-248. Coll. L.M. Fernie, 16. 21 November 1964.(M)

E-250....From a single plant consisting of 46 fruits. Same locality as E-248. Coll. L.M. Fernie, 17. 21 November 1964. (M)

E-251....From a single plant consisting of 30 fruits. Same locality as E-248. Coll. L.M. Fernie, 18. 21 November 1964. (M)

E-252....Rep. sample consisting of 15 fruits. Same locality as E-248, but from plants in the village outside of the plantation proper. Coll. L.M. Fernie, 19. 21 November 1964. (M)

E-253....Rep. sample consisting of 18 fruits. Agaro-Manna, Kaffa Prov. Coll. L.M. Fernie, 20. 22 November 1964. (M)

E-254....Rep. sample consisting of 32 fruits. Same locality as E-39. Large flat cherry. Hemileia vastatrix observed. Coll. L.M. Fernie and Floyd Bolton, 21. 23 November 1964. (E,M,O,P,T)

E-255....From a single plant consisting of 41 fruits. Same locality as E-39. Long round green-tipped shoots. Coll. L.M. Fernie and Floyd Bolton, 22. 23 November 1964. (M)

E-256....Rep. sample consisting of 32 fruits. Alle village, about 15 km north of Gore, elev. about 1,770 m, 8°15' N, 35°33' E, Illubabor Prov. Hemileia vastatrix present. Coll. L.M. Fernie, 23. 24 November 1964. (M)

E-257....From a single plant consisting of 51 fruits. Same locality as E-256. Coll. L.M. Fernie, 24. 24 November 1964. (I, M)

E-258....Rep. sample consisting of 42 fruits. Mattu village, about 25 km north of Gore, elev. about 1,570 m, 8°18' N, 35°05' E, Illubabor Prov. Hemileia vastatrix present. Coll. L.M. Fernie, 25. 24 November 1964. (M)

E-259....Rep. sample consisting of 31 fruits. Same locality as E-258. Shoots copper-tipped. Coll. L.M. Fernie, 26. 24 November 1964. (M)

E-260....Rep. sample consisting of 64 fruits. Gore, elev. 2,020 m, 8°9' N, 35°32' E, Illubabor Prov. Shoots bronze and green-tipped. Coll. L.M. Fernie, 27. 25 November 1964. (I, M)

E-261....Rep. sample consisting of 111 fruits. Same locality as E-30. Shoots bronze and green-tipped. Hemileia vastatrix present. Coll. L.M. Fernie and Floyd Bolton, 28. 25 November 1964. (E,M,P,T)

E-262....From a single plant consisting of 29 fruits. Same locality as E-30. Hemileia vastatrix present. Coll. L.M. Fernie, 29. 25 November 1964. (M)

E-263....From a single plant consisting of 22 fruits. Same locality as E-30. Hemileia vastatrix present. Coll. L.M. Fernie, 30. 25 November 1964. (M)

E-264....Rep. sample consisting of 335 fruits. Balt village, elev. 2,080 m, Maji sub-province, Kaffa Prov. Shoots faintly bronze-tipped; medium large fruit with a persistent style. In shade of fig tree. No Hemileia vastatrix observed. Coll. L.M. Fernie and Floyd Bolton, 31. 2 December 1964. (E,I,M,P,T)

E-265....Rep. sample consisting of 79 fruits. Same locality as E-264. Plants with large leaves and fruits and green-tipped shoots. Coll. L.M. Fernie and Floyd Bolton, 32. 2 December 1964. (E,M,P,T)

E-266....Rep. sample consisting of 163 fruits. Same locality as E-264. Plants with very large fruit and dark bronze-tipped shoots. Coll. L.M. Fernie and Floyd Bolton, 33. 2 December 1964. (E,I,M,P,T)

E-267....From 2 plants consisting of 145 fruits. Same locality as E-264, elev. 2,140 m; small narrow leaves; plants in shade of Ensete ventricosum. Coll. L.M. Fernie and Floyd Bolton, 34. 2 December 1964. (E,I,M,P,T)

E-268....Rep. sample consisting of 307 fruits. Kursi (Chersi) village, about 15 km west of Maji, elev. about 1,870 m, about 6°10' N, 30°33' E, Kaffa Prov. Plants with bronze-tipped shoots; growing in Cordia africana shade. Leaf insect damage due to Epiploma dohertyi Warr. (Leaf skeletonizer). Coll. L.M. Fernie and Floyd Bolton, 35. 3 December 1964. (E,M,P,T)

E-269....From 2 plants consisting of 48 fruits. Same locality as E-268. Shoots light bronze-tipped; plants with long fruit. Coll. L.M. Fernie and Floyd Bolton, 36. 3 December 1964. (I,M,P,T)

E-270....From a single plant consisting of 111 fruits. Same locality as E-268. Plants with large fruits and large broad leaves growing in shade of Dracaena and Ficus. Coll. L.M. Fernie and Floyd Bolton, 37. 3 December 1964. (E,M,P,T)

E-271....From a single plant consisting of 13 fruits. Same locality as E-268. Shoots green-tipped. Coll. L.M. Fernie and Floyd Bolton, 38. 3 December 1964. (M)

E-272....Rep. sample consisting of 55 fruits. Kolu (Colu) village, about 35 km west of Maji, elev. 1,550 m, about 6°9.5' N, 35°18' E, Kaffa Prov. Coll. L.M. Fernie and Floyd Bolton, 39. 5 December 1964. (E,M,P,T)

E-273....Rep. sample consisting of 103 fruits. Hemileia vastatrix present. Teppi airport, elev. 1,320 m, about 7°9' N, 35°18' Illubabor Prov. Hemileia vastatrix present. Coll. L.M. Fernie and Floyd Bolton, 40. 5 December 1964. (E,M,P,T)

E-274....Rep. sample consisting of 23 fruits. Bore village on Agaro-Gera road, elev. about 1,800 m, Kaffa Prov. Shoots green-tipped; cultivated in shade of Millettia ferruginea. Coll. L.M. Fernie, 41. 7 December 1964. (E,M,P,T)

E-275....Rep. sample consisting of 50 fruits. Gicho village on Agaro-Gera road, elev. about 1,800 m, Kaffa Prov. Coll. L.M. Fernie, 42. 7 December 1964. Hemileia vastatrix present. (E,M,P,T)

E-276....From a single plant consisting of 21 fruits. Hemileia vastatrix present. Same locality as E-275. Coll. L.M. Fernie, 43. 7 December 1964. (E,M,P,T)

E-277....From a single plant consisting of 10 fruits. From coffee farm of F. Gebre Christos, elev. 1,550 m, Komba district, Agaro sub-province, Kaffa Prov. Coll. Floyd Bolton. 26 November 1964. (E,P,T)

E-278....Random sample consisting of 60 fruits. Same locality as E-80, elev. 1,830 m; flat ribbed bean; shoots green-tipped. Coll. Floyd Bolton. 26 November 1964. (E,P,T)

E-279....From a single plant consisting of 12 fruits. Same locality as E-248. Plants with large leaves, light bronze shoots, round fruits and very large flowers. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-280....From a single plant consisting of 10 fruits. Same locality as E-248. Plants with roundish cherries, a large depressed calyx and green-tipped shoots. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-281....Random sample consisting of 11 fruits. Same locality as E-248, elev. 1,930 m. Coll. Floyd Bolton. 21 November 1964. (P,T)

E-282....From a single plant consisting of 15 fruits. Same locality as E-35. Plants with wide, medium long leaves and long cherries with a persistent calyx and green-tipped shoots. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-283....Random sample consisting of 23 fruits. Same locality as E-248. Shoots green-tipped. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-284....Random sample consisting of 42 fruits. Same locality as E-248. Plants with round flat cherries and medium wide and medium long leaves with green-tipped shoots. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-285....Random sample consisting of 32 fruits. Same locality as E.248. Plants with round flat cherries and green-tipped shoots. Material from original forest plants left in place when the plantation was established. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-286....From a single plant consisting of 18 fruits. Same locality as E-248. Plants strongly vigorous, with wide green leaves, medium round cherries, and green-tipped shoots. Coll. Floyd Bolton. 21 November 1964. (E,P,T)

E-287....Random sample consisting of 17 fruits, Shebe district, Jimma sub-province, Kaffa Prov. Plants with flat, square cherries, green-tipped shoots, and wide leaves. Coll. Floyd Bolton. 26 November 1964. (E,P,T)

E-288....From a single plant consisting of 14 fruits. Same locality as E-166. Plants with large nearly round cherries. Coll. Floyd Bolton. 6 December 1964. (E,P,T)

E-289....From a single plant consisting of 7 fruits. Same locality as E-35. Coll. Floyd Bolton. 22 November 1964.

E-290....From a single plant consisting of 22 fruits. Same locality as E-166. Shoots green-tipped. Coll. Floyd Bolton. 6 December 1964. (E,P,T)

E-291
to
E-300...From single plants. Same locality as E-81. Coll. L. Monaco. 26 November 1964. (E, O, P, T); E-293, E-296, E-298 (O, P, T) only.

E-301
to
E-309...From single plants. Same locality as E-30. Coll. L. Monaco. 23 November 1964.

(E-301).....(E, M, O, P, T)
(E-302).....(O, P, T)
(E-303).....(O, P, T)
(E-304).....(E, O, P, T)
(E-305).....(E, O, T)
(E-306).....(E, O, P, T)
(E-307).....(O, T)
(E-308).....(E, O, P, T)
(E-309).....(E, P, T)

E-310
to
E-314...From single plants. Same locality as E-166. Coll. L. Monaco. 26 November 1964.

(E-310.....(E, O, P, T)
(E-311).....(E, O, P, T)
(E-312).....(E, O, P, T)
(E-313).....(O, T)
(E-314).....(E, O, P, T)

E-315
to
E-322...From single plants. Same locality as E-68. Coll. L. Monaco. 26 November 1964 (E, O, P, T)

E-323
and
E-324...From single plants. Limmu subprovince, vicinity of Suntu village, Kaffa Prov. Coll. L. Monaco. 26 November 1964 (E, O, P, T)

E-325
to
E-352...From single plants. Same locality as E-87. Coll. L. Monaco. 30 November 1964 (E, O, P, T) except:

(E-327).....(O, P, T)
(E-331).....(E, O, T)
(E-334).....(O, T)
(E-342).....(O, T)
(E-345).....(E, M, O, P, T)

E-353
to
E-374...From single plants. Same locality as E-128. Coll. L. Monaco. 2 December 1964 (E, O, P, T) except:

(E-356).....(O, P, T)
(E-364).....(O, P, T)
(E-365).....(E, M, O, P, T)
(E-372).....(E, M, O, P, T)
(E-373).....(O, P, T)

E-375
and
E-376....From single plants, growing along the trail. Same locality as E-88. Coll. L. Monaco. 2 December 1964. (E,O,P,T)

E-377
to
E-384....From single plants, growing along the trail, ca 8 km. from Gera on Afallo trail, elev. about 1,900 m, about 7°43' N, 36°18' E, Kaffa Prov. Coll. L. Monaco. 1 December 1964. (E,O,P,T)except E-379, E-382, E-383 (O,P,T).

E-385
to
E-392....From single plants, growing along the trail. Same locality as E-88. Coll. L. Monaco. 2 December 1964.

E-385	E,O,P,T	E-389	E,M,O,P,T
E-386	E,O,P,T	E-390	E,O,P,T
E-387	E,O,P,T	E-391	E,O,P,T
E-388	O,P,T	E-392	E,O,P,T

E-393....From a single plant cultivated along road, about 39 km northeast of Gera on Agaro road, elev. about 1,900 m, about 7°51' N, 36°37' E, Kaffa Prov. Coll. L. Monaco. 3 December 1964. (E,O,P,T)

E-394
to
E-400....Samples from single plants, cultivated along the road, about 17 km northeast of Gera on Agaro road, elev. about 1,900 m, about 7°51' N, 36°37' E, Kaffa Prov. Coll. L. Monaco. 3 December 1964. (E,O,P,T) except E-394 (O,P,T)

E-401
to
E-407....From single plants, cultivated along road. Same locality as E-130. Coll. L. Monaco. 3 December 1964. (E,O,P,T); E-402 also to (M).

E-408
to
E-411....From single plants cultivated at coffee processing station owned by Ras Andergachew, about 8 km west of Bonga on Wush Wush road, elev. about 1,700 m, about 7°15' N, 36°13' E, Kaffa Prov. Coll. L. Monaco. 6 December 1964. (E,O,P,T); E-411 also to (M).

E-412
to
E-415....From single plants along road, 5 km from Bonga, elev. about 1,600 m, 7°15' N, 36°13' E, Kaffa Prov. Coll. L. Monaco. 6 December 1964. (E,O,P,T); E-412 also to (M)

E-416
to
E-421....From single plants cultivated near the governor's house, Bonga, elev. about 1,800 m, about 7°15' N, 36°13' E, Kaffa Prov. Coll. L. Monaco. 6 December 1964. (E,O,P,T)

E-422
to
E-436....From single plants growing spontaneously in forest, about 8 km southwest of Teppi village, elev. about 1,200 m, about 7°10' N, 35°18' E, Illubabor Prov. Coll. L. Monaco. 9 December 1964. (E,O,P,T); except E-425 (O,T), E-426 (O,P,T), E-427 (O,T) E-428 (O,P,T)

E-437
to
E-446....From single plants growing spontaneously in forest, 8 km east of Teppi village, elev. about 7°10' N, 35°18'E, Illubabor Prov. Coll. L. Monaco. 10 December 1964.

(E-437).....(E,M,O,P,T)
(E-438).....(O,M,P,T)
(E-439).....(E,M,O,P,T)
(E-440).....(O,M,P,T)
(E-441).....(E,M,O,P,T)
(E-442).....(M,O,T)
(E-443).....(E,M,O,P,T)
(E-444).....(M,O,T)
(E-445).....(E,M,O,P,T)
(e-446).....(E,M,O,P,T)

E-447
to
E-453....From single plants growing spontaneously in forest. Same locality as E-437. Coll. L. Monaco. 10 December 1964. (E,M,O,P,T); E-448 (M,O,T) only.

E-454
to
E-459....From single plants growing spontaneously in forest along Teppi-Mizan Teferi trail to Baco River, elev. about 1,200 m, about 10 km southeast of Teppi village, about 7°9' N, 35°22' E, Illubabor Prov. Coll. L. Monaco. 11 December 1964. (E,M,O,P,T); E-445 (M,O,P,T) only.

E-460
to
E-462....From single plants cultivated in Teppi village, elev. about 1,200 m, 7°10' N, 35°18' E, Illubabor Prov. Coll. L. Monaco. 10 December 1964.

(E-460).....(E,M,O,P,T)
(E-461).....(E,M,O,P,T)
(E-462).....(E,O,P,T)

E-463
to
E-466....From single plants growing spontaneously in forest, about 7 km southeast of Teppi village, Teppi-Mizan Teferi trail to Baco River, elev. 1,240 m.

E-467
to
E-473....From single plants cultivated in Fichi village. Same locality as E-160. Coll. L. Monaco. 3 December 1964. (E,O,P,T); E-469 also to (M)

E-474
to
E-492....From single plants. Same locality as E-81. Coll. L. Monaco. 26 November 1964. (E,O,P,T) except:

(E-474.....(E,O,T)
(E-479.....(E,T)
(E-482.....(E,O,T)

(E-485)....(E,M,O)
(E-489)....(E,M,O,P,T)

E-493
to
E-497....From single plants. Same locality as E-80. Coll. L. Monaco. 26 November 1964. (E,O,P,T); except E-496 (E,O,T), E-497(O,T)

E-498....From a single plant. Same locality as E-114. Herbarium voucher, Meyer 8974. (E,O,P,T)

E-499....Random sample from plants grown around a tukle (Ethiopian round thatched house) at Bolku, a place a few kilometers south of Benessa, on a difficult trail to the Berber Uaha River, elev. 1330 m, about 6°50' N, 35°30' E, Kaffa Prov. Herbarium voucher, Meyer 8988. 21 December 1964. (E,M,O,P,T)

E-500
and
E-501....From single plants. Same locality as E-115. Herbarium voucher, Meyer 8984. 19 December 1964.

(E-500).....(E,M,O,T)

(E-501).....(E,O,T)

E-502
to
E-505....From single plants. Same locality as E-499. Coll. F.G. Meyer. 21 December 1964. (E,O,P,T); E-502 also to (M)

E-506
to
E-515....From single plants, 1 km east of Ainamba village, elev. 1,500 m, 6°53' N, 35°28' E, Kaffa Prov. Semi-wild or perhaps originally planted and then naturalized under a large Ficus tree. Herbarium voucher, Meyer 8989. 22 December 1964. (E O P T); E-506, E-508, E-511, E-513, and E-515 also to (M)

E-516
to
E-522....From single plants cultivated near a dwelling at Tunteta, just below escarpment of ridge on trail from Ainamba to Vorcu, overlooking the broad valley and Sheko forest to the southwest and the Tana Plantation, elev. 1,620 m, about 6°52' N, 35°27' E, Kaffa Prov. Grown from seeds brought from the Sheko forest. Herbarium voucher, Meyer 8990. 23 December 1964. (E,O,P,T); E-516, E-517, E-519, E-520, E-521, E-522 also to (M)

E-523....From a single plant with leaves the largest of any seen on the present tour. Under a large Ficus tree, about 4 km southwest of Mizan Teferi airport on Tana Plantation road, elev. about 1,400 m, 6°55' N, 35°26' E, Kaffa Prov. Voucher specimen, Meyer 8991. 23 December 1964. (P,T)

E-524....Random sample from plants cultivated around houses in Omonadda village, about 72 km southeast of Jimma (about 20 km east of main road turning at Little Ghibie River), elev. about 1,800 m, 7°37' N, 35°14' E, Kaffa Prov. Shoots deep bronze. Hemileia vastatrix observed. Coll. F.G. Meyer, 27 December 1964. (E,I,M,O,P,T)

E-525....From a plant about 10 ft tall by 12 ft wide and flat-topped. Cultivated in front of house near church, approached by turning first left across stream after leaving Ghion Hotel, Jimma, Kaffa Prov. The plant has leaves and flowers smaller than in plants seen elsewhere in the Jimma district and orthotropic shoots occur spontaneously throughout the specimen. The fruit was longer, up to 27mm, than any observed in Ethiopia and at maturity the calyx was often persistent. Hemileia vastatrix present. Herbarium voucher, Meyer 9050. 29 December 1964. (E,I,O,P,T)

E-526....From a single plant at the same site as E-525, but the fruit is nearly round and not so long. The flowers are as small as in E-525. Coll. F.G. Meyer. 29 December 1964. (E,M,O,P,T)

E-527 to E-540....From single plants cultivated in Bonga and growing spontaneously in forest along Wush Wush road, about 7 km from Bonga, elev. 1,600 - 1,790 m, about 7°15' N, 36°12' E, Kaffa Prov. Hemileia vastatrix occurs in the area. Herbarium voucher, Meyer 9067. 21 December 1964. (E,O,P,T)

E-541....Random sample from same locality as E-527. Coll. F.G. Meyer. 31 December 1964. (E,O,P,T)

E-542 to E-554....From single plants at Wush Wush Plantation, 22 km west of Bonga, elev. 1,920 m, about 7°15' N, 36°8' E, Kaffa Prov. Cultivated in rows in a heavily thinned forest. Plants raised from seeds collected from spontaneous plants in the nearby forest. Herbarium voucher, Meyer 9078. (E,O,P,T).

E-555....Random sample, 30 km northwest Jimma on Agaro road, Kaffa Prov. Cultivated by Ato Abadico Marro. Coll. Ato Worku Makonnen. 5 January 1965. (E,O,P,T)

E-556....Random sample from 18 plants cultivated under natural shade of Cordia africana, Albizia schimperiana, Millettia ferruginea, Zeghie peninsula, near Zeghie village, elev. about 1,780 m, 11°42' N, 37°20' E, Gojjam Prov. Shoots apparently green-tipped, not recognizably bronze at this the dormant season. Fruit light red with whitish lined markings. Herbarium voucher, Meyer 9094. 13 January 1965. (I,M,O)

E-557
to
E-574....From single plants. Same locality as E-556. Herbarium voucher, Meyer 9094. 13 January 1965. (E,O,P,T).

E-575
to
E-578....From single plants. Near church along main road in town of Bahar Dar, Lake Tana, elev. 1780 m, Gojjam Prov. Plants resembling those found on Zeghie Peninsula. Herbarium voucher, Meyer 9096. 14 January 1965. (E,O,P,T)

E-579....Coffea arabica 'Mocha'. Random sample from plants cultivated at Faghena Experiment Station, on escarpment, 56 km north of Asmara, elev. 1,700 m, about 15°35' N, 38°58' E, Eritrea. Shoots green-tipped. Introduced to the area shortly after 1902 by Italians, probably from Yemen. Herbarium voucher, Meyer 9097. 15 January 1965. (E,I,M,O,P,T)

E-580....Random sample from plants of E-575 to E-578. Herbarium voucher, Meyer 9096. 14 January 1965. (I)

E-581....Random sample from Giaba village and vicinity, about 6°17' N, 35°9' E, Maji sub-province, Kaffa Prov. Reputably from spontaneous plants in forest, although this information in indefinite. Obtained by runners employed to collect seeds at this place. January 1965. (E,M,P,T)

E-582....Random sample from Gai village and vicinity, about 6°17' N, 35°11' E, Maji sub-province, Kaffa Prov. Reputably from spontaneous plants in forest, although this information is indefinite. Obtained by runners employed to collect seeds at this place. January 1965. (E,M,P,T)

Seed introductions grown only at the Central Coffee Research Institute (C.C.R.I.), Chikmagalur District, Mysore State, INDIA. Coll. R. L. Narasimhaswamy. (Except E-621)

E-583....Selected sample from several plants with large and broad, squat-shaped fruits. Same locality as E-21. Plants multi-stemmed and untopped; shoot leaves bronze to dark bronze and some green. (C.C.R.I. 2606). 14 November 1964.

E-584....Selected sample from several plants with large and dark red fruits. Same locality as E-16. Bean abnormalities very evident. (C.C.R.I. 2605). 15 November 1964.

E-585....Selected sample from several plants growing spontaneously in Kantheri forest, about 20 km s.e. of Shashemene, elev. ca 2,000 m, about 7°7' N, 38°40' E, Shoa Prov. Leaves with cuneate base and long drip-tip; shoots green, a few light bronze; fruits long and large with small navel, ripening red; beans long with straight central cut, very few abnormalities; leaf rust not seen. (C.C.R.I. 2610). 14 November 1964.

E-586....Selected sample from several plants. Same locality as E-36. Leaves large and broad and the fruits long and broad. High bean abnormality observed. Occasional Hemileia vastatrix observed. (C.C.R.I. 2615). 21 November 1964.

E-587....Random sample consisting of fruits as in E-36 and E-586 as well as some that are longer and broader. High bean abnormality very evident. (C.C.R.I. 2613). 21 November 1964.

E-588....Selected sample from several plants. Same locality as E-30. Plants with vigorous growth with small roundish fruits. Defective beans very low. Hemileia vastatrix observed sparingly. (C.C.R.I. 2618).

E-589....Selected sample from several plants. Same locality as E-30. Fruits large and flattish. One bean showed similarities in morphology to those of C. liberica. Bean abnormalities low. Hemileia vastatrix present. (C.C.R.I. 2620). 23 November 1964.

E-590....Selected sample from several plants. Same locality as E-30. Fruits long and broad. Bean abnormality low. Hemileia vastatrix observed sparingly. (C.C.R.I. 2621). 23 November 1964.

E-591....Selected sample from several plants. Same locality as E-30. Plants with narrow linear leaves similar to C. arabica 'Angustifolia'. Bean abnormality very low. Hemileia vastatrix present. (C.C.R.I. 2619). 23 November 1964.

E-592....Selected sample from several plants. Same locality as E-81. Plants with small linear leaves and small roundish fruits, ripening red

with a small navel. Bean abnormality very low (C.C.R.I. 2627). 26 November 1964.

E-593...From a single plant. Same locality as E-81. Fruit very long and large; beans long and narrow. (C.C.R.I. 2628). 26 November 1964.

E-594...From a single plant. Same locality as E-87. Plants with broadly linear drooping leaves; shoot leaves bronze to dark bronze; fruits large, ripening red; bean abnormality very high. (C.C.R.I. 2640). 30 November 1964.

E-595...From a single plant. Same locality as E-87. Leaves roundish-oblong, resembles S.353 of C.C.R.I., India; fruit large, long, pointed at one end and round at the other; shoot leaves dark bronze to purple; some bean abnormality observed. (C.C.R.I. 2638). 30 November 1964.

E-596...From a single plant. Same locality as E-87. Leaves small, narrowly linear; fruits roundish; shoot leaves dark bronze; some bean abnormality observed. (C.C.R.I. 2637). 30 November 1964.

E-597...From a single plant. Same locality as E-87. Leaves large; fruits large squat-shaped, ripening red; beans large, thick and rounded at both ends. Bean abnormality high. (C.C.R.I. 2622). 30 November 1964.

E-598...From a single plant. Same locality as E-87. Leaves small, narrow, linear; fruits large, ripening red; beans long and narrow, pointed at one end and rounded at the other. Bean abnormality low. (C.C.R.I. 2626). 30 November 1964.

E-599...From a single plant. Same locality as E-87. Plants of the Ennarea type, i.e. with narrow linear leaves distinctly wavy-margined; bean abnormality very considerable. (C.C.R.I. 2624). 30 November 1964

E-600...From a single plant. Same locality as E-87. Plants of the Ennarea type; fruits large and squat-shaped, ripening red; beans rounded at both ends, abnormalities low. (C.C.R.I. 2623). 30 November 1964.

E-601...Random sample from all plants collected at this site. Same locality as E-87. Hemileia vastatrix seen but rare; bean abnormalities very high. (C.C.R.I. 2639). 30 November 1964.

E-602...From a single plant. Same locality as E-85. Leaves long and broad with a long drip tip; fruits long and large with a small navel and ripening red; beans long, pointed at one end and round at the other. (C.C.R.I. 2630). 2 December 1964

E-603...Selected sample from several plants. Same locality as E-85. Leaves large; fruits squat-shaped; beans large, a few pointed at one end and the others rounded, with few abnormalities. (C.C.R.I. 2633). 2 December 1964.

E-604...Selected sample from several plants. Same locality as E-85. Plants with small, narrow, linear leaves; fruits large; beans long, some pointed at one end and the others rounded, with a few abnormalities. (C.C.R.I. 2632). 2 December 1964.

E-605...Random sample. Same locality as E-85. Leaves variously large and small, the shoot leaves green and bronze; fruits large; bean abnormality low; leaf rust not observed. (C.C.R.I. 2635). 2 December 1964.

E-606...Sample from 4 plants behind St. George Hotel, Bonga, elev. about 1790 m, ca. 7°15' N, 36°13' E, Kaffa Prov. Plants with small, linear leaves and small roundish fruits with small navel. Roundish small beans with low abnormality; shoot leaves bronze. (C.C.R.I. 2643).6 December 1964.

E-607...From a single plant. On the edge of Bonga village, elev. about 1790 m, about 7°15' N, 36°13' E, Kaffa Prov. Fruits long and narrow; shoot leaves bronze; very low bean abnormality. (C.C.R.I. 2644). 6 December 1964 (E, I, P, T)

E-608...Selected sample from several plants. Same locality as E-408. At a place called Chara, 8 km. west of Bonga on Wush Wush road. Plants with large leaves and large squat-shaped fruits; bean abnormalities high; Hemileia vastatrix abundant on the plants. (C.C.R.I. 2642). 6 December 1964

E-609...From 3 plants. At a place called Arira, ca. 8 km. southwest Teppi village, el. ca. 1200 m, ca. 7°10' N, 35°18' E, Illubabor Prov. Plants with large thick very dark green leaves; shoot leaves light to dark bronze; fruits large squat-shaped; bean abnormalities low; Hemileia vastatrix observed on some plants. (C.C.R.I. 2641). 9 December 1964

E-610...Selected sample from several plants growing spontaneously in the forest at a place referred to locally as Daremmo Arira very near to locality E-609; Hemileia vastatrix observed. (C.C.R.I. 2650). 9 December 1964.

E-611...Random sample from many plants. Near Arira (see E-609). Plants with large leaves and bronze shoots; fruits large squat-shaped with a small navel; bean abnormality low; Hemileia vastatrix observed. (C.C.R.I. 2649). 9 December 1964.

E-612...Selected sample from several plants. Same locality as E-437. Leaves large, deep green with nearly straight margins; fruits squat-shaped, large, one of which measured 21.7 mm in length, flat on two sides, with a small navel; shoots light to dark bronze; bean abnormality very low; Hemileia vastatrix observed. (C.C.R.I. 2653). 10 December 1964

E-613...From 3 plants in deep forest growing spontaneously. Leaves large; fruits long, flat on two sides with small navel; beans long with some abnormalities. Same locality as E-118. (C.C.R.I. 2652). 10 December 1964.

E-614....Random sample from many plants. Cultivated around house compounds in Teppi village, elev. about 1,200 m, about 7°10' N, 35°18'E, Illubabor Prov. Leaves large, dark green with nearly straight margins; fruits large, squat-shaped with small navel; shoot leaves bronze; Hemileia vastatrix observed. (C.C.R.I. 2647) 10 December 1964.

E-615....Selected sample from several plants. From plantings behind house of Ato Shibeshi at Mizan Teferi airport, elev. 1,400 m, about 6°55' N, 35°25' E, Kaffa Prov. Plants 8-9 years old; leaves large with straight margins with a tendency to droop; shoot leaves bronze; fruits large, squat-shaped with small navel; Hemileia vastatrix observed. (C.C.R.I 2658) 18 December 1964.

E-616....Selected sample from several plants. Ainamba village, elev. 1,500 m, 6°53' N, 35°28' E, Kaffa Prov. Plants under shade with large leaves; shoot leaves bronze; fruits large; beans long with a tendency to being pointed at one end; Hemileia vastatrix occasional. (C.C.R.I. 2673). 22 December 1964.

E-617....Selected sample from several plants. Same locality as E-616. Fruits squat-shaped, flat on two sides with small navel; beans rounded at both ends. (C.C.R.I.2674). 22 December 1964.

E-618....Selected sample from several plants. Same locality as E-616. Plants with broad thick dark green leaves; fruits small of good shape; some beans long and narrow and others broad and roundish (C.C.R.I. 2671) 22 December 1964.

E-619....Selected sample from several plants. Governor's compound (same locality as E-616). Leaves large; fruits large, squat-shaped; shoot leaves bronze; Hemileia vastatrix observed. (C.C.R.I. 2656). 22 December 1964.

E-620....From a single plant. Same locality as E-619. Leaves narrowly linear; fruits long and narrow; beans long and narrow; shoot leaves bronze. (C.C.R.I 2655) 22 December 1964.

E-621....Random sample from many plants. Hemileia vastatrix present. Same locality as E-516. (C.C.R.I 2684) 23 December 1964. (E,I,M,O,T)

E-622....C. arabica 'Ennarea'. Plants with deep bronze tip and the first pair of leaves remaining bronze to maturity. Fruit not ripe. Not the same as coffee cultivated as Ennarea in Kaffa Province. Cultivated at Faghena Experimental Station, 57 km northeast of Asmara, elev. 1700 m on the escarpment, ca. 15°35' N, 38°50' E. Eritrea. Fruit said to ripen in April. No coffee leaf rust observed. Collected as seedling plants and sent by American Consul, Asmara. Oct. 1966. (P,T)

E-623....C.arabica 'Mocha'. Plants with green tips. Fruit ripe in January. Cultivated at same locality as E-622. Collected as seedling plants and sent by American Consul, Asmara. October 1966. (P,T)

USE OF P.I. (PLANT INTRODUCTION) NUMBERS IN FAO COFFEE MISSION REPORT

COFFEA ARABICA

F.C. Meyer

P.I.* Number	Col. Number	P.I.* Number	Col. Number
305639	E-7	685	E-315
640	E-17	686	E-316
641	E-18	305687	E-317
642	E-19	688	E-318
643	E-22	689	E-319
644	E-30	690	E-320
645	E-261	691	E-321
646	E-301	692	E-322
647	E-302	693	E-69
648	E-303	694	E-70
649	E-304	695	E-80
650	E-305	696	E-84
651	E-306	697	E-278
652	E-307	698	E-493
653	E-308	699	E-494
654	E-309	305700	E-495
655	E-35	701	E-496
656	E-41	702	E-497
657	E-42	703	E-81
658	E-43	704	E-291
659	E-44	705	E-292
660	E-45	706	E-293
661	E-46	707	E-294
662	E-47	708	E-295
663	E-48	709	E-296
664	E-67	710	E-297
665	E-71	711	E-298
666	E-244	712	E-299
667	E-36	713	E-300
668	E-37	714	E-474
669	E-38	715	E-475
670	E-52	716	E-476
671	E-53	717	E-477
672	E-54	718	E-478
673	E-55	719	E-479
674	E-56	720	E-480
675	E-57	721	E-481
676	E-58	722	E-482
677	E-59	723	E-483
678	E-60	724	E-484
679	E-61	725	E-486
680	E-66	726	E-487
681	E-72	727	E-488
682	E-39	728	E-489
683	E-254	729	E-490
684	E-68	730	E-491

* P.I. Number = Plant Introduction Number, U.S. Department of Agriculture.

P.I.* Number	Col. Number	P.I.* Number	Col. Number
305731	E-492	305783	E-501
732	E-85	784	E-116
733	E-87	785	E-118
734	E-134	786	E-123a
735	E-146	787	E-123b
736	E-147	788	E-124
737	E-148	789	E-125
738	E-149	790	E-126
739	E-150	791	E-128
305740	E-151	792	E-353
741	E-152	793	E-354
742	E-153	794	E-355
743	E-154	795	E-356
744	E-155	796	E-357
745	E-156	797	E-358
746	E-157	798	E-359
747	E-158	799	E-360
748	E-159	305800	E-361
749	E-325	801	E-362
750	E-326	802	E-363
751	E-327	803	E-364
752	E-328	804	E-365
753	E-329	805	E-366
754	E-330	806	E-367
755	E-331	807	E-368
756	E-332	808	E-369
757	E-333	809	E-370
758	E-334	810	E-371
759	E-335	811	E-372
760	E-336	812	E-373
761	E-337	813	E-374
762	E-338	814	E-129
763	E-339	815	E-130
764	E-340	816	E-131
765	E-341	817	E-132
766	E-342	818	E-133
767	E-343	819	E-401
768	E-344	820	E-402
769	E-345	821	E-403
770	E-346	822	E-404
771	E-347	823	E-405
772	E-348	824	E-406
773	E-349	825	E-407
774	E-350	826	E-139
775	E-351	827	E-140
776	E-352	828	E-141
777	E-88	829	E-142
778	E-89	830	E-143
779	E-114	831	E-144
780	E-498	832	E-145
781	E-115	833	E-160
782	E-500	834	E-161

* P.I. Number = Plant Introduction Number, U.S. Department of Agriculture.

P.I.* Number	Col. Number	P.I.* Number	Col. Number
305835	E-162	305886	E-197
836	E-467	887	E-198
837	E-468	888	E-199
838	E-469	889	E-200
839	E-470	890	E-201
840	E-471	891	E-202
841	E-472	892	E-203
842	E-473	893	E-204
843	E-163	894	E-205
844	E-164	895	E-206
845	E-165	896	E-207
846	E-166	897	E-208
847	E-167	898	E-209
848	E-168	899	E-210
849	E-169	305900	E-211
850	E-170	901	E-212
851	E-171	902	E-213
852	E-172	903	E-214
853	E-173	904	E-215
854	E-174	905	E-216
855	E-175	906	E-217
856	E-176	907	E-218
857	E-177	908	E-219
858	E-178	909	E-220
859	E-188	910	E-221
860	E-246	911	E-222
861	E-247	912	E-223
862	E-288	913	E-224
863	E-290	914	E-225
864	E-310	915	E-226
865	E-311	916	E-227
866	E-312	917	E-228
867	E-313	918	E-229
868	E-314	919	E-230
869	E-179	920	E-231
870	E-180	921	E-232
871	E-181	922	E-233
872	E-182	923	E-233A
873	E-183	924	E-237
874	E-184	925	E-238
875	E-185	926	E-279
876	E-186	927	E-280
877	E-187	928	E-281
878	E-189	929	E-282
879	E-190	930	E-283
880	E-191	931	E-284
881	E-192	932	E-285
882	E-193	933	E-286
883	E-194	934	E-264
884	E-195	935	E-265
885	E-196	936	E-266

* P.I. Number = Plant Introduction Number, U.S. Department of Agriculture.

P.I.* Number	Col. Number	P.I.* Number	Col. Number
305937	E-267	305988	E-422
938	E-268	989	E-423
939	E-269	305990	E-424
940	E-270	991	E-425
941	E-272	992	E-426
942	E-273	993	E-427
943	E-274	994	E-428
944	E-275	995	E-429
945	E-276	996	E-430.
946	E-277	997	E-431
947	E-287	998	E-432
948	E-375	999	E-433
949	E-376	306000	E-434
950	E-385	001	E-435
951	E-386	002	E-436
952	E-387	003	E-437
953	E-388	004	E-438
954	E-389	005	E-439
955	E-390	006	E-440
956	E-391	007	E-441
957	E-392	008	E-442
958	E-377	009	E-443
959	E-378	010	E-444
960	E-379	011	E-445
961	E-380	012	E-446
962	E-381	013	E-447
963	E-382	014	E-448
964	E-383	015	E-449
965	E-384	016	E-450
966	E-393	017	E-451
967	E-394	018	E-452
968	E-395	019	E-453
969	E-396	020	E-454
970	E-397	021	E-455
971	E-398	022	E-456
972	E-399	023	E-457
973	E-400	024	E-458
974	E-408	025	E-459
975	E-409	026	E-460
976	E-410	027	E-461
977	E-411	028	E-462
978	E-412	029	E-463
979	E-413	030	E-464
980	E-414	031	E-465
981	E-415	032	E-466
982	E-416	034	E-499
983	E-417	035	E-502
984	E-418	036	E-503
985	E-419	037	E-504
986	E-420	038	E-505
987	E-421	039	E-506

*P.I. Number = Plant Introduction Number, U.S. Department of Agriculture.

P.I.* Number	Col. Number	P.I.* Number	Col. Number
306040	E-507	306091	E-558
041	E-508	092	E-559
042	E-509	093	E-560
043	E-510	094	E-561
044	E-511	095	E-562
045	E-512	096	E-563
046	E-513	097	E-564
047	E-514	098	E-565
048	E-515	099	E-566
049	E-516	306100	E-567
050	E-517	101	E-568
051	E-518	102	E-569
052	E-519	103	E-570
053	E-520	104	E-571
054	E-521	105	E-572
055	E-522	106	E-573
056	E-621	107	E-574
057	E-523	108	E-575
058	E-524	109	E-578
059	E-525	110	E-579
306060	E-526	111	E-117
061	E-527	302785	8627 (E-1)
062	E-528	306345	E-5
063	E-529	346	E-9
064	E-530	347	E-11
065	E-531	348	E-12
066	E-532	349	E-16
067	E-533	350	E-20
068	E-534	351	E-21
069	E-535	357	E-607
070	E-536	352	E-171A
071	E-537	353	E-323
072	E-538	354	E-324
073	E-539	267	E-576
074	E-540	268	E-577
075	E-541	306355	E-581 = J-237
076	E-542	356	E-582 = J-238
077	E-543	318715	E-622
078	E-544	318716	E-623
079	E-545		
080	E-546		
081	E-547		
082	E-548		
083	E-549		
084	E-550		
085	E-551		
086	E-552		
087	E-553		
088	E-554		
089	E-555		
090	E-557		

* P.I ntroduction Number, U.S. Department of Agriculture.

P H O T O G R A P H S

TAKEN DURING

FAO COFFEE MISSION TO ETHIOPIA

1964 - 1965

Fig. 12 - Forest coffee near Agaro, Kaffa Province underneath Cordia africana. Plants infected with coffee leaf rust (Hemileia vastatrix).
(Photograph: R.L. Narasimhaswamy)

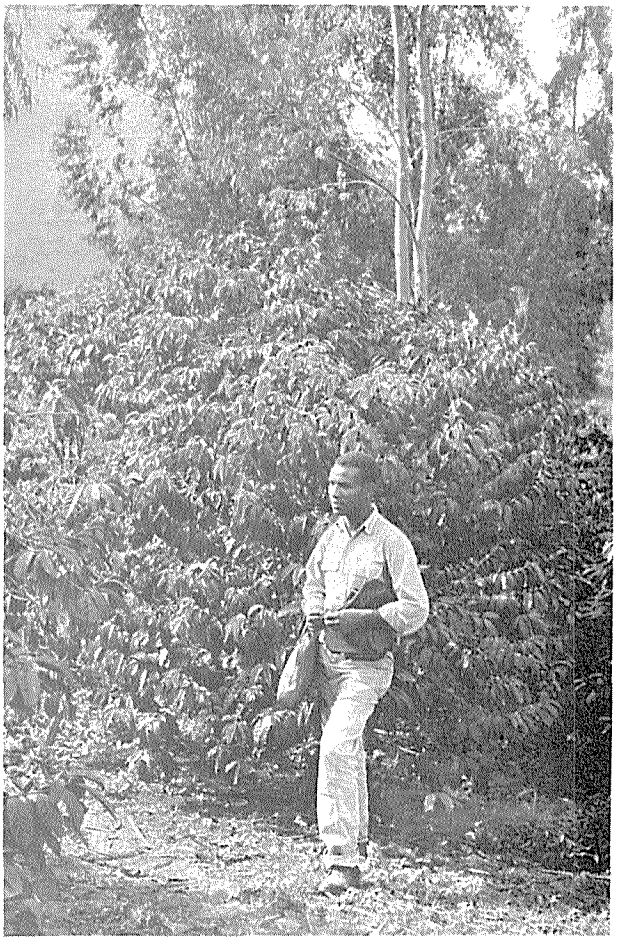

Fig. 13 - Planted coffee in Minch estate, about 2½ km from Mizan Teferi airport, of the Wobba type with dropping leaves. Kaffa Province.
(Photograph: R.L. Narasimhaswamy)

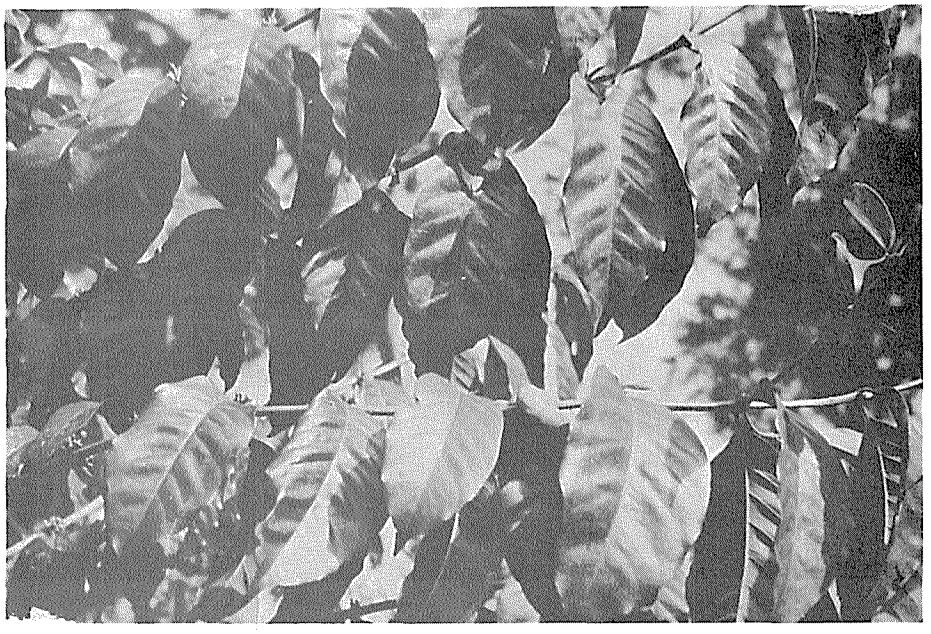

Fig. 14 - Close up of Sheko coffee, the type grown at the Minch estate, 2½ km from Mesan Teferi airport, Kaffa Province. Leaves broad with a slightly wavy margin and short drip tip. (Photograph: R.L. Narasimhaswamy)

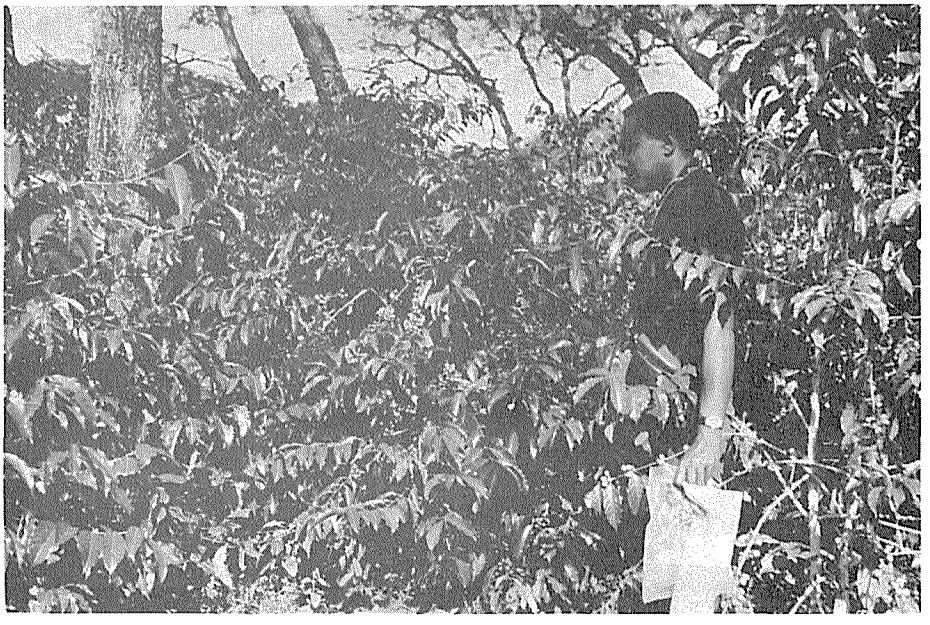

Fig. 15 -Coffee plants in Ato Teka Egano estate at Doyo near Jimma, Kaffa Province. Plant closely resembles selection of S. 31 of Central Coffee Research Institute, India. (Photograph: R.L. Narasimhaswamy)

Fig.16 - Coffee plants at Galanti-Teka Egano Co. estate, Gera, Kaffa Province. Leaves elliptic with a nearly straight margin and long drip tip; fruit large and squat. (Photograph: R.L. Narasimhaswamy).

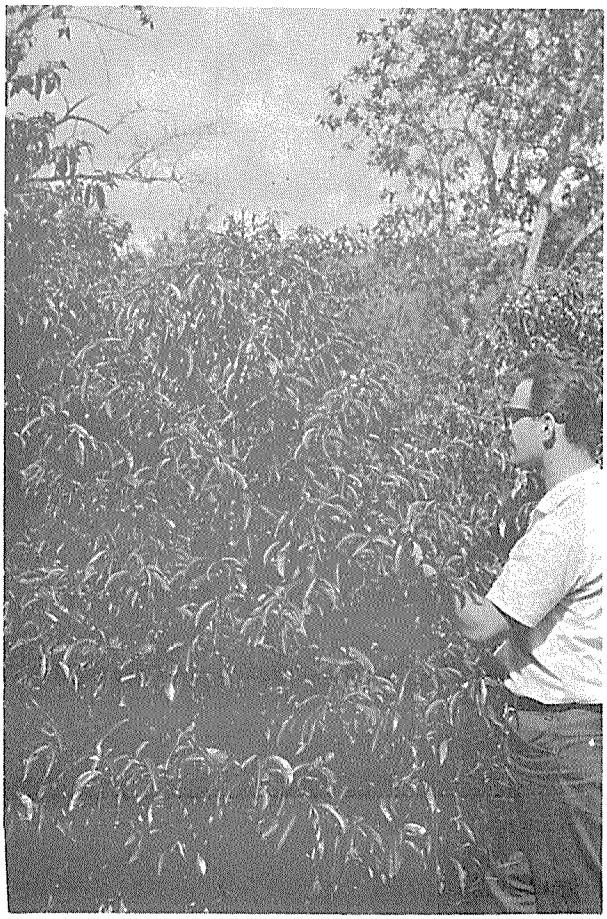

Fig.17 - Coffee plants at Ato Teka Agano estate in Doyo near Jimma, Kaffa Province. Leaves of the angustifolia type; branches with short internodes and roundish fruits. (Photograph: R.L. Narasimhaswamy).

Fig. 18 - Coffee plants at Galanti-Teka Egano Co. estate, Gera Kaffa Province. Leaves broad and thick with very dark brown tips, the margins rather strongly bullate or with a crumpled appearance. (Photograph: R.L. Narasimhaswamy).

Fig. 19 - Coffee plant in Ato Teka Agano estate at Doyo near Jimma, Kaffa Province. Resemblance was noted to S.288 selection of Central Coffee Research Institute, India. (Photograph: R.L. Narasimhaswamy).

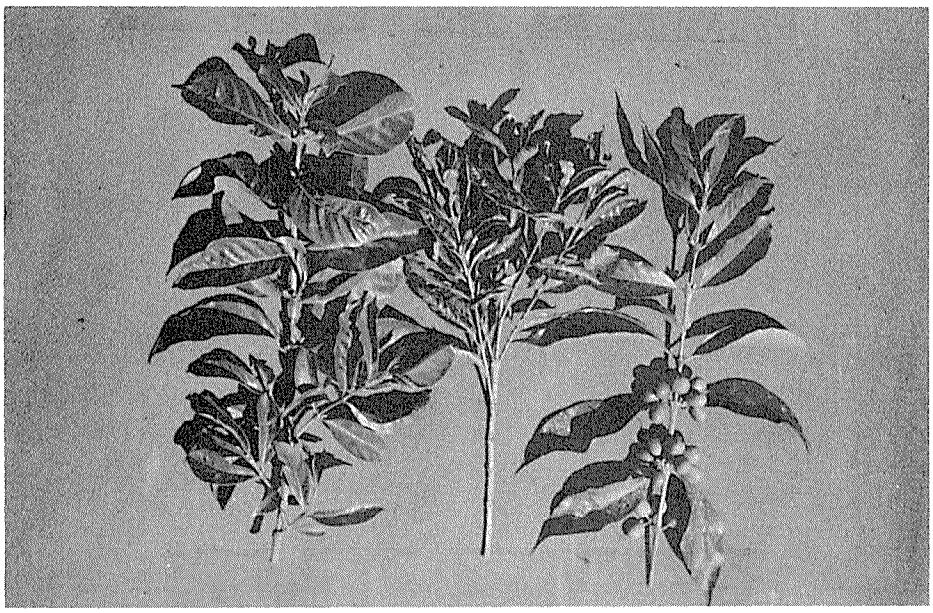

Fig. 20 - Twigs of coffee from Ato Teka Agano estate, Doyo near Jimma, Kaffa Province to show morphological differences found in plants growing at this place. (Photograph: R.L. Narasimhaswamy).

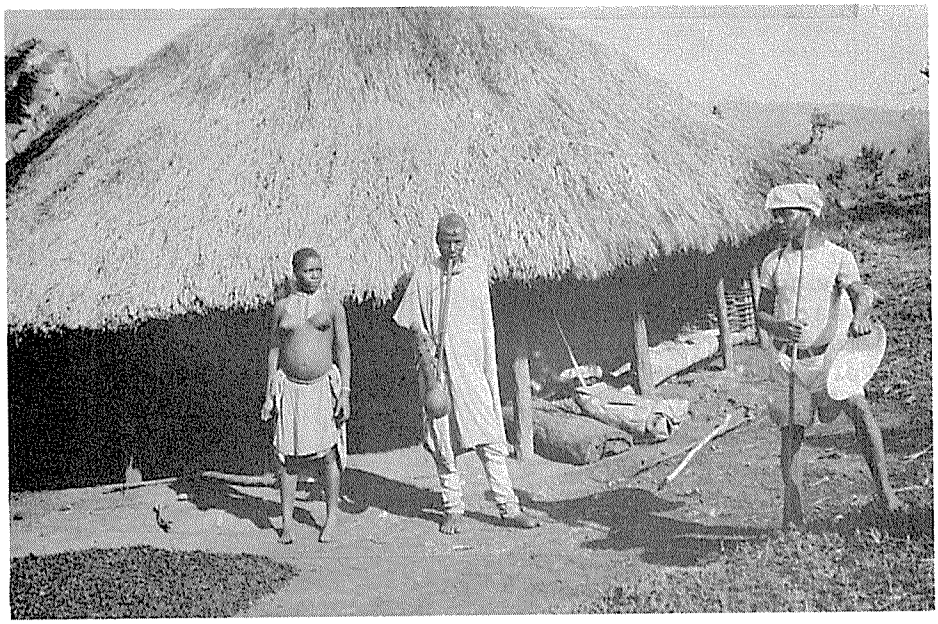

Fig. 21 - Coffee fruit drying in the sun at Bolku village, 15 km southeast of Mizan Teferi airport, Kaffa Province. The man in the centre is smoking a water pipe with locally grown tobacco. (Photograph: R.L. Narasimhaswamy).

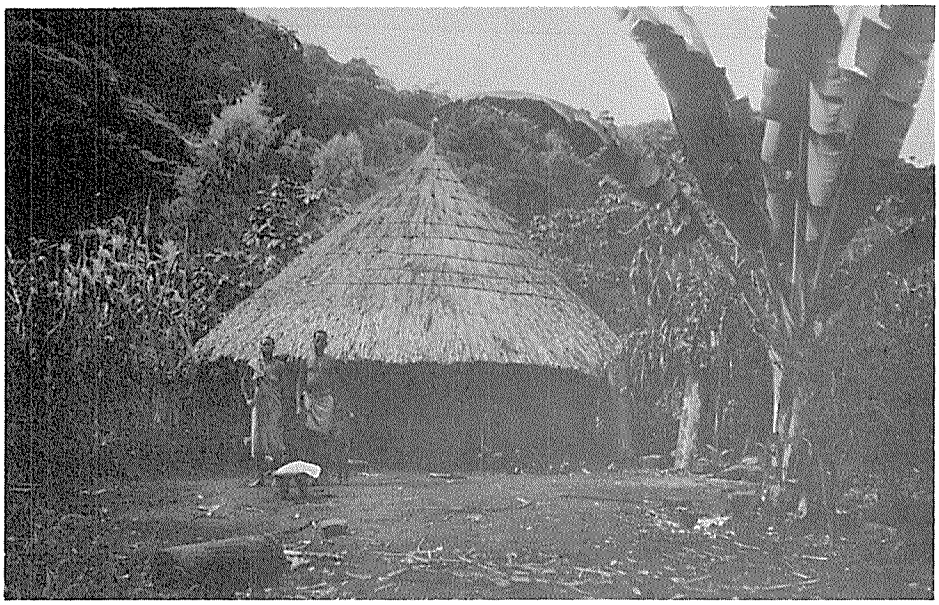

Fig. 22 - Isolated house at Tunteta, near Ainamba village. Note maize plants and false banana (Ensete ventricosum) both food plants. (Photograph: R.L. Narasimhaswamy).

Fig. 23 - Coffee plant at Tunteta, the leaves used for making an infusion and the pulp for cake. Coffee beans are used here for making the usual beverage. (Photograph: R.L. Narasimhaswamy).

Fig. 24 - Wush Wush Coffee Plantation, 22 km west of Bonga, elev. 3,100 m., Kaffa Province. The large trees are Olea welwitschii, Albizia sp. and Ficus sp. (Photograph: F.G. Meyer).

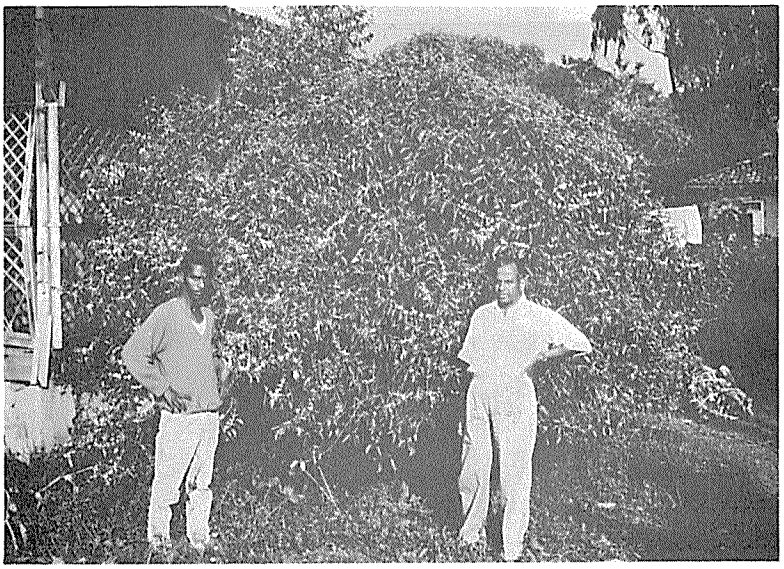

Fig. 25 - Coffea arabica. Seeds collected as E.525 (Meyer 9050) growing in front of a house at Jimma, Kaffa Province. In flower 29 December 1964. Fruit up to 27 mm long. (Photograph: F.G. Meyer).

Fig.30 - Spontaneous Arabica coffee plants in the forest about 5 km from Afallo, Illubabor Province. Height of plants about 8 m. (Photograph: R.L. Narasimhaswamy).

Fig.31 - Spontaneous Arabica coffee plants in the forest about 5 km from Afallo, Illubabor Province showing the characteristic branching habit from near the base. (Photograph: R.L. Narasimhaswamy).

Fig.28 - Coffea arabica in flower at Jimma, Kaffa Province, 29 December 1964. (Photograph: F.G. Meyer).

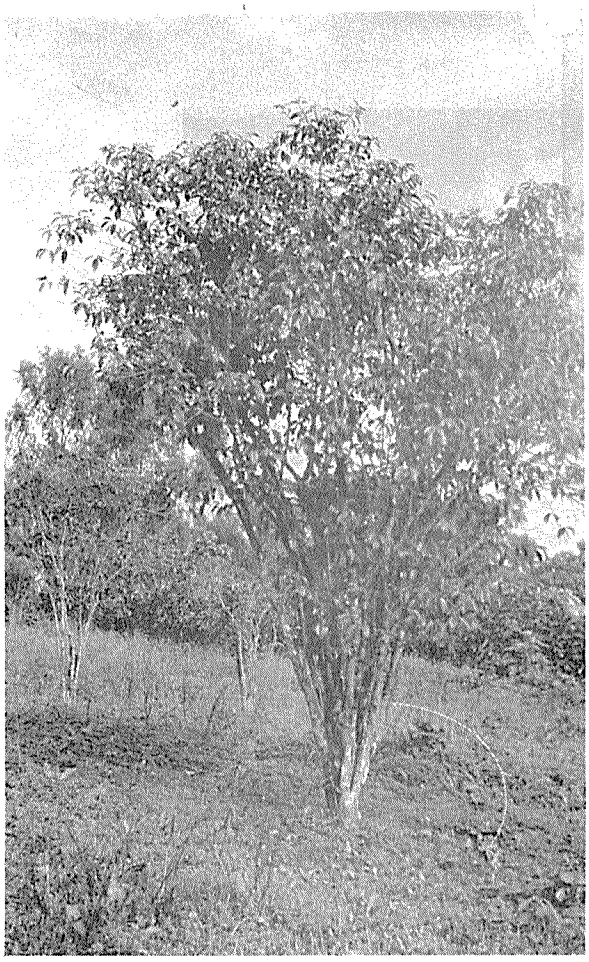

Fig.29 - Aged Arabica coffee tree near Teppi, Illubabor Province with characteristic branching from the base. (Photograph: R.L. Narasimhaswamy).

Fig.30 - Spontaneous Arabica coffee plants in the forest about 5 km from Afallo, Illubabor Province. Height of plants about 8 m. (Photograph: R.L. Narasimhaswamy).

Fig.31 - Spontaneous Arabica coffee plants in the forest about 5 km from Afallo, Illubabor Province showing the characteristic branching habit from near the base. (Photograph: R.L. Narasimhaswamy).

Fig. 32 - Coffee plants at Arira, a place 8 km southwest of Teppi, at about 1,300 m., Illubabor Province. (Photograph: R.L. Narasimhaswamy).

Fig. 33 - Spontaneous coffee plants in forest enroute to Baco River, Teppi-Mesan Teferi trail, Illubabor Province. (Photograph: F.G. Meyer).

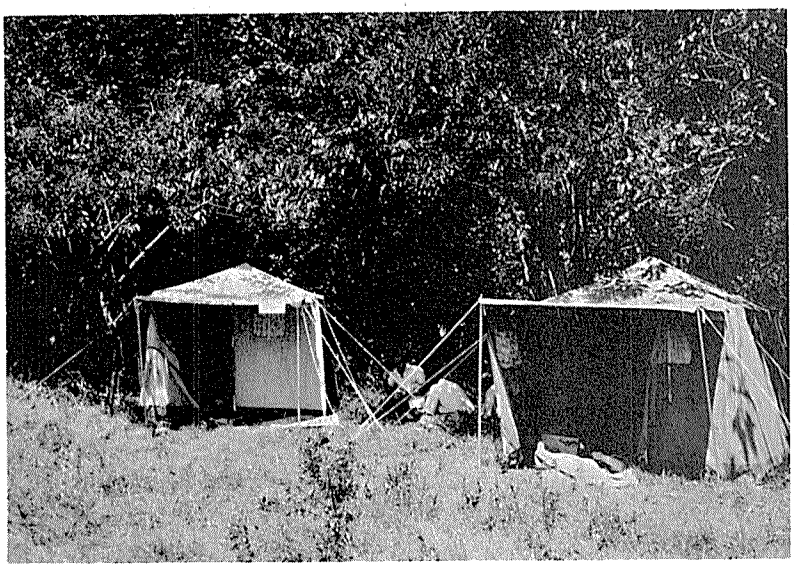

Fig.34 - Campsite on trail to Afallo, Illubabor Province. (Photograph: F.G. Meyer).

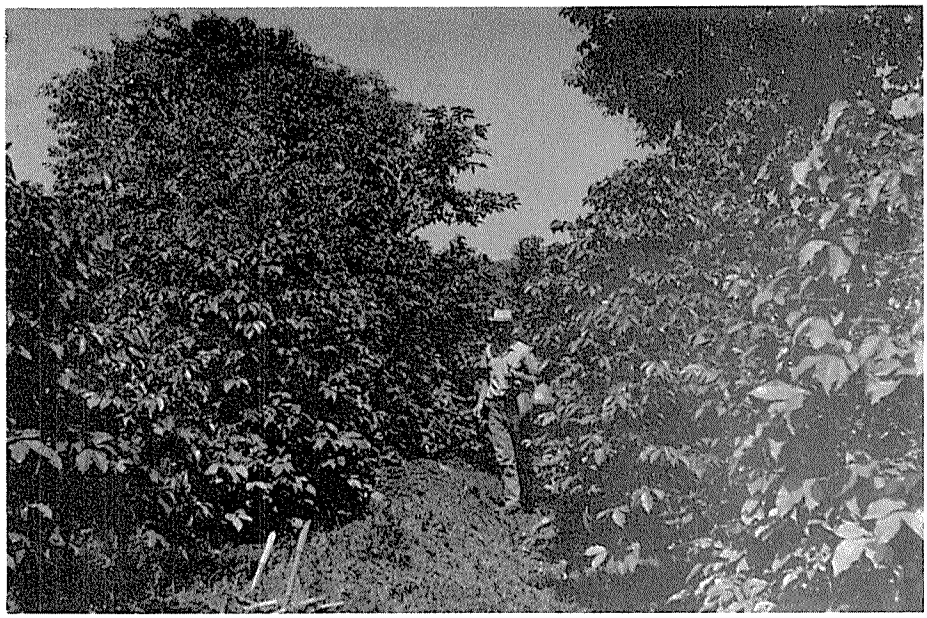

Fig. 35 - Planted coffee of the Harar type, on terraces along the main road near Hirna village, Chercher Hills, Harar Province. Plants infected with coffee leaf rust (Hemileia vastatrix). (Photograph: R.L. Narasimhaswamy).

Fig.36 - Coffee planted on terraces on open hillsides, Chercher Hills, 100 km east of Asbe Teferi, Harar Province.(Photograph: F.G. Meyer).

Fig.37 - Planting of coffee in plot 30m x 17m, 17 km north of Harar, 1 km north of Combulchia, elev. 2,100m., Harar Province.(Photograph: F.G. Meyer).

Fig. 38 - Four ways of selling Coffea arabica in the market at Harar, Harar Province: (left to right) dry cherry; dry leaves used for infusion (Kuti); hulls only (Hashara); green cherry (Buna Wahbera). (Photograph: F.G. Meyer).

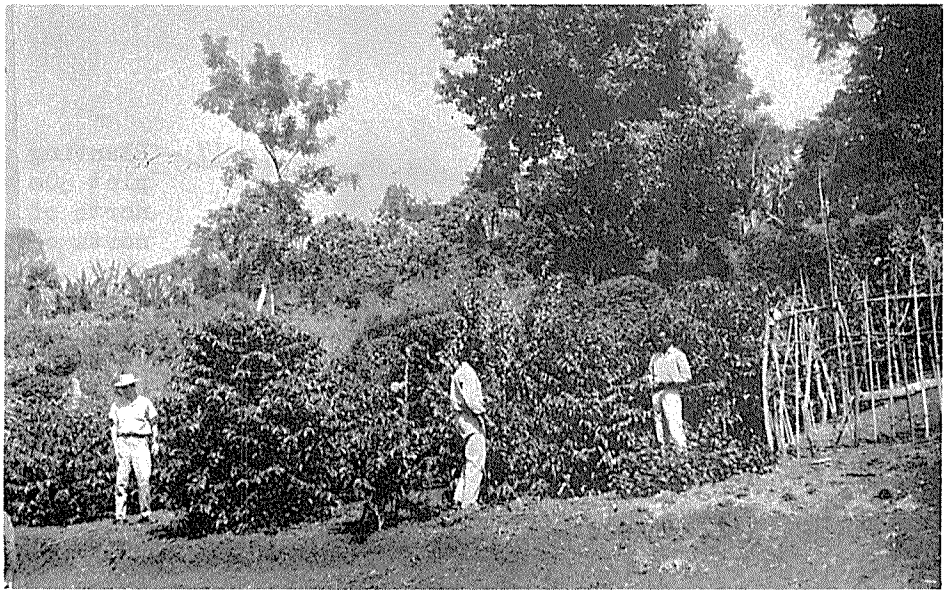

Fig. 39 - Cultivated coffee between Konga and Yirga-Cheffe, Sidamo Province. (Photograph: R.L. Narasimhaswamy).

Fig.40 - Coffea arabica on the Zeghie Peninsula showing the way it is planted at random, about six feet apart in a secondary forest. (Photograph: F.G. Meyer)

Fig. 41 - Coffea arabica on the Zeghie Peninsula showing plants with nearly ripe cherries. 13 January 1965. (Photograph: F.G. Meyer).

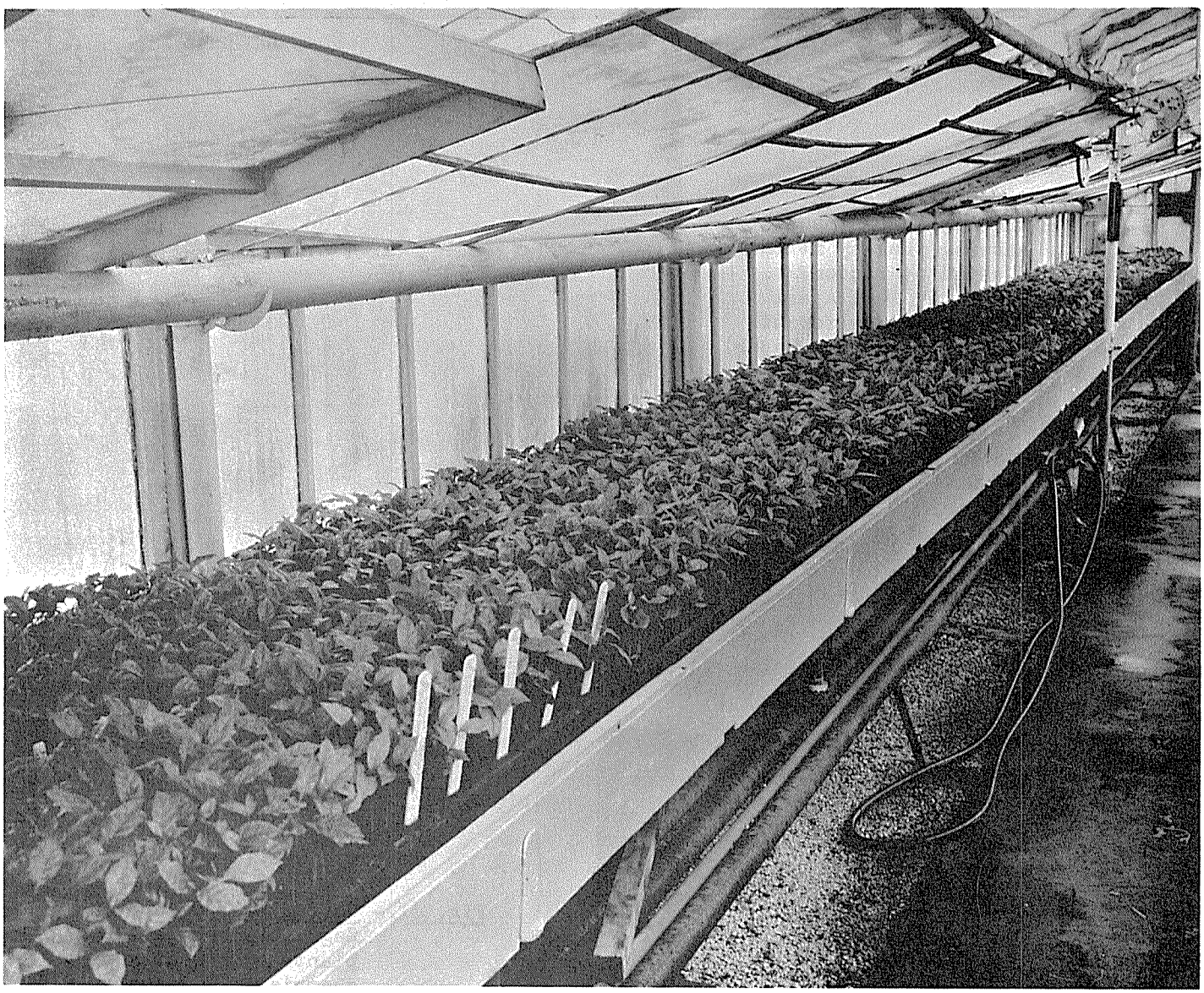

Fig. 42 - Portion of over 11,000 seedlings representing 488 introductions of Coffea arabica from Ethiopia at Plant Introduction Station, Glenn Dale, Maryland. Photo taken at age of three months just prior to sending of seedlings to Ethiopia, Costa Rica, and Peru, 6 June 1965. (Photograph: F.G. Meyer).

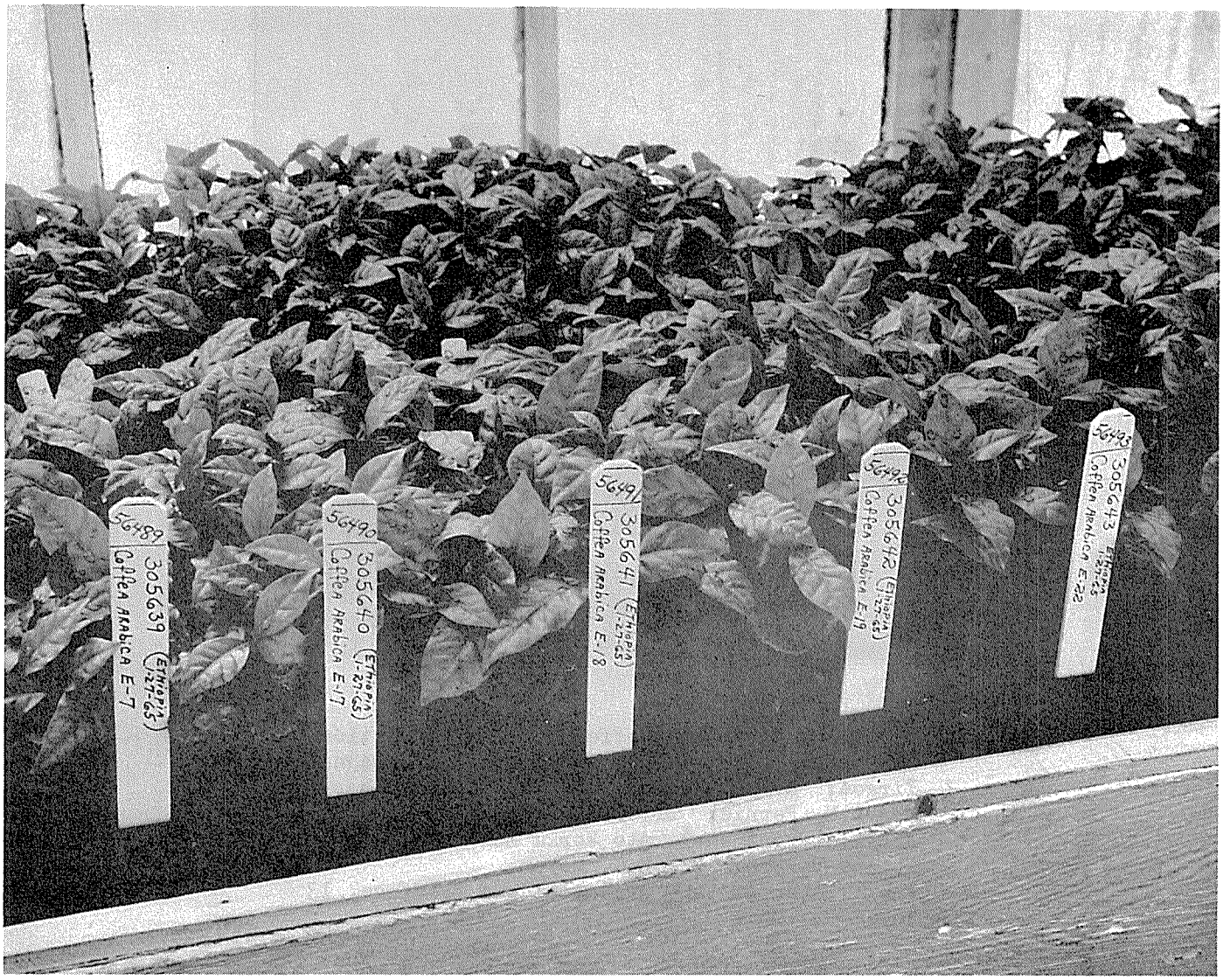

Fig.43 - Close up of seedlings showing the careful labeling of the material at Glenn Dale. (Photograph: F.G. Meyer)

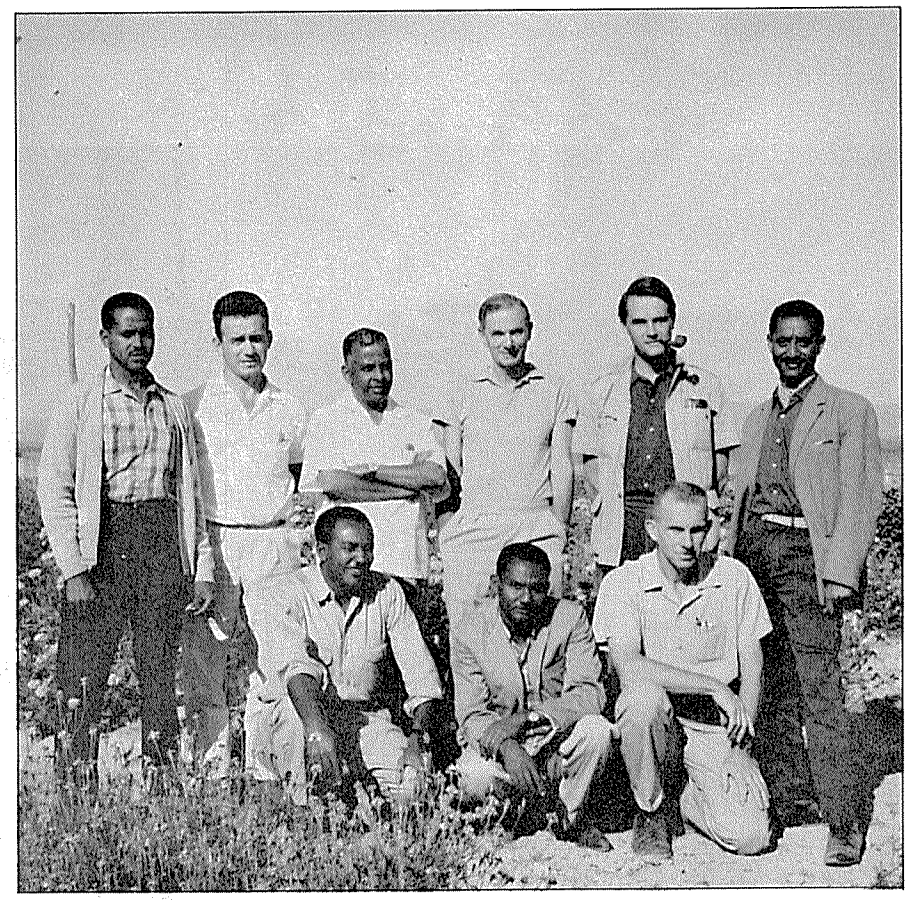

Fig.44 - Participants in FAO Coffee Mission expedition to Ethiopia: (left to right) back row, Dr. Dagnatchew Yirgou; Mr. L. Monaco; Mr. R.L. Narasimhaswamy; Mr. L.M. Fernie; Dr. D.J. Greathead; Ato Abebe Abaya; (front row) Ato Worku Makonnen, Ato Yilma Yomano-Berhan; Dr. F.G. Meyer.
Photo taken at Lake Awasa, Sidamo Province, 13 November 1964.

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