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NUMERICAL TAXONOMIC STUDY.

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THE BROMELIACEAE OF ECUADOR
AN ALPHA-NUMERICAL TAXONOMIC STUDY

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THE BROMELIACEAE OF ECUADOR
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ABSTRACT

The hypothesis has been tested that orthodox and numerical taxonomic methods concomitantly apply to floristic studies of flowering plants with useful results. In order to test this hypothesis, a large number of species from the Bromeliaceae, a tropical plant family containing nearly 2000 species was chosen. Our present knowledge achieved from this study of the Bromeliaceae in Ecuador is summarized in keys, descriptions and notes prepared for 275 species. The phenetic affinities of taxa with difficult taxonomic circumscriptions were quantified. Studies of the leaf-epidermis and germination of seeds together with seedling morphology contributed additional diagnostic characters for subfamilial circumscriptions. These features suggest that the subfamily Pitcairnioideae is less closely related to the other two subfamilies than they are to each other. The effort expended in order to evaluate classical and numerical taxonomic methods clarified for the author the thought processes that taxonomists must employ. It is concluded that the methods of numerical and classical taxonomy are not merely compatible but rather produce together much more than the sum of their component parts.

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INTRODUCTION

The Bromeliaceae of Ecuador provided an opportunity for an experiment in taxonomy. During three years of field work in that country the author collected materials for testing the hypothesis that newer numerical methods in taxonomy and classical methods of pattern recognition are not mutually exclusive but complementary in the ends achieved and that by utilizing these methods a desirable bromeliad flora could be produced.

The two principal goals of the present research have been, 1) an evaluation of numerical taxonomy and the utilization of its methods in order to shed light on the taxonomic method itself and to quantify taxonomic relations; 2) production of keys and descriptions for the known species of the Bromeliaceae in one country of South America.

The several sections of the text come together in the discussion of the taxonomic results, i.e. the keys and descriptions of the Bromeliaceae of Ecuador found in Appendix C. These taxonomic results and evaluations of methods and philosophy found in the discussion have been developed by means of synthesis of new data and new methods and philosophy plus classically utilized data, methods and philosophy.

LITERATURE REVIEW

A. Collections of Bromeliaceae from Ecuador and Related Areas

André has been the most important single collector of Ecuadorian Bromeliaceae. His specimens are numerous and his documentation is detailed. In November 1875 André began his travels through Venezuela, Colombia and Ecuador. He was primarily interested in horticulturalists but seemingly collected any bromeliad species encountered. Smith (1965) lists André's itinerary with collection numbers, dates and sites. By early June 1876 he had passed through Colombia and entered Ecuador. He traveled some 500 km within Ecuador, more than two thirds the length of the country, and ended his plant collecting in July 1876 near Loja in Southern Ecuador. In one month in the country André collected 47 different species and varieties. During his travels through Venezuela, Colombia and Ecuador, 1875-76, he collected a total of 129 species of Bromeliaceae and 14 varieties. Approximately 37 per cent of the different taxa that he collected were from Ecuador although only approximately 13 per cent of his time was spent there. His published work on the results of these travels (André, 1889) is beautifully and accurately illustrated with large plates. Of the 129 species included in this "Bromeliaceae Andreanae," he authored 83 of the species and 18 varieties. The Kew Herbarium has a nearly complete set of his bromeliad specimens and the Gray Herbarium has a somewhat less complete set.

Luis Sodiro, an Ecuadorian, collected in Ecuador until he died at the age of 73 in 1909. Although he did not specialize in the group, bromeliad species are numerous in his collections. Nearly all of Sodiro's herbarium material is deposited in the Berlin-Dahlem Herbarium. There are some duplicates in the poorly maintained "Sodiro Herbarium" at the Universidad Antigua in Quito, Ecuador.

Ludwig Diels (1937) lists all the Ecuadorian plant collectors up to 1935. In addition to André and Sodiro, the more important collectors of Ecuadorian bromeliad species are the following: George Barclay, 1836-1838; Hugh Cuming, 1837-1840; Heinrich Eggers, 1891-1897; Albert Hitchcock, 1923; Alexander von Humboldt, 1802-1803; Friedrich Lehmann, 1876-1881; and H. Poortman, 1882. To these should be added workers of recent years: Erik Asplund, 1950-1960; W. H. Camp, 1944-1945; Mulford B. Foster, 1948; and Elizabeth Naundorff, 1958-date. The latter sends her living material to Monsieur Marnier Lapostolle. The foregoing have been the more important collectors of bromeliad species from Ecuador.

Beer (1857), Baker (1889) and Mez (1896, 1934-35) were the first monographers of the Bromeliaceae. L. B. Smith has published extensively on this family and some of the more important of these are 1931, 1934, 1938, 1955, 1957, 1964, 1966.

Smith (1936, 1957) floristically treated the Bromeliaceae of the two countries contiguous with Ecuador. Peru was

credited with 171 species, Colombia with 371 species. Up to the time that the present research was initiated Ecuador remained an area for which no floristic treatment for the family was available.

B. Epidermal Characteristics and Seedling Morphology

The available information on two types of characters which have not been utilized previously to any degree are briefly reviewed in the following section. These characters are: 1) the leaf-epidermis and its trichomes and stomata, and 2) the seedling morphology. Little information as to the consistency and lack of constancy of these characters in individual plants or species is available in the literature.

1. Leaf-epidermis.

Much information concerned with the leaf-epidermis of the Bromeliaceae has been provided by plant anatomists. Tomlinson of Fairchild Tropical Garden, Florida, is preparing a contribution on the anatomy of the vegetative organs, especially leaves, of the Bromeliaceae. It is anticipated that this will be published as part of volume four of Metcalfe's Anatomy of the Monocotyledonae.

The trichomes, or peltate hairs have received attention for various, often non-taxonomic reasons. For example, Krauss (1948), treating them in considerable detail relates their importance as much to their efficacy in reducing transpiration as to absorbing moisture. She has reviewed the available

descriptive and interpretive work in regard to bromeliaceous trichomes.

Some of the more important workers who have attempted to define types of trichomes are: Bachman (1886), Richter (1891), Mez (1904) and Tietze (1906). There is poor agreement as to how to relate the various forms of trichomes to taxonomic groups within the family. Mez's (1904) suggestion that there are but two basic types of trichomes is most widely accepted. In one of his types, four well-defined central cells are surrounded by symmetrical concentric layers, the outermost layer consisting of greatly elongated cells, called an "ala." This trichome type has been studied especially in the subfamily Tillandsioideae. The second of Mez's trichome types is characterized by a lack of symmetry, being massive or filamentous and typical of the subfamily Pitcairnioideae. Krauss (1948) describing in detail the development and structure of trichomes on leaves of the pineapple, Ananas comosus, writes that some members of the third subfamily, Bromelioideae, have trichomes intermediate in form between the asymmetrical type found in the Pitcairnioideae and the symmetrical type found in the Tillandsioideae. Trichomes have not been utilized to any degree by taxonomists in operational classifications within the family Bromeliaceae. The reasons for this are either that taxonomists have not been aware of the possibilities of their use or have felt that trichomes were not reliable indicators having taxonomic value.

The disposition of the stomata on the leaves and their comparative sizes have been mostly bypassed by taxonomists although Solereder and Meyer (1929) and Krauss (1948) provide some information on these characters which could be taxonomically useful. This has probably been overlooked because many taxonomists are not familiar with the pertinent literature. Krauss (1948) described the ontogeny and the structure of the mature stomata in the pineapple. The stomata, she writes, are approximately 25 micra in diameter and their average density on the leaf surface varies from 70 to 85 stomata per square millimeter. She noted some of the differences between mature stomatal structure in this member of the subfamily Bromelioideae and the stomata in plants belonging to one of the two other subfamilies described by Linsbauer (1911). Harold Robinson (1966, personal communication) has used the structure of the substomatal ring cells of Navia, Cottendorfia and Connellia to good effect in helping L. B. Smith classify certain difficult groups in the subfamily Pitcairnioideae.

2. Seedling morphology.

The literature on seedling morphology in the Bromeliaceae is restricted to the paper of Thomas and Holmes (1930) who describe the development and structure of the seedling of the pineapple. Under cultivation the radicle begins to emerge from the apex of the seed five weeks after germination when it is pushed out by elongation of the cotyledon which remains

within the testa. By six weeks the plumule appears as a protuberance on the embryo. The stem remains short and the cotyledon stays within the seed for some time, apparently acting as an absorptive organ for the developing seedling.

C. Classical Taxonomy

Taxonomy represents the principles and processes by which plants and animals are described and organized into a non-chaotic arrangement. Description of organisms and their arrangement into a system is a prerequisite which then can enable biologists to: a) exchange biotic information, b) attempt to relate organisms in space and c) in time. The practicing taxonomist usually deals with a group of organisms which relates to the taxonomic framework which has been developed over the years.

Taxonomy has been defined in several different ways. Classically, biologists (e.g., Simpson, 1961) have considered taxonomy to be one component of systematics along with classification, nomenclature and biogeography. In this sense it is the placement of organisms into the categories of classification, that is, into phyla, classes, orders, etc. Wagner (1967) defines taxonomy as the placement of organisms into categories and systematics as the study of the comparative relations of organisms. Lawrence (1951) and Benson (1957, 1962) have defined taxonomy as identification, nomenclature and classification but have also inextricably intermingled taxonomy with phylogeny.

Taxonomy to Simpson and probably to most biologists today is the act of classifying and includes nomenclature and identification. The tendency is to separate taxonomy from phylogeny and to use the term systematics for the combination of evolutionary considerations (phylogeny) together with classification, nomenclature, identification and biogeography.

Alpha-taxonomy (Turrill, 1942) is the first stage in the process of describing and organizing plants and animals into a non-chaotic arrangement with the primary goals being recognition and description of taxa apart from evolutionary interpretations.

Interpretative studies of possible evolutionary processes particularly at the specific and infra-specific levels have been called beta- and gamma-taxonomy, however, biosystematics is the term used most frequently for these studies of the evolutionary process at the specific and infra-specific levels.

Many early taxonomists advanced guidelines for choosing data (characters). Linnaeus' Critica Botanica sets forth his ideas on what constitutes valid characters for taxonomists and is available in a translation by Hort (1938). Lawrence (1951) lists Adanson, Lindley, De Candolle and Joseph Hooker as among the early botanists who attempted to describe taxonomic procedures. De Candolle emphasized the importance of anatomical characters, Adanson encouraged the use of as many

characters as possible and Bentham and Hooker, following De Candolle, included much more detail.

Lawrence (1951) emphasized the importance to taxonomy of the recognition by modern botanists that gross morphological features alone are often inadequate. To Lawrence (1951), Benson (1957) and to most botanists data should be carefully selected from considerations of presumed conservativeness, conservative characters being those which are minimally affected by the environment. From the time of Linnaeus to the 20th century it has usually been assumed, if not stated, that floral parts are more conservative and better serve the needs of the taxonomist than do vegetative parts.

In addition to assumptions about conservative characters, classifications have also usually been based upon presumptively primitive and advanced characters. Lawrence, for example, under "Fusion and Modification of Perianth Parts," states (p. 85) that ". . . most botanists accept the view that a perianth composed of free and distinct parts. . . is more primitive than one in which such parts are partially or completely connate or adnate." A number of other criteria for primitiveness are given such as spiral versus cyclic arrangement of floral parts, ovary position and number of parts of a perianth whorl, to mention but a few.

D. Numerical Taxonomy

In 1957 and 1958 Sokal and others published papers describing methods of numerical taxonomy (NT) for quantifying phenetic affinity, that is, quantifying the taxonomist's evaluation of the phenotypic similarities and differences. This work has also been termed (Mayr, 1965) "numerical phenetics." The proposed numerical taxonomic method prompted an intense reexamination of the principles of both zoological and botanical taxonomy. These methods for quantifying estimates of similarities between operational taxonomic units (OTUs) entail the use of scoring sheets for recording data (characters) and electronic processing of them from "punch cards."

Numerical taxonomy utilizes a large number of characters. Sokal and Sneath (1963) suggest using not less than 40 and preferably more than 60. The problem of how to ascertain for any given taxonomic study just how many characters are necessary is discussed by Sokal and Sneath in their book but remains unsolved.

As few as 6 characters to over 150 have been used to estimate phenetic affinity and applied to numbers of OTUs from 3 to 196 and more. Papers by Rogers and Tanimoto (1960), Soria and Heiser (1961), Hamann (1961), Hall (1964), Rogers and Fleming (1964), Katz and Torres (1965), Heiser, Soria and Burton (1965), Crovello (1966), Davidson and Dunn (1966, 1967), Proctor (1966), Kendrick and Weresub (1966), Wirth,

Estabrook and Rogers (1966), Goodall (1964, 1966), and Irwin and Rogers (1967) are some of these NT studies in botanical taxonomy.

Contrary to classical taxonomy, assumptions in NT work are kept to a minimum. One of the basic principles of Sokal and Sneath (1963) is that no phylogenetic assumptions should play a part in an operational taxonomic classification. They begin their book with a criticism of the "taxonomic principle" that it is possible to approach an understanding of the phylogeny of an organism through the study of the characters of extant taxa. They call this circular reasoning. They say, a) a taxonomist notes correlated characters in a group, b) a taxonomist offers these correlated characters as evidence for a phylogenetic relationship among the members of the group, and c) then the taxonomist declares that because these characters are found in the group they must be important characters and can be used as criteria for membership of the members themselves as well as others in the taxonomic group. At least one assumption, however, is usually made in NT work and this is that characters should be weighted equally.

Gilmartin (1967) has summarized some of the criticisms leveled against NT. Much of this criticism comes from biosystematists, biologists committed to a "study of evolution," who say that any effort made to separate the act of ordering organisms from evolutionary concepts and assumptions is fallacious. Work which has been called numerical taxonomy such

as that of Anderson (1949, 1954, 1956) and Anderson and de Winton (1935), Pearson (1926), Mahalanobis (1936), Rao (1952), Fisher (1936) is more accurately described as biosystematics or techniques applicable to biosystematics. A pragmatic distinction between numerical taxonomy and methods applicable to biosystematic studies has been made by Gilmartin (1967). She writes that taxonomists using large numbers of characters which are applied to rather smaller numbers of units of classification are using numerical taxonomy while those who work with smaller numbers of characters applied to large numbers of OTUs, as in population studies of intra-specific variation, are doing quantitative taxonomy.

A more basic distinction between taxonomy and biosystematics (and therefore also between numerical taxonomy and biosystematics) was recognized by Epling and Catlin (1950) well before the advent of numerical taxonomy. Epling and Catlin distinguished between the goals of the taxonomist and those of the biosystematist (or genecologist as they used the term): i.e., taxonomy dealing with the results of evolution in a descriptive fashion and biosystematics (i.e., genecology) dealing with the process of evolution.

Williams (1967) distinguishes taxonomy from biosystematics which he terms experimental taxonomy. The latter to him is a type of physiological genetics, the results of which may be useful to a taxonomist.

Numerical taxonomy has frequently been criticized as a

method; however, the criticism has often been directed toward the philosophy of NT rather than to the methodology. Blackwelder (1967) is one of the most recent critics of NT. He writes that taxonomy need not change its methods and on page 66, applauds the methodological stability of taxonomy. "The method and logic of classification as developed by the ancient philosophers and adopted by Linnaeus and his followers, works as well today as it did 200 years ago. Taxonomists have had very little reason to want to change it or even to discuss it. There is simply no reason why the methodology of taxonomy should have changed drastically. . ."

Many biologists, nevertheless, such as Sokal and Sneath, Ehrlich (1958, 1961, 1964), Rohlf (1963a, 1963b, 1964, 1965), James (1963) and Sattler (1963) as well as Hull (1966), a philosopher, agree that the classical methods of taxonomy are not completely sufficient for taxonomy.

The method of NT was available long before the advent of electronic computers. Jaccard (1901) developed a coefficient for ecological comparisons. Cain and Harrison (1958) devised an estimate of phenetic affinity, the mean character difference, and did not mention the use of computers in their paper. However, Michener and Sokal (1957) and Sokal and Michener (1958) and all subsequent papers describing methods of NT analysis assumed the availability of electronic computers.

Several different kinds of estimates of phenetic affinity

or similarity indices have been described and these are reviewed by Sokal and Sneath (1963). Methods of clustering OTUs are also described in Sokal and Sneath (1963) as well as in Wirth, Estabrook and Rogers (1966) and Proctor (1966).

Some efforts have been made to obtain similarity indices which relate to probability values, e.g., Goodall (1964, 1966), Davidson and Dunn (1966, 1967). Goodall, using data on Stipa (Gramineae) and also on some bacterial data taken from a paper by Lysenko and Sneath (1959), endeavored to obtain a probabilistic similarity index. A given similarity index was compared with the similarity index which would occur if the character states (attribute values of Goodall) were randomly chosen. That is, a given similarity index between a pair of OTUs was compared to that of pseudo-OTUs manufactured from a random selection of states of the characters. Goodall's null hypothesis was that the character states shown by the two real OTUs represented a random sample of character states in the population from which the two OTUs were taken.

It would appear that the methods of numerical taxonomy would be especially applicable to an alpha-taxonomic study, as this type of taxonomy is minimally involved with phylogenetic assumptions and usually entails a very limited number of specimens being available from any given taxon. Hypothetically the use of a large number of variates (characters) for each specimen, would facilitate taxonomic arrangement of the

specimens and specific circumscriptions for which few specimens were available for study.

Although numerical taxonomic methods have quantified the phenetic affinities between OTUs, they do not seem to have been applied previously toward quantifying circumscriptions obtained through the time-honored methods of pattern recognition inherent in classical taxonomy. The circumscriptions, arrived at by the systematist's abilities in recognizing patterns, in large part, have remained indefinable because of the extremely large numbers of characters involved in the patterns of variation of the OTUs. With the methods of NT, however, these circumscriptions can be defined in quantified terms and having achieved this goal it might then be possible to compare various circumscriptions as, for example to compare the circumscriptions of two different genera, or two species or even taxa belonging to different kingdoms. Quantification of classically determined circumscriptions, heretofore a neglected aspect of NT, became an important goal of the present research.

E. Species Distributions and Some Environmental Factors.

The naturally occurring distribution of the members of the Bromeliaceae within Ecuador is likely to be controlled in large part by available light and moisture, as these have been considered to be the two most significant limiting factors for the growth of these plants.

Downs (1964) and Downs and Piringer (1958) found that

light was a limiting factor in seed germination of 17 bromeliad species. Pittendrigh (1948), who observed that the vertical distributions of bromeliad plants did not vary in spite of extreme differences in overall humidity, concluded that light was the single most important environmental factor affecting distribution of specimens. Solar radiation was shown by Garth (1964) to be directly related to stem elongation in Tillandsia usneoides, Spanish moss. He found that growth rates were not associated with moisture or temperature changes but that rate of growth was decreased by shade conditions.

However, very little is known about the actual quantities and daily or annual patterns of availability of light and water for most bromeliad habitats. As an example, although the fauna and flora inhabiting the water of "tank bromeliads" in Costa Rica and Jamaica have been analyzed by Picado (1913) and Laessle (1961) in some detail, the environmental factors outside of the bromeliad "tank" were only mentioned incidentally.

The vegetation types in Ecuador have been described by Gortaire and Cardeñas (1967) in accord with Holdridge's (1967) system of life-zone classification. They list 25 vegetation types for Western and Andean Ecuador. Two forest areas on the eastern slopes of the Ecuadorian Andes were studied by Grubb, Lloyd, Pennington and Whitmore (1963) and Grubb and Whitmore (1966, 1967) for climatic effects, light,

physiognamy, structure and floristics: 1) a montane forest site near Borja at 1700 m and 2) a lowland forest site at 300 m, 40 miles southeast of Tena. In the montane forest Grubb and Whitmore (1967) found more lianas and epiphytes (including bromeliad plants) than in the lowland forest and they have attributed this difference to the presence of fogs in the montane forest area. They counted 710 epiphytic Bromeliaceae per 465 square meters in one montane forest plot and 77 individuals in a similar plot in the lowland forest. They record that the amount of light received both at ground level and at the forest canopy was greater in the montane forest plot than at the lowland plot.

Rumley (in Griffiths, Henry and Rumley, 1965) related rainfall pattern to altitude and developed equations to describe the relationship as it occurs in Ecuador. In doing so he incidentally provided valuable geographic and seasonal information on rainfall patterns within Ecuador, as for example, the lack of a well-defined dry season throughout much of the eastward facing slope of the Andes such as occurs in the westward facing slopes.

The Massenerhebung effect noted by Beard (1955) and Eyre (1963), among others, is described as the lowering of altitudinal limits of vegetation types observed on isolated mountains especially insular ones in contrast to the higher limits on large continental mountain masses. Previously it has not been noted on large mountain masses.

From the paucity of publications alone it is obvious that there are few environmental data available for Ecuador. The data that are available are scattered throughout various publications and none of these has attempted to relate patterns of climatic factors with the distributions for any species.

Utilizing the available facts and concepts of the taxonomy, morphology and distribution of the Bromeliaceae as reviewed in the preceding paragraphs it was decided that the several broad ideas should be subjected to attack. The attacks would be both by conventional and by numerical taxonomic methods, with the general objectives being to test the suggestion that a more useful and satisfactorily complete flora for this plant family could be prepared utilizing the two methodologies concomitantly than could be prepared otherwise.

Data on stomatal and seedling morphology have not been used extensively by taxonomists dealing with the Bromeliaceae but if they should prove to be consistent and distinctive they would provide useful taxonomic criteria.

MATERIALS AND METHODS

In order to obtain materials and information from the field and from experiments for testing and modifying the hypotheses and ideas set forth in this dissertation, the following field and laboratory activities were performed. Most of these were elementary routines but those of special nature are described below insofar as they pertain to the results which will be described in the following section.

Collections of Bromeliaceae were made by the author while in residence in Ecuador between 1961 and 1964. A field trip to Ecuador from Honolulu during the summer of 1965 provided additional herbarium specimens as well as seeds and living plants. During the summer of 1966 ten weeks were spent at the United States National Museum in studying herbarium specimens on deposit there and on loan from several other herbaria. Raw data obtained from the examination of these specimens were recorded on 5 x 8 format cards and an example of these is to be found in Appendix A.

Approximately 1186 exsiccatae have been examined. Three hundred and nine of these were collected by the writer and 877 were collected by others and are on deposit in one or more of the following herbaria, United States National Museum, Gray Herbarium of Harvard University, Field Museum of Natural History, The Kew Herbarium and the Paris Museum National d' Histoire Naturelle. The author's own collections are on deposit at the United States National Museum.

Leaf-epidermis

Slides of paradermal sections of the upper and lower leaf-epidermis were prepared from more than 95 specimens. Preparations were made from one to two square centimeter pieces of the leaf-blade taken from just above the sheath. Pieces were placed in concentrated lactic acid and maintained at approximately 58°C for several days until they became translucent and soft. Under a dissecting microscope the epidermal and subepidermal layers were carefully peeled off and placed on a slide with glycerin to make a temporary mount. By tearing gently when peeling it was usually possible to obtain at the termination of a peel, a very thin section of epidermis alone without the subtending hypodermal layer. Photographs of these slides were made using high contrast copy film with a Zeiss photomicroscope. Selected examples of these photomicrographs are presented in Figures 1-48 of Appendix B. This method of preparation worked as well with herbarium specimens as with living material. Herbarium material was maintained slightly longer in warm lactic acid than was live material.

Seedling Morphology

Seeds of 36 different species belonging to each of the subfamilies were planted on shredded "hapu" (Hawaiian tree fern trunks) and sphagnum mix and watered by an automatic sprinkling system which provided a fine spray for 10 seconds

each three minutes during daylight hours. Seedling germination and seedling development were followed up to three months.

Classical Taxonomy

One thousand one hundred and eighty-six specimens of Ecuadorian Bromeliaceae were examined: like-specimens were brought together and these were compared with type specimens and with descriptions of previously-described taxa. In the orthodox work the decisions of what constituted like-specimens were made on the basis of my appraisal of the patterns of characters. Preliminary lists and floristic assemblages were made from raw data recorded on 5 x 8 format cards (Appendix A) and discarded as they were refined by combination with the numerical taxonomic results. Cards were filled out for each of more than 290 specimens. A less-complete assessment was recorded for the remainder of the specimens on plain 5 x 8 cards. Whenever available, information about the living plants was considered.

Numerical Taxonomy

The details of the numerical taxonomic method used here as selected from the literature and developed in the course of the present research are described in Appendix D in detail. However, a brief description follows.

An International Business Machine (IBM) 7040/44 and an IBM 360/44 with core capacities of 32K and 64K, respectively, were used in the electronic data processing. The operational

taxonomic units (OTUs) are individual specimens.

The data consist of 104 characters and these are listed in Appendix D. Two hundred and eighteen of the 1186 specimens were scored for numerical taxonomic (NT) analysis. Characters were chosen with two principles in mind. First, an effort was made to avoid the use of redundant characters. Second, an effort was made to obtain a large number of characters including many which had not previously been explicitly used by taxonomists dealing with the Bromeliaceae. These were used in addition to characters which have been explicitly applied.

Each character was divided into "states." An example of a qualitative character is petal color which was divided into six different states on the basis of experience. These are white, yellow, red-orange, violet, pink and green. A quantitative character is exemplified by plant height which was divided into six different ranges also subjectively. Each such state (i.e., range) was given a unique number for ease of scoring the specimens and these numbers were in sequential order from 101 through 530. All characters were multi-state, the number of states being from three through six.

The scoring was done, in general, from the 5 x 8 printed format cards. Scoring sheets provided by the IBM Company were used to record the scores. IBM punch cards were then punched and verified professionally from the scored sheets.

A computer program was written (Appendix D) with the

help of the program consultants at the University of Hawaii Computing Center. This program provided for the computation and print-out of the distance values (D_{ij}) for every possible pair of OTUs. It was possible to use one hundred OTUs at a maximum for any given input since the memory-core capacity of the computer became limited with more than 100 OTUs. In practice, no more than about 60 OTUs were submitted in any one input. The distance value, the quantification of the estimate of phenetic affinity among the OTUs is the negative logarithm of the similarity index (S_{ij}), which index was calculated by the computer by dividing the sum of the matches in character states between OTUs by the sum of the number of character states compared. The logarithmic transformation to yield D_{ij} is printed-out in matrix form.

Although details of the complete methodology (Appendix D) are not repeated here three points are worthwhile mentioning in brief. Using the numerical taxonomic methods it was possible to: 1) assess the effect of missing data upon the phenetic distances; 2) sample classically obtained taxonomic circumscriptions at several levels in the taxonomic hierarchy of classification; 3) compare two different NT methods by submitting the same 63 OTUs to my own computer program and through the kindness of Theodore Crovello to the University of Kansas NT program.

The cluster method described by Rogers and Fleming (1964) was attempted and a computer program for this was

written. However, efforts to perfect this portion of the program were terminated when it was learned from Rogers (personal communication, 1966) that he had abandoned this particular type of clustering as an unreal type of data analysis.

Species Distribution and Some Environmental Factors

Information for the majority of the specimens included the date of collections, the stage in the life-cycle of the specimen at the time of collection, the altitude and the geographic location within Ecuador. These data could be compared with one another and with data on the quantities and patterns of rainfall and light insofar as they are known. Therefore, the methods for this section of the dissertation involved the accumulation of pertinent data and the comparison of the physical elements with the biological ones in order to test pertinent hypotheses.

RESULTS

The application of these methods yielded such a mass of data and so many observations that they could not be comfortably included in the dissertation text; therefore the raw data pertaining to this dissertation are included in Appendices A, B, C, and D. The data were variously reduced as indicated in the following paragraphs and are included in tables, graphs or other illustrations.

A. Leaf-epidermis

Figures 1 through 48 in Appendix B are photomicrographs showing stomata and trichomes of the leaf-epidermis of some of the specimens. In the specimens examined from the subfamily Pitcairnioideae, the characteristic-asymmetrical trichomes (Figure 13) often covered the stomata. The trichomes of the members of the subfamily Tillandsioideae which were examined were all highly symmetrical.

The stomatal density and disposition provided an additional taxonomic character. Table I summarizes the results of a comparison of these characters in the three subfamilies. In the two genera of the Pitcairnioideae which were studied, stomatal density varied from 70 to 200 per square millimeter. Figures 1-5 and 9-13, Appendix B, illustrate this density distribution. These can be compared with the stomata in the specimens of the Bromelioideae presented in Figures 45-48, which were much more widely dispersed with densities of less

TABLE I. SUMMARIZATION OF EPIDERMAL DIFFERENCES
OBSERVED BETWEEN THREE SUBFAMILIES OF BROMELIACEAE

SUBFAMILY	STOMATAL SHAPE	STOMATAL DISPOSITION	TRICHOME TYPE
Pitcairnioideae	elliptic (width- length ratio .50-.60)	densely dis- posed in lon- gitudinal rows (70-200/mm ²)	both fila- mentous and massive, cen- tral-4-cells absent, no ala
Bromelioideae	round to subelliptic (width- length ratio .80-.90)	moderately densely dis- posed (less than 25/mm ²)	massive, cen- tral-4-cells present or absent, incon- spicuous ala
Tillandsioideae	elliptic to round, variable	variable, dense to sparse (usu- ally less than 25/mm ²)	symmetrical, central-4- cells present, concentric layers, well- developed ala

than 25 per square millimeter. The stomata of specimens from the subfamily Tillandsioideae were also scattered and their density (Figures 14-44) was less than 25 per square millimeter. The shape of the stomata was found to be consistently elongate-elliptic with width-length ratios of from 0.50 to 0.60 in specimens from the Pitcairnioideae. The stomata were consistently round with a width-length ratio close to 0.90 in specimens examined from the subfamily Bromelioideae. Those of the Tillandsioideae were variable in shape.

B. Seedling Morphology

Observations were made (Table II) on the seedlings of 30 different species reared from the seeds of 38 collections representing 25 Tillandsioideae, 5 Pitcairnioideae and 1 Bromelioideae. The percentage of germination varied from 0 per cent to 90 per cent. Two distinct types of cotyledon-morphology were noted. In seedlings belonging to the subfamily Pitcairnioideae the cotyledon emerged from the seed coat and assumed a leaf-like form, the seed coat remaining conspicuously attached to the apex of the cotyledon. In seedlings belonging to the other two subfamilies, Tillandsioideae and Bromelioideae, the cotyledon remained within the seed coat for some time, never assuming a leaf-like form, and remained as a simple basal sheath around the seedling stem. A well-developed primary root was found in members from the subfamily Pitcairnioideae.

TABLE II. SUMMARIZATION OF DIFFERENCES IN SEEDLING MORPHOLOGY IN THREE SUBFAMILIES OF BROMELIACEAE

SUBFAMILY	TIME OF EMERGENCE OF COTYLEDON	PRIMARY ROOT GROWTH	ADVENTITIOUS ROOT GROWTH
Pitcairnioideae	emerges early, assumes leaf-like form before first leaf appears	well-developed primary root which continues to grow	present by about 25 days
Bromelioideae (<u>Ananas comosus</u>)	remains within seed coat until two or more leaves appear, never assumes leaf-like form	ceases to grow after about one month	present by 45 days
Tillandsioideae	remains within seed coat until two or more leaves appear, never assumes leaf-like form	<u>No</u> primary growth	present by 60 days

Adventitious roots were clearly observable by about one month after germination. The rootcap of the Tillandsioideae seedlings sloughed-off about one month after germination and no elongation of the radicle was discerned.

Ananas comosus was the only species of the Bromelioideae for which seedling germination was observed and these seedlings produced a primary root which ceased to develop after about one month.

C. Classical Taxonomy

The results of the classical and numerical taxonomic study are both encompassed (Appendix C) in the keys and descriptions for some 275 species of Ecuadorian Bromeliaceae. Taxa have been ordered largely within the preexisting taxonomic framework provided by botanists such as Mez and L. B. Smith. Illustrated keys for the identification of the species and varieties have been constructed. Descriptions have been written to include information deemed to be particularly valuable for determining specimens in the field. Among the taxa described (Gilmartin, 1968) are eight previously-undescribed species, ten previously-undescribed varieties and four previously-described species, which had to be reduced to taxonomic synonymy.

Also included in Appendix C is a list of the more common collection sites with their latitude and longitude. Photographs of specimens illustrating 100 taxa as well as maps showing topography and major rivers and towns are also

included. The herbarium specimens collected by the author are all on deposit at the United States National Museum.

D. Numerical Taxonomic Results

The distance value matrices (number of distances = $218(217)/2 = 23,653$) represent the direct results of the numerical taxonomic methods and in Appendix D several examples of these matrices are reproduced. Theoretically, 104 characters were available for every paired comparison between operational taxonomic units (OTUs, specimens here). However, the actual number of characters used is only up to 85 because the same information was not always available for every OTU (specimen). Such incompleteness in the character sets is called "missing data" although quite distinct from the use of this term as applied in standard statistical methods.

The results (detailed in Appendix D) of subjecting three taxonomic problems to NT methods are described and include: 1) missing data, 2) quantification of taxonomic circumscriptions for sampling classical circumscriptions and 3) decisions on especially difficult taxonomic determinations. Estimates were made of the mean and the variance of phenetic distances computed with character sets that because of missing data differed in: a) kind and b) number of characters.

The F-test in the analysis of variance and Bartlett's test for homogeneity of variance of phenetic distance computed with different sets of characters were performed with the following results. Prior to performing these tests it was verified that the distance values of the phenetic distance matrix being tested were normally distributed. Utilizing the

three mean phenetic distances among eight OTUs computed with three different randomly-selected sets of 50 or more characters each, no indication of heterogeneity of variance was exposed nor was there any indication of a significant difference between the three means. Further tests involving comparisons of distance values between pairs of OTUs also produced a non-significant difference between means and no heterogeneity of variance whenever at least 50 characters were selected. Within Appendix D, Figures 4, 5, 6, and 7 are included the complete results of each of these tests.

Estimates were made of the change in the spread in variance of the phenetic distances which occurred when different numbers of characters were used to compute the phenetic distances between OTUs (specimens). These revealed that the numbers of characters and the variance of phenetic distance were roughly inversely proportional. The curve in Figure 1 graphically displays the approximate inverse relation between standard deviation of the phenetic distances and the number of characters used to compute the distances. For example, with 65 randomly-selected characters the standard deviation of the mean of the distance values for 28 paired comparisons ranged from 0.32 to 0.37 while with 20 randomly-selected characters the standard deviation of the mean of the distance values for the same 28 paired comparisons ranged from 0.34 to 0.45. Thus, not only the size of the variance but also the range in variance increased as the number of characters

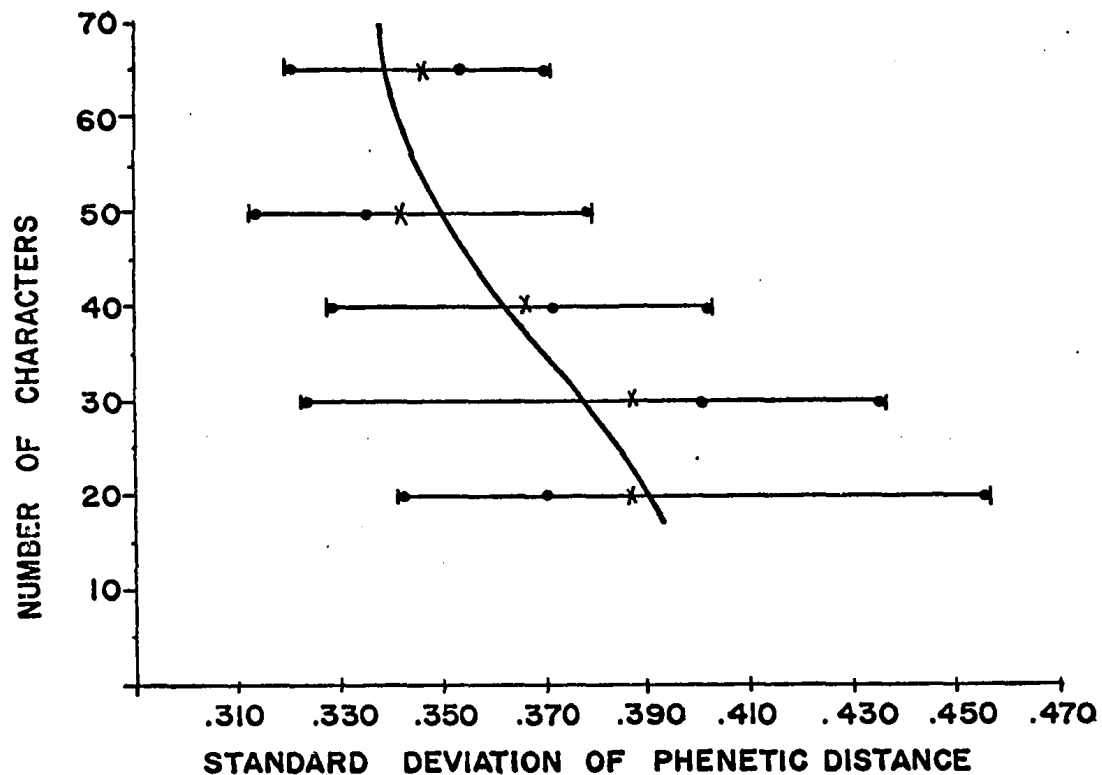


FIGURE 1. STANDARD DEVIATION PLOTTED
AGAINST NUMBER OF CHARACTERS

Three sets each of 20, 30, 40, 50 and 65 randomly selected characters were applied to 8 OTUs and the standard deviations of the phenetic distances are indicated by the solid O's. The means of each of the three SD are indicated by the X's. The trend in SD is indicated by the curve.

decreased. A two-step method devised by the writer is described in Appendix D for estimating the variance of phenetic distance computed with different sizes of character sets given a) a particular size character set and b) the standard deviation of the distance values computed with several randomly-selected character sets of this same size.

Quantifications of the taxonomic results (Tables IIa-e of Appendix D) were made and Figure 2 displays those to be used in the discussion. Quantifications of the several kinds of circumscriptions were based upon the phenetic distances between OTUs which the author recognized by conventional taxonomic methods as among the Ecuadorian Bromeliaceae. In this figure the mean distances between pairs of specimens for subfamilial, generic, subgeneric, and specific circumscriptions are indicated by the distances from the origin to the arcs. For example, the results of sampling the generic circumscription with 76 phenetic distance values randomly-selected from phenetic distances between OTUs classically allotted to the same genera but to different subgenera were as follows: the mean phenetic distance (with 60-77 characters) was 1.75 and with two standard deviations from the mean yields a confidence interval ($p = 0.05$) of 1.25 to 2.25. Another example, is the subgeneric circumscription. The sample of this circumscription was made with 28 phenetic distances randomly selected from phenetic distances between OTUs classically allotted to the same subgenera but to different species.

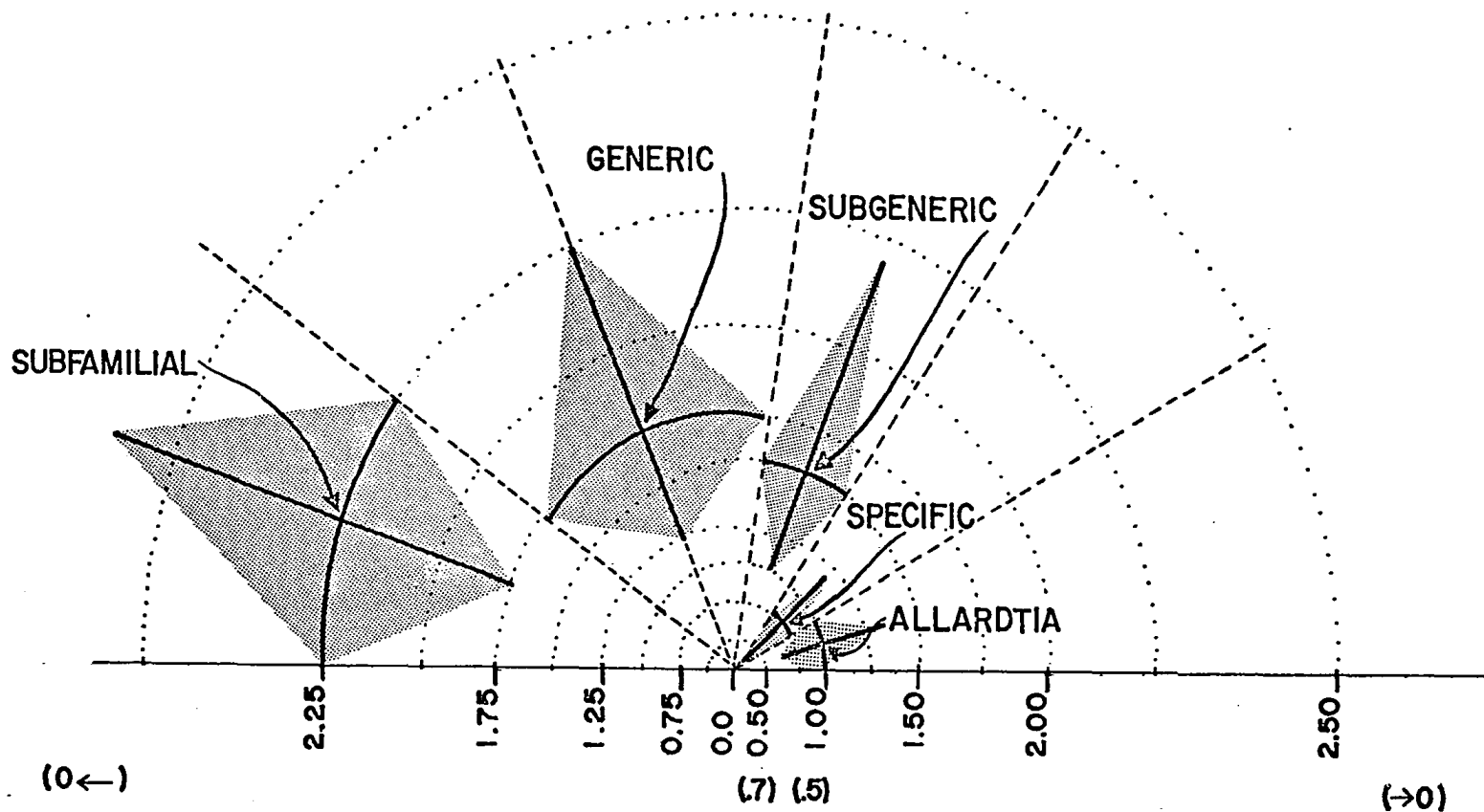


FIGURE 2. CIRCUMSCRIPTION OF SOME TAXONOMIC CATEGORIES WITH ECUADORIAN BROMELIACEAE

Radii are indicated in distance values from 0 to 2.50 where distance is the negative logarithm of the similarity index of Rogers and Fleming. Equivalent similarity indices in parentheses subtend some distance values. Mean phenetic distances are indicated by the distances between the origin and the bold-face arcs. The arc-bisectors show the confidence intervals at the $p=0.05$ level.

The mean phenetic distance (with 60-77 characters) was approximately 1.50 which with two standard deviations from the mean yields a confidence interval ($p = 0.05$) of 1.00 to 2.18.

The above described procedure and results for sampling classically-determined taxonomic circumscriptions were each based upon several taxa. In addition, one particular subgenus, Allardtia, was subjected to quantification of circumscription (same subgenus, different species) and as displayed in Figure 2 revealed a mean phenetic distance between OTUs classically placed within the Ecuadorian Allardtia of 1.00 and with two standard deviations, a confidence interval ($p = 0.05$) of 0.87 to 1.11.

Data which illustrate the application of results such as displayed in Figure 2 are drawn in Table III to summarize for discussion an illustration of how this sort of quantification of taxonomic circumscriptions may be used in making taxonomic decisions. The mean phenetic distance among six OTUs of questionable taxonomic determination was 0.93 and the standard deviation was 0.192. By comparison, the mean phenetic distance between these six and two others was 1.27 with standard deviation of 0.17. These mean phenetic distances among the six indeterminate OTUs and between these and two determined OTUs from different species can then be compared with data abstracted from Figure 2 which graphically presents the results of sampling classically determined circumscriptions.

TABLE III. MEAN PHENETIC DISTANCE AMONG
 OTUs (SPECIMENS) DIFFICULT TO DETERMINE
 AND AMONG CLASSICALLY-DETERMINED OTUs.

	Mean Phenetic Distance	Standard Deviation from the Mean
Among 6 Indeterminate OTUs from the Subgenus <u>Allardtia</u>	0.93	.19
Among 28 Conspecific OTUs	0.75	.19
Between the 6 Indeterminate OTUs and 2 other OTUs from <u>Allardtia</u> but not Conspecific	1.27	.17
Among 31 OTUs from the same Subgenera but not Conspecific	1.57	.28

E. Species Distributions and Some Environmental Factors

Data were assembled from observations and from the literature in order to be able to relate species distributions with environmental factors. Table IV displays a selection of these data and presents the distribution and associated altitudinal and geographical locations of 10 species of Ecuadorian Bromeliaceae having a trans-Andean distribution. Table V presents a selection of the rainfall maxima and the range in relative humidities for several comparable altitudes for the western and eastern slopes of the Andes.

A few species had distributions which included areas both from within the Andean mountain mass and also from the periphery of the western Andean front. Tillandsia nubis and Pitcairnia scepstrigera, for example, have been collected from the Chiriboga and Tandapi regions from well within the mountain mass in northern Ecuador at 1000-1500 m and also from between Guayaquil and El Tambo and Bucay at 300-900 m near the western front of the Andean westward extension. Tillandsia fraseri has been collected at 2000 m from near Niebli and at 1200 m from near Huigra. A few species were cosmopolitan in distribution, for example, Pitcairnia heterophylla which has been collected east and west, from 120 to 2300 m, and Vriesea cyclindrica which is restricted to the western slopes but has been collected at altitudes from 600 to 2200 m.

In Appendix C there are a great many altitudinal ranges given for the collections of different species. Several

TABLE IV. ELEVATIONS ABOVE SEA LEVEL OF
COLLECTION SITES FOR SPECIES OF ECUADORIAN
BROMELIACEAE WITH TRANS-ANDEAN DISTRIBUTIONS.

Species	Western Andean Slopes meters	Eastern Andean Slopes meters
<u>Puya clava-heraculis</u>	4-4500	3500
<u>Puya glomerifera</u>	27-3300 27-3000	2000 1740
<u>Puya parviflora</u>	22-2900 2500	2100
<u>Pitcairnia pungens</u>	2700 2500 2000 21-2200	1000 14-1800 1800
<u>Tillandsia confertiflora</u>	3000	1200 18-2200
<u>T. confinis</u>	30-3400	15-1600 600
<u>T. emergens</u>	30-3600	1000
<u>T. orbicularis</u>	35-4000	2100 2700 2800 2800 2600
<u>T. straminea</u>	2500 2400 2000	1000-2200
<u>T. towarensis</u>	3100	2400

TABLE V. RELATIVE HUMIDITIES FOR 1963 AND RAINFALL MAXIMA OVER A FOUR-YEAR PERIOD. Data abstracted from publications of the Ecuadorian Hydrographic and Meteorological Service (Anon., 1963) and Rumley (in Griffiths, Henry and Rumley, 1967).

Climatic Extremes	Western Slopes		Eastern Slopes	
	Catamayo (1238 m)	La Naranja (528 m)	Pastaza (1043 m)	Sucua (910 m)
Relative Humidity %	40-94	75-94	70-94	80-98
Elevations of Rainfall maxima in meters	800-1200		1200-1600	

supra-specific taxa have a relatively uniform distribution in regard to altitude and some of these have been selected here for later discussion. The genus Puya is nearly restricted to the highlands having been collected in Ecuador only from between 2000 and 4800 m and usually from well over 2600 m. The subgenus Phytarrhiza is largely distributed in the lowlands, especially in western Ecuador, with specimens from sea level to 2500 m. Tillandsia caerulea is the only member of the subgenus which consistently showed a high altitude distribution of 1000 to 3300 m.

Most of the members of Allardtia, a subgenus of Tillandsia particularly well-represented in Ecuador (47 species and varieties), is distributed consistently in the highlands. Excepting for the eastern slopes, distribution in Ecuador of members of this subgenus is restricted to altitudes exceeding 1500 m and usually from 2200 to 3100 m. The representatives from the eastern slopes occur from 600 to 1200 m.

The genus Guzmania is distributed in Ecuador at mid-altitudes from 100 to 2700 m but mostly below 2200 m and more than one-half the species seem to be restricted to an eastern slope distribution. On the other hand, Pseudo-Catopsis, a well-represented subgenus in Ecuador (32 species and varieties) is largely found on the western slopes and has a wide range in altitudes from 50 to 3300 m.

DISCUSSION

Studies on the epidermis, seedling morphology and phylogenetic considerations will be discussed in the following section. Classical and numerical taxonomy will be discussed together since they each contributed to the production of the keys and descriptions, and to the evaluation of the methods and philosophy of numerical taxonomy. Finally, the available information on species distribution and some factors of the environment will be discussed.

A. Leaf-epidermis and Seedling Morphology

The disposition of the stomata, their shape and the trichome-morphology were found to be consistent within the same plant and also seemed to be so within the same species. Several other features of the leaf-epidermis, for example, the presence of ergastic substances such as silica bodies, tannins, raphides as well as the thickness of the radial walls and the degree of undulation of the tangential walls were considered but found to be inconsistent and were therefore rejected.

When approximately the same area of the plant was sampled for stomata and trichomes, the same configurations and densities of these organs were observed.

The present results on trichomes in regard to the three subfamilies summarized in Table I, indicate greater diversity between the Pitcairnioideae and the other two subfamilies than between each of the latter two. Mez (1904) described two basic trichome forms and did not mention the filamentous form commonly observed and found in the present work to occur in the subfamily Pitcairnioideae.

The trichomes of the genera of Pitcairnioideae which were studied were either filamentous or massive. In Pitcairnia the stomatal apparatus may be completely covered by an isolated mass of filaments.

The stomatal shape and density have not previously been related to taxonomic groups. The present results (Table I) have been considered with regard to subfamilial circumscriptions. They indicate that the subfamily Pitcairnioideae as studied here has stomata which are strongly elongate-elliptic and densely disposed with there being at least 70 stomata per square millimeter. It should be noted, however, that Harold Robinson (personal communication) feels that not all members of the Pitcairnioideae have elongate-elliptic stomata. Robinson may either be studying species which the present author would exclude from this subfamily or perhaps the characteristic elongate-elliptic stomata noted here are actually not consistent throughout the entire subfamily. The possibility that Robinson's findings result from studies of different portions of the leaves, perhaps older portions, is not

likely since the present work has demonstrated that samples of different portions of leaves showed consistency in stomatal shapes.

The Tillandsioideae and Bromelioideae stomata are much less elongate and have densities between 9 and 25 stomata per square millimeter. These density-estimates are somewhat different from those reported by Krauss (1948) for pineapple (a bromelioidean species) which averaged 70 to 85 stomata per square millimeter. Her estimates, however, were made from the central portion of the leaf and perhaps cannot be compared directly with the current estimates which were obtained from portions of the leaf-blade just acropetal to the leaf-sheath. Unlike the shape, stomatal density was found to vary considerably depending upon the portion of the leaf which was sampled.

That the differences in epidermal characters between the three subfamilies are striking is evidenced by the fact that epidermal studies frequently made it possible to determine purely vegetative material to subfamily. This was demonstrated during the course of the present work, when the author was able to determine subfamilies from casual examination of photographs prepared from several different leaf-epidermis slides. This type of application is not usually necessary, although if a taxonomist suspects that an herbarium sheet represents mixed material, epidermal characters may offer a check. For example, L. B. Smith, in examining

a particular herbarium specimen at the Berlin-Dahlem Herbarium concluded on the basis of morphology that either an undescribed species was represented or that an Aechmea (Bromelioideae) perhaps had been mounted by mistake with a leaf of some species from a different subfamily. Following the present application of epidermal studies to leaf-material provided by Smith, it became clear that the epidermis was of the Pitcairnioidean type suggesting that Smith's suspicion of a mixed herbarium specimen was correct.

Although this application of epidermal characters is certainly helpful, it is not the most important application. Of greater importance here is the additional insight into the phyletic nature of the subfamilies that is afforded. Table I, for example, illustrates the great degree of difference between the Pitcairnioideae and either of the other two subfamilies.

Information on seedling morphology in the Bromeliaceae prior to the current research was restricted to Ananas comosus. The present work in this regard, summarized in Table II, indicates that the seedlings of the Bromelioideae and the Tillandsioideae are similar and distinct from those of the Pitcairnioideae. Members of the former two subfamilies have a cotyledon with an apparent haustorial function. The cotyledon remains within the seed coat well into seedling development and never assumes a conspicuous leaf-like role. The cotyledon in the Pitcairnioideae, to the contrary, emerges

very early from the seed coat and assumes a leaf-like role. The primary root is ephemeral in the Bromelioideae and absent in the Tillandsioideae. The Pitcairnioideae, to the contrary, has well-developed primary roots. During seedling development adventitious roots appear earliest in the Pitcairnioideae and latest in the Tillandsioideae. These features are undoubtedly linked to the terrestrial habit of the Pitcairnioideae and the epiphytic habit of the Tillandsioideae. The indication is that the Bromelioideae are basically epiphytic in habit.

An evaluation of the differences within the two subfamilies Bromelioideae and Tillandsioideae emphasizes their mutual similarities and their distinctiveness from the Pitcairnioideae. The position of the Pitcairnioideae, as a subfamily of the Bromeliaceae, appears to differ from that of the other two subfamilies. I suggest, based on these considerations, that the Pitcairnioideae is a group much more distantly related to either of the other subfamilies than they are to one another. This judgement is not entirely at variance with current ideas on the phylogeny of the family. Currently the Pitcairnioideae is considered to include the oldest members of the family Bromeliaceae. However, whether it is merely older than its putative sister subfamilies or whether the differences are so great that they stretch familial circumscription is a matter which remains an open question.

Harms (1930) and Smith (1936) in discussing phylogeny of the Bromeliaceae have emphasized union of parts, type of fruit and type of seed. They contrast the Pitcairnioideae and Tillandsioideae, with capsular fruits, usually appendaged seeds and very slight union of floral parts with the subfamily Bromelioideae, which has baccate fruits, naked seeds, and floral parts showing complete union. This union is evidenced by the inferior ovaries which are consistently present except for one genus.

In my opinion the seed appendages and the union of floral parts as considered by Smith and by Harms, have been overemphasized. In the first case, union of floral parts, it can be shown that this may be quite variable even within the same species. A specimen of Puya maculata, for example, had some flowers forming a single capsule while other flowers produced two or three separate fruits. This suggests that the expression of the apparently genetically controlled union of parts is easily altered. The degree of superiority of ovaries, another manifestation of the union of parts, is also extremely variable even within the same inflorescence in species of Puya and Pitcairnia. The union of sepals is especially variable in the Tillandsioideae and the same inflorescence may have flowers with sepals nearly equally free and others with sepals posteriorly high-connate.

The appendages of the seeds of the Tillandsioideae, i.e., the outgrowths of the integuments, do not seem to be

structurally similar to the wing-form appendage of the seeds in species of Pitcairnioideae. The seed of Tillandsioideae more closely resembles that of the naked-seeded Bromelioideae. The seedlings (Table II) also reflect affinity between the Tillandsioideae and Bromelioideae and distinctiveness from the Pitcairnioideae.

It is obvious that more data on epidermal characteristics are needed and it is to be emphasized that it is relatively easy to obtain these data. By using the micro- and photographic techniques described above one can easily observe and record such epidermal features. If the taxonomist has the time and inclination he can obtain information on the substomatal ring cells from the same slides by critical focusing.

In summary, epidermal and seedling characters are consistent within individuals and species as well as in higher categories. For this reason these characters are to be recommended as providing extremely useful information for taxonomic work.

All of these points concerned with morphology and epidermal features suggest the possibility of the Bromeliaceae being a polyphyletic group with the subfamily Pitcairnioideae representing an evolutionary line distinct from that of the other two subfamilies.

B. Classical and Numerical Taxonomy

The keys and descriptions for some 275 bromeliad species represent the results of a combined attack on a floristic problem by both the numerical and the classical taxonomic methods. The use of nearly 100 characters for quantitatively estimating the phenetic affinities among the operational taxonomic units (OTUs, specimens here) facilitated the taxonomic arrangement and description of these specimens. The difficulties imposed by not being able to sample populations because of the paucity of specimens of any given species were overcome in part by the facility inherent in numerical taxonomy (NT) (also called numerical phenetics) for explicitly sampling the characters of each individual specimen more thoroughly. In addition, the evaluation of NT methods clarified and extended the mental processes that taxonomists employ.

During the course of employing numerical and classical taxonomic methods for developing the keys and descriptions it became necessary to clarify some commonly used terms which apparently have not been construed in exactly the same way by all biologists. Such terms as classification, taxonomy, systematics and biosystematics as well as the more recently employed term, phenetics, have each been subjected to various connotations. For example, Lawrence (1951) and Mayr (1963) use taxonomy and systematics interchangeably. Simpson (1961), on the other hand, includes taxonomy along with phylogeny as components of systematics. To me, the definition of Simpson seems the more useful one.

The term phenetics is descriptive of one technique of taxonomy. It is a technique that may aid the systematist in his efforts to allocate taxa to taxonomic groupings.

The difficulties accruing to the definitions of taxonomy and systematics result from, perhaps, a narrowness of view on the part of those biologists who attempt to make their definitions in the light of specific problems. To me, the two terms seem to be analogous to two gears of different diameters that intermesh one with the other, systematics representing the larger gear and taxonomy the smaller one. However, because various workers may emphasize different facets of problems it may become a matter of opinion whether: 1) systematics encompasses taxonomy, 2) systematics and taxonomy are interchangeable terms or 3) taxonomy encompasses systematics. The fact is, however, that the most usual usage of the term taxonomy has been that of the allocation of specimens into taxonomic groupings and with angiosperms this is necessarily carried out largely by an appraisal of extant taxa with phylogenetic facts playing only a small part. For this reason, I feel that systematics should be reserved for the all-encompassing term which includes taxonomy, nomenclature, identification and phylogeny. Taxonomy is therefore one facet of systematics. Phenetics, in turn, is one of the techniques which a systematist uses.

The publications purporting to espouse the philosophy of NT have particularly stressed the distinctions between taxonomy and phylogeny and have created considerable controversy.

However, if taxonomy is considered as just one of the components of systematics along with phylogeny there is no controversy between NT, a taxonomic tool, and phylogeny. Williams' (1967) evaluation of numerical taxonomy and phylogeny are similar to my own. He feels that a phylogenetic classification is not the only useful type of classification. However, I would perhaps disagree with him as to the systematist's ultimate goal. To me it is undeniable that the overriding goal is perfection of phylogeny. This is, of course, a goal that is necessarily never attained. The taxonomic studies of a systematist may contribute to approaching this goal.

The crux of the importance of NT has not been emphasized sufficiently even by its foremost proponent, Robert Sokal. The truly significant contribution of NT lies in its ability to quantify phenetic relationships. Systematists have become bogged down in controversies on such topics as phyletic versus phenetic classifications, character weighting versus equal weighting and even in controversies over machine versus human classifications. The value of NT in quantifying pattern recognition may become more apparent if it is recognized that NT is primarily a taxonomic tool which systematists utilize in their efforts to describe and interpret the results of evolution.

The point that NT can help describe the results of evolution is important, for to date, quantification of phenetic affinities has only helped to describe the results of evolution

and could not shed any more light on the process of evolution than could classical methods. In this sense, the attempt of Sokal and Sneath to separate phenetics from phylogeny has been very important.

The assumption of the importance of reproductive isolation has been much emphasized especially by systematists studying the process of evolution as well as by taxonomists describing the results. Mosquin (1966) writes that reproductive isolation alone should not be used to the exclusion of other features and he was able to demonstrate that the predictive value of a classification based upon many features is much greater than the predictive value of a classification based solely on reproductive isolation. This is another way of stating one of the principles of Sokal and Sneath, that a desirable, general purpose classification demands the use of a large number of characters from as many categories as possible.

The question might be asked of the advocate of NT, what is the advantage of quantification of phenetic affinities? There is the advantage of being able to quantify degrees of similarity simultaneously for all OTUs (i.e. specimens). Rather than saying, OTU "a" is somewhat closer to "b" than to "c", we can say, the phenetic distance of OTU "a" to "b" is 0.45, the phenetic distance of "a" to "c" is 0.62. Thereby, we have made possible a standard of comparison. For now, if a fourth OTU is found and we want to know how it relates phenetically to the other three, we might find that the

phenetic distance of "a" to "d" is 0.38. We then know, in the context of the particular character array used to compute these phenetic distances, that not only is "d" slightly closer to "a" than "b" but we also have an estimate of how much closer.

As to probability estimates, I do not feel that to date any satisfactory means of obtaining a probabilistic estimate of affinity is available. Goodall's (1964, 1966) attempts to obtain this by comparing affinities between real OTUs to affinities between manufactured OTUs, fail, I feel, because his approach involves a basic and totally false assumption. Goodall tests the null hypothesis: character states (= attribute states) portrayed by real OTUs are a random sample of a population of character states. The facts are, however, that any group of OTUs such as specimens that a systematist ordinarily chooses to work with will always show associated characters. In fact, a test of the null hypothesis should always cause rejection because phenetic affinities between "manufactured" OTUs will always differ significantly from the phenetic affinities between "real" OTUs. The reason for this is that the OTUs are not chosen at random but, on the contrary, are chosen because of their correlated character states.

The quantifications of the phenetic affinities described in the results were utilized in order to facilitate the taxonomic decision-making process involved with the determinations and circumscriptions of the bromeliads of Ecuador.

However, before these phenetic distance values could be applied there had to be tests for the possible effects that missing data might have upon phenetic distances as these have never been ascertained by any previous NT research.

It seemed conceivable that missing data, that is characters for which information was incomplete, might so change the phenetic distances that it would be misleading to compare values obtained with non-identical sets of characters. The tests described in the results, however, showed that when the number of characters exceeded about 50, the distance values obtained with different, randomly selected sets of these did not differ significantly.

Missing data can result not only in character sets differing qualitatively but also in sets differing in the number of characters. A method was devised and tested for obtaining a predictive estimate of the standard deviation for different sizes of sets of characters. The method proved reliable and made it possible to compare two or more phenetic distances even though they may have been computed with sets of characters having different numbers of characters.

Once it had been established that the effects of missing data upon phenetic distance values in the present work were not significant then the phenetic distances between classically determined OTUs (specimens here) could be sampled and circumscriptions quantified. This approach of quantifying taxonomic circumscriptions is described here for the first time in the results. By utilizing these

quantifications of samples of classically arrived at taxonomic circumscriptions, Figure 2, it was possible to allocate OTUs which had previously been impossible to satisfactorily determine.

For example, six specimens of Tillandsia subgenus Allardtia were particularly difficult to place. Using classical methods it seemed to me that two belonged to the typical variety of T. fendleri, one to a new variety, one to a new species and the other to T. stenoura Harms. In fact, this is much the way that an early draft of the keys to the species was written. Nevertheless there was doubt in my mind. Because of serious doubt the specimens were scored for NT analysis and submitted along with others to the computer program for obtaining phenetic distance values.

Displayed in Table III are the pertinent phenetic distance values. The phenetic distance among the six was 0.93 and the standard deviation was 0.19 which can be compared to the mean phenetic distance between these six and two other OTUs (determined to be of different species but also in Allardtia) of 1.27 with a standard deviation of 0.17. The mean phenetic distance for specific circumscription and the mean phenetic distance for subgeneric circumscription (Figure 2) being respectively $.75 \pm 0.4$ and 1.5 ± 0.5 , it seemed more appropriate to allocate the six OTUs to the same species. With the foregoing phenetic distance values in mind I felt justified in the interest of consistency

within the subgenus to circumscribe all six specimens within one species. Had I allocated the six specimens as originally planned, I would not have been consistent with the taxonomic treatment of the Bromeliaceae.

The application illustrated by the six questionable OTUs is but one example of how the utilization of the phenetic distance matrices helped in formulating the keys and descriptions for the Ecuadorian Bromeliaceae.

The question arises as to how valid the samples of classically determined taxonomic circumscriptions may be. Might not very different, i.e. larger phenetic distances, be found if the specimens being compared were from various geographic areas and not all from one country? The answer is probably yes, if the evolutionary age of the taxa in the two areas was not similar. By evolutionary age is meant the age which takes into account not just absolute time but also rate of change, i.e., rate of evolution. Thus, the subgenus Allardtia in Ecuador appears to be relatively compact (Figure 2). The phenetic distances between Ecuadorian specimens belonging to this subgenus yet not conspecific is smaller than that found between Ecuadorian specimens belonging to other subgenera. This could indicate that the Ecuadorian Allardtia is evolutionarily younger than say Ecuadorian Pseudo-Catopsis or Ecuadorian Tillandsia. However, before the subgenus Allardtia as a whole could be rated, phenetic distances between specimens of this subgenus and from other geographic areas would have to be determined.

The applicability of these samples of phenetic distances for the five types of circumscriptions is justified only for comparisons with phenetic distances between specimens of Ecuadorian Bromeliaceae.

Some taxa seem to be more variable than others; for example, species' circumscriptions for a variable species, e.g., Tillandsia latifolia (phenetic distances between specimens of this species were 0.98 to 1.3) would include, supposedly, greater phenetic distance between its member individuals than would a less variable species, e.g., T. truncata (phenetic distances between specimens of this species were 0.4 to 0.6).

It is my feeling as a result of the present study, that so-called variable species, however, will not always prove to have quite as high phenetic distances between their member individuals as might at first be expected. The variability may be conspicuous because of a relatively few variable characters. Numerical taxonomic methods, with the utilization of large numbers of characters, might somewhat minimize the apparent variability.

The variability of species and standardization versus nonstandardization of the data relate to a problem which was revealed during the course of this study. Subsequent to working up the character array for the Ecuadorian Bromeliaceae referred to in the results it became apparent that there are two aspects of taxonomic distance. On the one hand, there are distances which largely reflect a slight but discernible

difference in many characters: that is, the two OTUs are uniformly slightly different in most of their characters. On the other hand, there are distances which largely reflect great differences in a few characters, the other characters being nearly identical in the two OTUs.

The resolution of distance between OTUs in the first instance can be satisfactorily achieved with multistate characters and a matching coefficient without scaling or normalizing (standardizing) the data. Since the differences are all uniformly slight, scaling would not have much effect. However, fine resolution of distance in the second instance can be satisfactorily achieved only with a scaled or standardized type of matching coefficient. Without scaling, the large differences would not be taken into account and would play no greater part in determining the distance values than small differences. The result would be that with OTUs largely similar but strikingly different in a few characters, one would find, perhaps, higher similarity indices (smaller distances) than one might wish.

Nonscaled data and standardized data for the same 63 OTUs (specimens of Ecuadorian Bromeliaceae) which were submitted respectively to my program and to that of Kansas University produced very similar relative distance between the OTUs. This probably indicates simply that with my particular character set and these 63 OTUs large differences in a relatively few characters were not an important factor in setting phenetic distances.

Certainly the potential resolving power of a matching coefficient obtained with scaled data for multistate characters is considerably greater than one obtained with non-scaled data. Whether or not the taxonomist wants this fine type of resolving power is a decision that he must make. It is my feeling that a taxonomist generally does not want this sort of resolving power. If a general purpose type classification is desired then large differences in a few characters should be deemphasized rather than the contrary.

Utilizing the matching coefficients or distance values, most NT computer programs provide some process for clustering the OTUs and include a print-out of phenograms. However, the problems inherent in clustering and generating phenograms are still unresolved. Phenograms usually distort phenetic relationships and this distortion has been recognized by Sokal. He has developed a cophenetic value which enables one to determine the correlation between the similarity matrix and the phenogram and gives a measure of the distortion imposed by the phenogram. The correlation of an 0.83 reported here for the 63 OTUs indicates that the phenogram did not unduly distort the phenetic similarities.

The present work has been described by Fosberg (1967) as representative of the moderate numerical taxonomic approach. The work of Irwin and Rogers (1967), Hall (1964) and Wirth, Estabrook and Rogers (1966) could also be described as representing the moderate approach in numerical taxonomy or numerical phenetics. No particular claim to greater

objectivity of the operational classification is made by any of these authors or by me. However, I might differ with Irwin and Rogers, for example, in emphasis. They apparently view NT analysis as strictly an aid in taxonomic decision making. I view NT methods as being also the best possible way to obtain an insight into the problem of quantification of taxonomic circumscriptions and the only possible way that a systematist can quantify large numbers of characters in the circumscription of taxa.

It will be in part through the method of quantifying circumscriptions that we will then be able to arrive eventually at answers to such questions as, "are there many different kinds of species, kinds of genera, etc." and, "what are the different kinds". That is, for example, are animal species' circumscriptions different from plant species' circumscriptions; or are tropical specific circumscriptions different from temperate specific circumscriptions? Numerical phenetic techniques will have to be used in order to approach questions such as these and others concerned with the number and kinds of characters that should be used assuming the desirability of a particular kind of classification.

C. Species Distribution and Some Environmental Factors

Altitudinal data were available for most of the 1186 specimens of Ecuadorian Bromeliaceae examined. Although probably not of direct importance, altitude nevertheless reflects other environmental conditions, particularly those conditions involved with three of the factors which are most important to bromeliad plant distribution, light, water and temperature.

Temperature, although always important as a regulator of the rate of metabolic processes is probably of less importance as a primary factor in the growth and distribution of the members of this tropical plant family than are light and water. It is, however, indirectly effective, that is, the availability of moisture is in part determined by temperature and reflected in the relative humidity.

The relative humidity as well as the distribution of the species which occurred on both the eastern and western slopes of the Andes presented marked contrasts in regard to their altitudinal limits for the two slopes. The relative humidity at corresponding elevations on the two sides of the Andes (Table IV) tends to be higher on the eastern slopes than on the western slopes. The distribution of bromeliad species (Table III) (altitudinal limits within species having trans-Andean distributions being clearly lower on the eastern than the western slopes) is converse to the position of maxima rainfall on the two slopes. The rainfall maxima occur several hundred meters higher on the

eastern slopes than on the west. The lowering of species distributions on the eastern slopes may be caused in part by the consistently higher relative humidity there. The plants are not so subject to desiccation on the eastern slopes at altitudes between 600 and 2200 m, for example, as on the west because, first, there is a much less well-defined dry season and second, the relative humidity extremes are less and the relative humidity is generally higher. This exemplifies the importance to the growth and survival of these plants of consistency in the rainfall pattern and the relative unimportance of high annual maxima of rainfall.

The factor of light so greatly emphasized by Pittendrigh (1948) and Garth (1964) must play an important role in the species distribution. Certainly the work described by Downs (1964) indicates that seeds must be exposed to light in order to germinate. In regard to light and humidity, my results indicate that not only must germinating seeds be exposed to light but also to a favorable amount of humidity since the plumose appendaged seeds, in particular, mold and germination is arrested if they are subjected to continually high relative humidities.

The emphasis upon moisture by Grubb et al. (1963, 1966, 1967) and their deemphasis of light is in contrast to the interpretation of Pittendrigh (1948) and Garth (1964) who each emphasized light as the important factor in the growth of bromeliad plants. Grubb et al., nevertheless, note that

their own measurements showed that more light reaches the canopy as well as the ground at the montane station (where there were more bromeliad plants per hectare) than at the lowland forest station (where there were fewer bromeliad plants per hectare and these were more scattered). I feel that in regard to the distribution of bromeliaceous species, both light and moisture are crucial with light being more important for the survival of adult plants and moisture being more important during germination and during the juvenile stage of growth. In this sense, the distribution of the seeds (and in the long-view, distribution of species) is most strongly affected by moisture availability together with favorable amounts of air movement which can produce optimum percentages of relative humidity. The growth of the adult plant, however, and its termination with the initiation of sexual reproduction is most strongly affected by the factor of light.

Massenerhebung effect is descriptive of the role that size and degree of isolation of the land mass plays in setting altitudinal ranges of vegetation types and has been described as occurring on islands in particular. Largely it remains in the realm of conjecture. It has been suggested that exposure to winds and the secondary effects of these upon moisture availability are important in lowering altitudinal limits of plants on isolated mountains. The effect has not been previously mentioned as occurring on any portions of large continental mountains. However, it seems likely that the

Massenerhebung effect is evidenced in the lowered altitudinal limits of bromeliad species in the most western extensions of the Andes as described in the results for two species, Tillandsia nubis and Pitcairnia scepstrigera. The exposure of the western extension of the Andean front is probably nearly as great as that occurring on isolated mountains.

The present analysis of Bromeliaceae species' distribution with regard to altitude and concomitant patterns of variation of rainfall emphasizes the dependency of geographic species' distribution upon moisture and light availability as determined by factors such as cloud cover, relative humidity and air movement. Conspicuous among the effects of these factors are the subjects set out in the following paragraphs.

Since at no point in their life-cycles are epiphytic bromeliads tied to the soil they strongly reflect the atmospheric conditions of the forest communities with which they are associated. Thus these epiphytes are reliable indicators of atmospheric conditions. For this reason efforts spent in observing and interpreting their 1) growth, 2) distribution and 3) breeding behavior can be doubly rewarding.

The availability of moisture at the canopy level in forests might be determined at least approximately from the growth reaction which some epiphytic bromeliad species appear to express while others do not. This reaction is one of producing more or fewer trichomes on their leaves in the different habitats.

An example of a species with extremely well-developed trichomes which must be described as densely lepidote yet occurring in a moist habitat is afforded by T. tetrantha var. aurantiaca. This has been collected from near km 38 Catamayo-Loja in a very wet cloud-forest region at about 2500 m. The region where this variety was so common, however, was remarkable for the amount of wind. The fact that the high winds were a usual occurrence was attested to by the results of wind sculpturing of the cliffs and the form of the scrubby trees. There are many areas in the Andes where the wind is funneled through narrow passes. Some of these occur in cloud forest areas. The winds certainly appear to bring about somewhat xeric conditions in what might appear otherwise to be hydric conditions by causing high rates of evapo-transpiration.

The distributions of some species are indicative of certain elevations above sea level as for example, nearly all Ecuadorian species of the genus Puya being from elevations above 2600 m and nearly all Ecuadorian species of the genus Phytarrhiza being from elevations below 2500 m. These distributions within Ecuador could be compared to the overall distribution for these taxa and to the tectonic history of parts of South America in order to elucidate patterns of plant-migration.

The observation that species which are closely related often evidence well-defined and different flowering-times, suggests a possible mechanism for population differentiation

and species formation. Time of flowering did not seem to be associated with geographical location nor altitude. On the contrary, several different species growing in the same area often flowered at different times. This was especially noticeable with species that may be closely related otherwise, e.g., T. scaligera and T. monodelpha of the subgenus Phytarrhiza. The former flowers from September through December and the latter flowers from March through May. They are common and occur frequently together on the central coast at altitudes of 40 to 400 m. It seems possible that time of flowering itself may be an isolating factor leading to further differentiation and even speciation.

The present study can be considered a taxonomic one. However, the vistas that taxonomic research help to open extend into all the existing facets of botany, from the specialties of descriptive anatomy through those of phenetics, phylogeny, biosystematics, physiology and to autecology and synecology. Every facet of botany in turn has a potential role to play in helping to produce the descriptions and interrelations of taxonomic groups which a systematic botanist in the capacity of a taxonomist must try to produce.

CONCLUSIONS

Studies on epidermal characters of specimens of Ecuadorian Bromeliaceae, especially stomatal disposition and configuration and seedling morphology have provided taxonomically reliable information and in addition have suggested that with the inclusion of the subfamily Pitciarnioideae, the family Bromeliaceae may be polyphletic in origin.

As a result of employing classical and numerical taxonomic methods during the course of producing keys and descriptions for some 275 Ecuadorian species of the Bromeliaceae, it is concluded that the methods are not only compatible but actually produce more together than either could alone. It was found that the numerical taxonomic technique of using as many well-defined characters as possible stimulated a very close and critical examination of the organisms under study.

The alpha taxonomy resulted, in part, from the numerical taxonomic analysis. A similar but not identical classification would have been produced if I had adhered strictly to classical taxonomic methods. Regardless of how much or how little the utilization of numerical taxonomy affected the taxonomic decisions, however, it is recognized that the entire process of plant classification became infinitely clearer in my own mind as a result of this study.

The numerical taxonomic analyses stimulated the development of a method for quantifying and evaluating the circumscriptions which have been developed through classical methods.

In order to obtain the quantifications it was necessary first to devise techniques for testing the effects that lack of complete information for every specimen (missing data) had in altering the numbers and kinds of characters. The techniques proved satisfactory and reliable.

The quantifications of classically-determined circumscriptions revealed more than a single kind of variability of the operational taxonomic units (OTUs, specimens in most of the present work) and more than one kind of phenetic distance between the OTUs. Phenetic distance between OTUs may reflect, on the one hand, slight but discernible differences of many characters and on the other hand, great differences in a few characters, the others being nearly identical. It is suggested that there are several different kinds of taxonomic circumscriptions as well, and that through the methods of numerical phenetics we will eventually be able to learn, for example, how animal species' circumscriptions differ from plant species' circumscriptions or how temperate specific circumscriptions differ from tropical ones.

Distribution of the Bromeliaceae within Ecuador revealed a marked tendency for species with trans-Andean distributions to have lower altitudinal limits on the eastern than on the western slopes of the Andes. This may be caused in part by the more consistent rainfall pattern and higher relative humidities over much of the eastern slopes where no marked dry season occurs in contrast to the western slopes. Some

taxonomic groups such as Puya and the subgenus Allardtia of Tillandsia consistently demonstrated a high altitude distribution. The former was seldom found below 2600 m and the latter was generally found between 1500 and 3000 m altitudes. It is suggested that because epiphytic bromeliad plants are free from the influence of the soil they could well be used as reliable indicators of the atmospheric conditions existing in the forest canopies where they are usually found.

APPENDIX A
FORMAT CARDS FOR RECORDING DATA

Tillandsia (Allardtia) complanata Benth.
(genus) (species)

No. 1111 AJG

A.J. Gilmartin

June 1966

9 Aug. 1965

(determined by)

(det. date)

(coll. date)

HABIT

34 x 40 cm. erect to spreading rosette (code as spreading)

The numerous scapes all coming off one side of plant. One meter from ground in cleared area with much broken scrubby trees nearby recently burned. Growing individually.

SUBSTRATUM

	<u>at least 35 x 1 mm</u>	<u>cm.</u>	<u>neutral</u>	<u>curved</u>
at least 20			(color)	(erect, curved, etc.)
	<u>at least 32 x 1 mm</u>	<u>cm.</u>	<u>neutral</u>	<u>strictly erect</u>
not imbricate			(color)	(erect, reflexed, etc.)
	<u>30-34 x 4-5-5</u>	<u>cm.</u>	<u>green, spotted red</u>	<u>flat, papery</u>
blade lingulate,			(color)	(flat, involute, etc.)
apex acute	<u>4-5 scales/linear mm, much appressed</u>			<u>spreading to reflexed</u>
	(surface)			(erect, spreading, reflexed, etc.)
	<u>11-14 x 7.5-8</u>	<u>cm.</u>	<u>much purple</u>	<u>dense, appressed lepidote</u>
blade-sheath angle 10°			(color)	(surface)
	<u>ovate</u>		<u>conspicuous</u>	
	(shape)		(conspicuous, indistinct, etc.)	
	<u>rectangular-terete</u>		<u>?</u>	<u>covered</u>
RACHIS	(cross section)		(color)	(exposed - covered)
	<u>leaf thickness at sheath apex - ca. .25 mm</u>			

APPENDIX A. FORMAT CARDS FOR RECORDING DATA

Tillandsia (Allardtia) complanata Benth.

No. 111 AJG

(genus)

(species)

	length	width	attitude	color	shape	surface
at least 20 INFLORESCENCE bud & flower	2.5-3 cm	9-11 mm		scarlet	elliptic	glabrous
primary branches	one subinflorescence sterile bract					
secondary branches	FLORAL BRACTS: papery, nerved obviously, ecarinate, apex acute SEPALS: papery, lepidote within, apex acute, slightly carinate					
tertiary branches						
primary bracts						
secondary bracts						
floral bracts 4-5	15 mm	11 mm	erect	red	ovate	glabrous
sepals free equally free						
connate	12 mm	3-4 mm	erect	?	ovate	glabrous
petals free free						
joined				lavender		naked
flowers, c petals 21-22 mm						
sin petals						
ovary	4-5 mm	?				
stamens _____, exerted _____	includ. by 3-4 mm, connate to petals no					
(length)	shorter than petals (yes, no, partly)					
FRUIT _____, seeds _____	3-4 mm (distance between flowers)					

LOCALITY Prov. Azuay, km 40 Cuenca-Loja, edge of cultivated filed, had been burned
~~moist scrub, 3000 m, tank-filled with water~~
 COMMENTS broad-leafed form. two leaf fragments, one for lactic acid at US and
other to take back to Honolulu in envelope. Close to but not in sight of humans.

APPENDIX A. FORMAT CARDS FOR RECORDING DATA continued

APPENDIX B
EPIDERMAL CHARACTERISTICS AND SEEDLING MORPHOLOGY

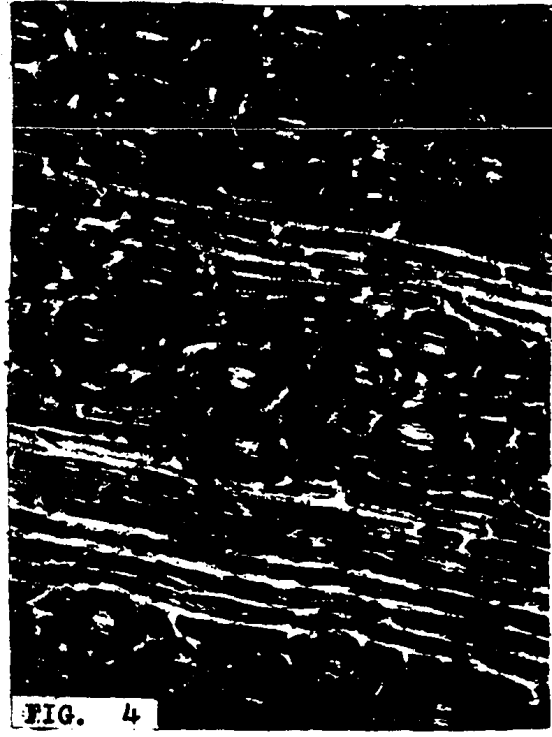
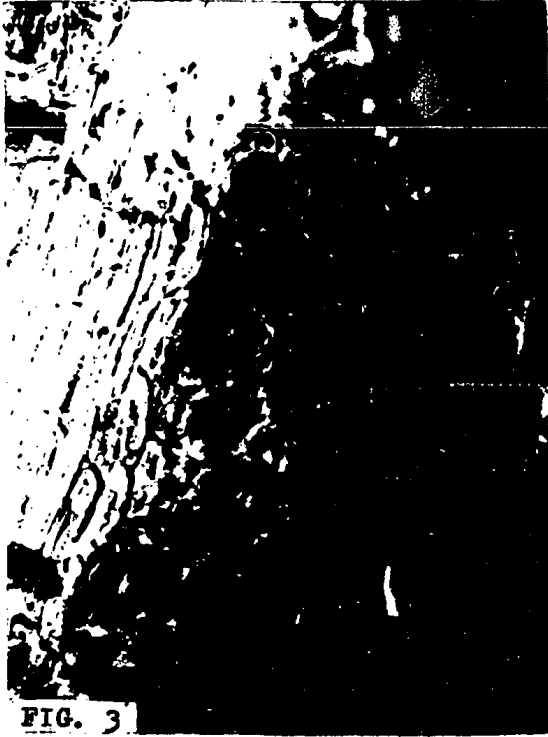
Subfamily	Stomatal shape	Stomatal disposition	Trichome type
Pitcairnioideae	elliptic (width-length ratio .50-.60)	densely dis- posed in longi- tudinal rows (70-200/mm ²)	both fila- mentous and massive, central-4- cells absent, no ala
Bromelioideae	round to subelliptic (width-length ratio .80-.90)	moderately densely dis- posed (less than 25/mm ²)	massive, central-4- cells present or absent, inconspicuous ala
Tillandsioideae	elliptic to round, variable	variable, dense to sparse (usually less than 25/mm ²)	symmetrical, central-4- cells present, concentric layers, well developed ala

TABLE I. APPENDIX B. Summarization of the differences observed between the three subfamilies of the Bromeliaceae of individual stomata, density of stoma, and the trichome type. The observations were made upon some 90 specimens of slightly more than 50 species.

Subfamily	Time of emergence of cotyledon	Primary root growth	Adventitious root growth
Pitcairnioideae	emerges early, assumes leaf-like form before first leaf appears	well developed primary root which continues to grow	present by ca. 25 days
Bromelioideae (<u>Ananas comosus</u>)	remains within seed coat until 2 or more leaves appear, never assumes strongly leaf-like form	ceases to grow after ca. 1 month	present by 45 days
Tillandsioideae	remains within seed coat until 2 or more leaves appear, never assumes strongly leaf-like form	<u>No</u> primary root growth	present by 60 days

TABLE II. APPENDIX B. Summarization of some differences in seedling morphology between members of the three subfamilies of the Bromeliaceae. For the Bromelioideae, only seedlings of Ananas comosus were available for comparison.

Figure 1.--stomata, Firmin 412, Puya glomerifera. x 500;
Figure 2.--stomata, AJG 1130, Puya thomasiana. x 500; Figure
3.--stomata, Hutchison 6146, Puya westii, x 500; Figure 4.--
stomata, AJG 1134, Puya parviflora, x 500.



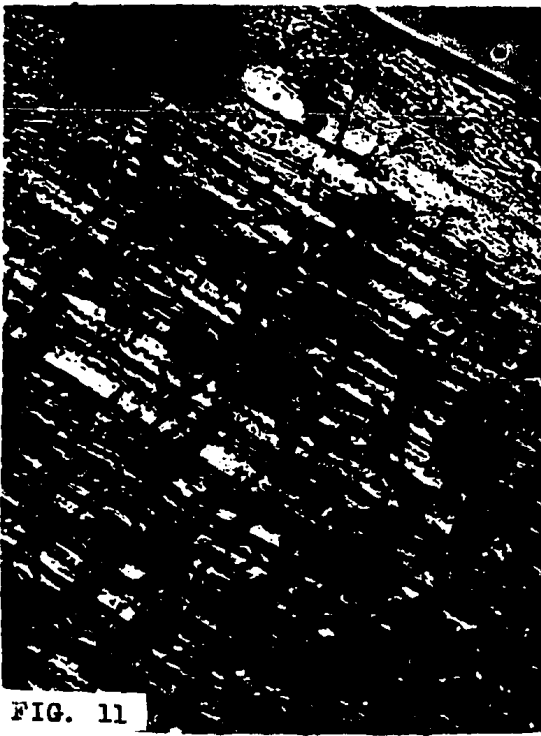
FIGURES 1-4. (Appendix B)

Figure 5.--stomata and epidermis, Asplund 16997, Puya hamata. x 500; Figure 6.--trichome, Asplund 20227, Puya glomerifera. x 500; Figure 7.--trichome, Camp 2399, Puya glomerifera. x 500; Figure 8.--filamentous trichomes, Asplund 20227, Puya glomerifera. x 500.



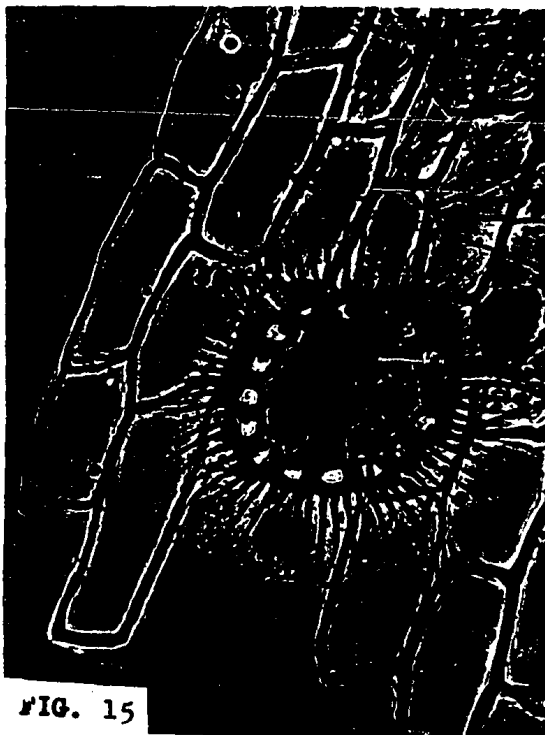
FIGURES 5-8. (Appendix B)

Figure 9.--stomata and epidermis, Acosta Solis 12279, Pitcairnia costata. x 500; Figure 10.--stomata and epidermis, Penland and Summers 230, Pitcairnia pulchella var. xanthopetalon. x 500; Figure 11.--epidermis and subtending layers, AJG 1169, Pitcairnia pavonii. x 500; Figure 12.--stomata, Haught 3179, Pitcairnia pungens. x 500.



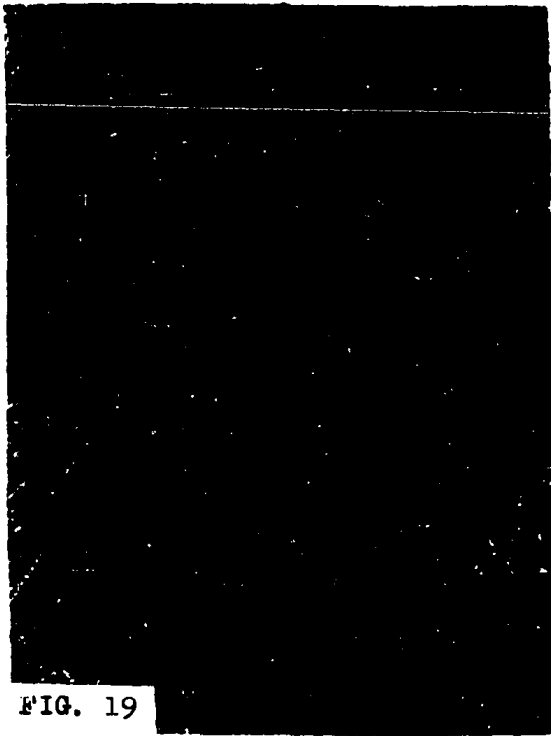
FIGURES 9-12. (ap. endix B)

Figure 13.--stomata and trichomes, Camp E2172, Pit-
cairnia pavonii. x 500; Figure 14.--trichomes, Acosta Solis
7853, Tillandsia umbellata. x. 500; Figure 15.--trichome,
AJG 1120, Tillandsia straminea. x 500; Figure 16.--trichomes
and one stoma, Drake 699, Tillandsia triglochinoides. x 500.



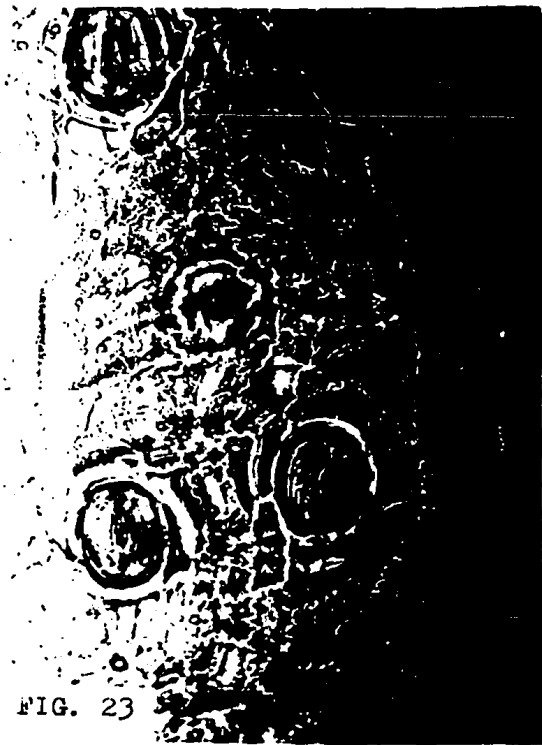
FIGURES 13-16. (Appendix B)

Figure 17.--stomata and portion of one trichome, Benoist s.n., Tillandsia recurvata. x 500; Figure 18.--one stoma, one trichome, Benoist 3917, Tillandsia arcuans. x 500; Figure 19.--three stomata and trichomes, epidermis and silica bodies, AJG 1154, Tillandsia demissa. x 450; Figure 20.--stomata and thick-walled epidermis, AJG 841, Tillandsia stenoura. x 450.



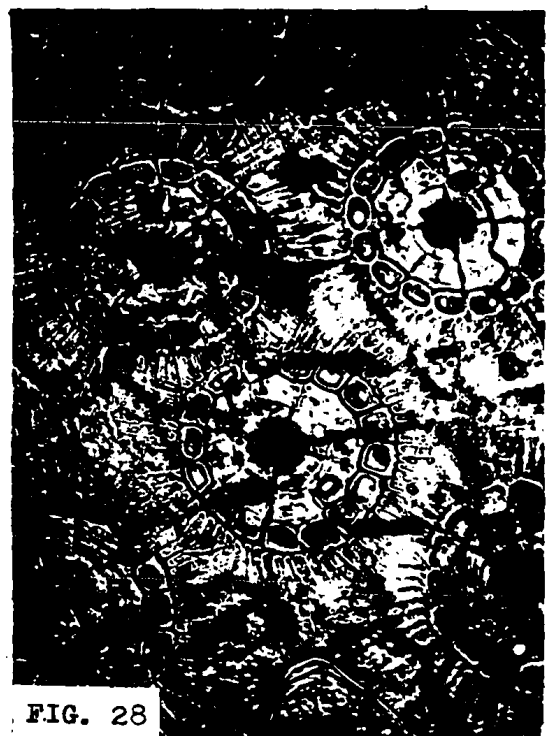
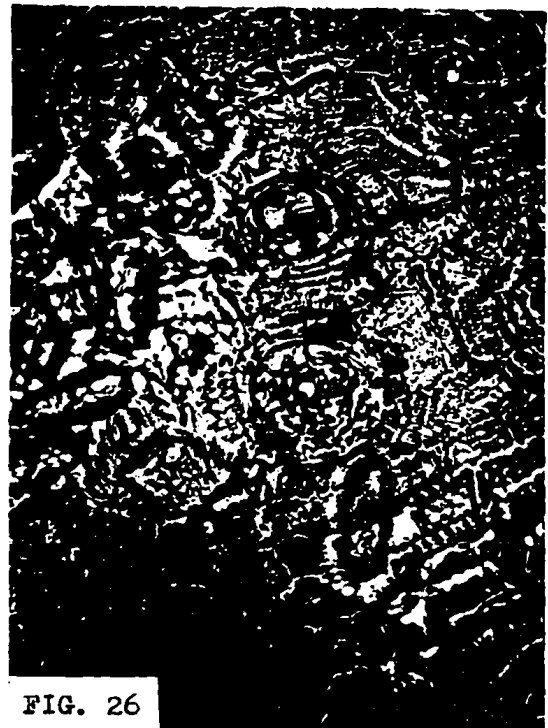
FIGURES 17-20. (Appendix B)

Figure 21.--one stoma and trichomes, AJG 1164, Tillandsia quadripinnata. x 500; Figure 22.--one stoma and trichomes, AJG 1180, Tillandsia quadripinnata. x 500; Figure 23.--four stomata, thick-walled epidermis and silica bodies, AJG 623, Tillandsia orbicularis. x 500; Figure 24.--two stomata and parts of trichomes, central portions only, AJG 1098, Tillandsia barbeyana. x 500.



FIGURES 21-24. (Appendix B)

Figure 25.--one stoma and trichomes, thick-walled epidermis, AJG 883, Tillandsia insularis. x 500; Figure 26.--one stoma and trichomes, AJG 809, Tillandsia multiflora. x 500; Figure 27.--one stoma, several trichomes, AJG 1135, Tillandsia adpressa. x 500; Figure 28.--several trichomes with thick-walled cells in second layer, AJG 1152, Tillandsia pugiformis. x 500.



FIGURES 25-28. (Appendix B)

Figure 29.--one stoma and several trichomes, AJG 1132, Tillandsia tetrantha. x 500; Figure 30.--one stoma, several trichomes, AJG 1138, Tillandsia sinuosa. x 500; Figure 31.--several stomata, one trichome, AJG 871, Guzmania xanthobractea. x 500; Figure 32.--one stoma, parts of trichomes, AJG 1054, Guzmania monostachia. x 500.

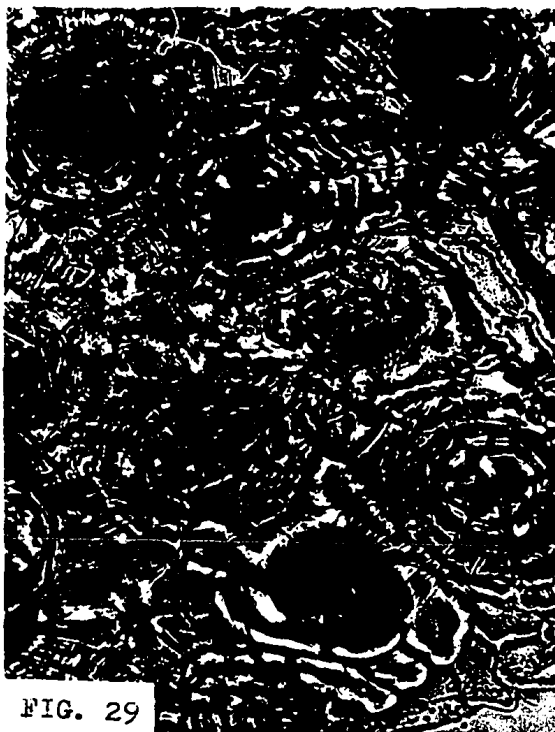


FIG. 29



FIG. 30

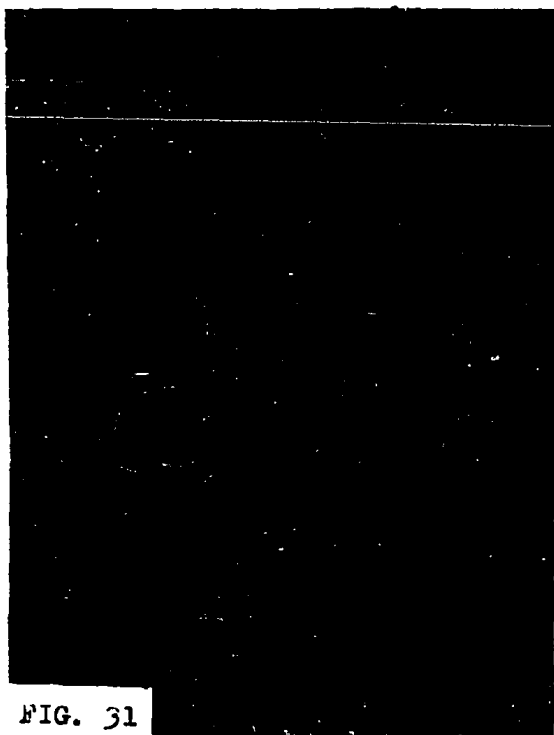


FIG. 31

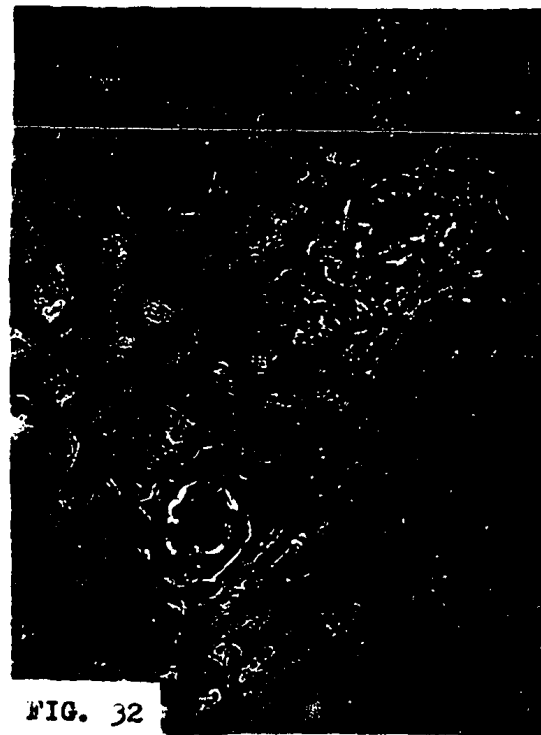
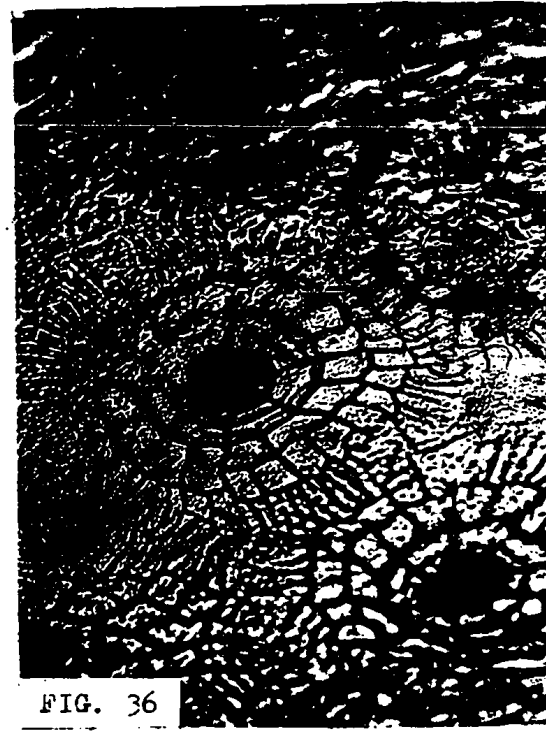
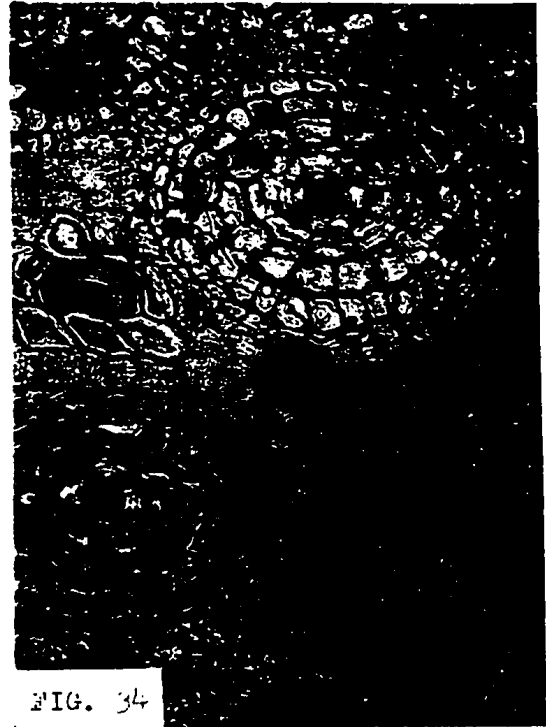


FIG. 32

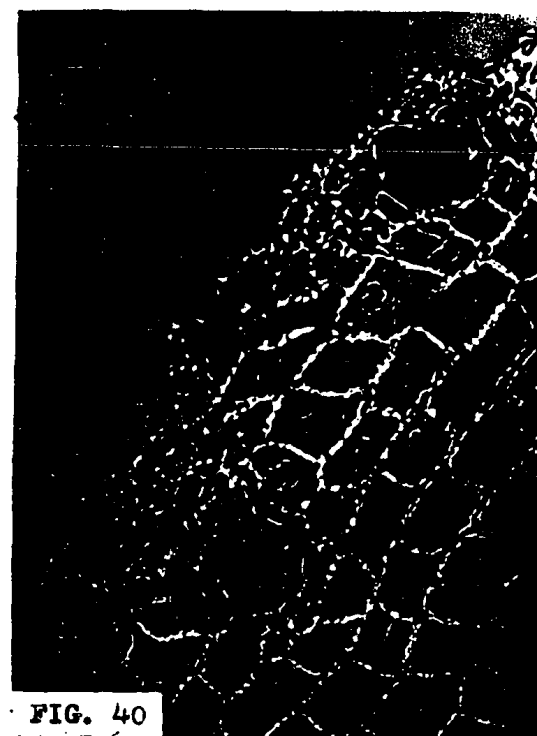
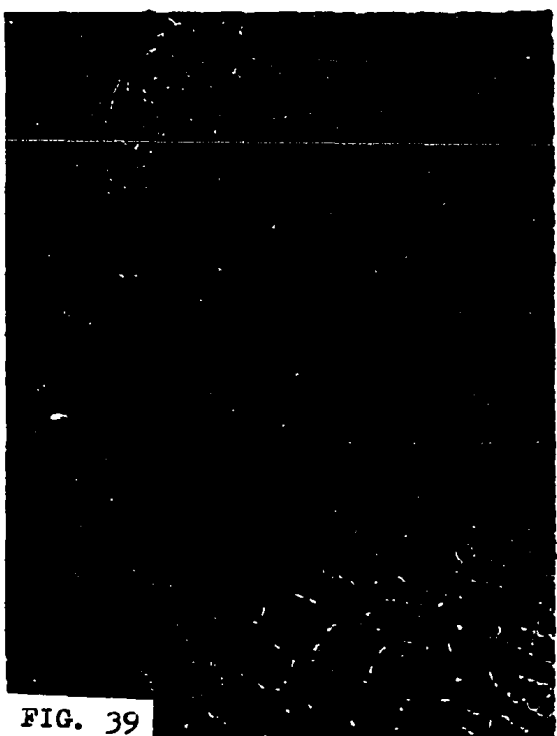
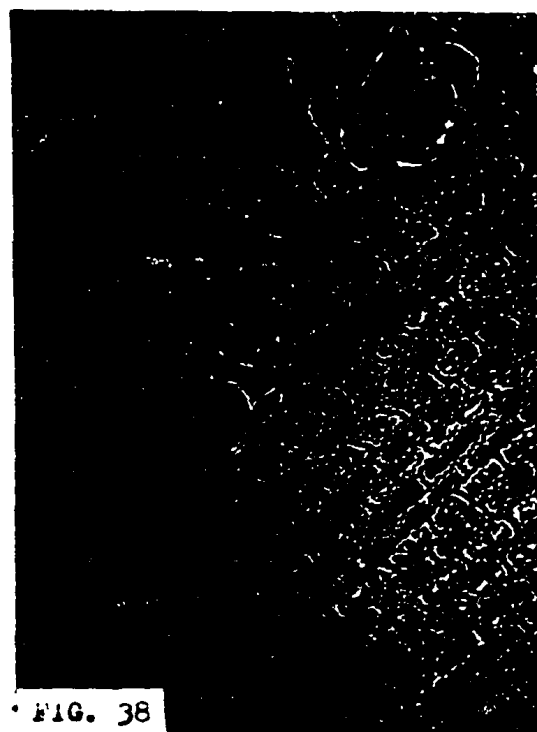
FIGURES 29-32. (Appendix B)

Figure 33.--one stoma, several trichomes, conspicuous silica bodies in epidermal cells, AJG 861, Guzmania sanguinea. x 500; Figure 34.--two stomata, several trichomes, AJG 1073, Guzmania fuerstenbergiana. x 500; Figure 35.--one stoma, epidermis with silica bodies, AJG 862, Guzmania patula. x 500; Figure 36.--several trichomes, AJG 872, Guzmania angustifolia. x 500.



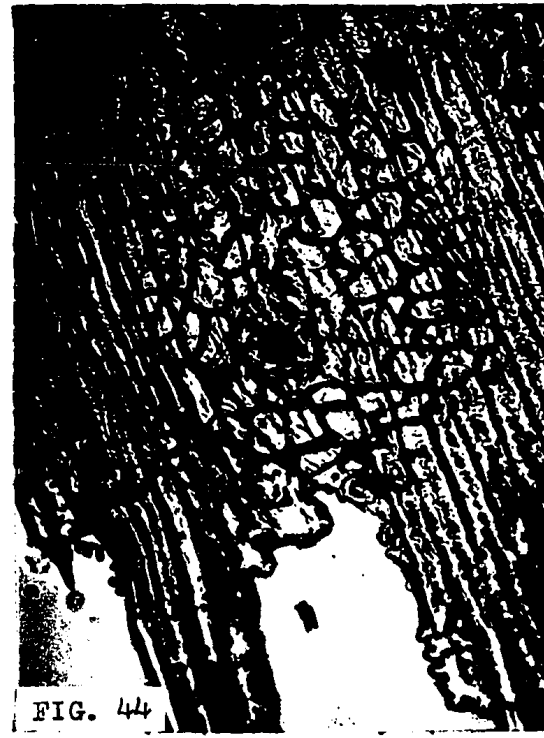
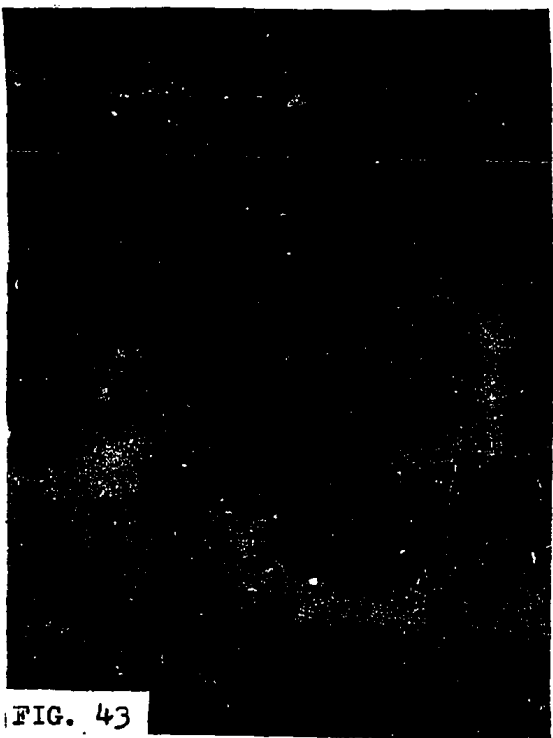
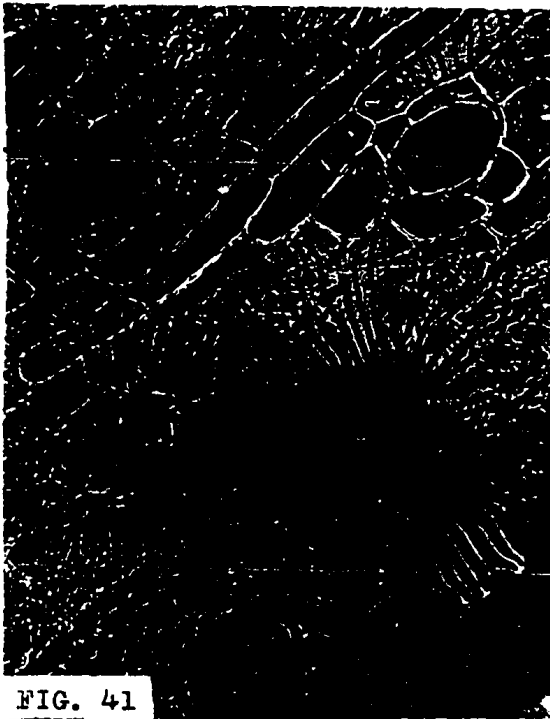
FIGURES 33-36. (Appendix B)

Figure 37.--one stoma, one trichome, AJG 767, Guzmania
lingulata. x 500; Figure 38.--two stomata, one trichome,
conspicuous silica bodies in epidermal cells, AJG 1059,
Guzmania schezeriana. x 500; Figure 39.--several trichomes,
AJG 1140, Guzmania morreniana. x 500; Figure 40.--one stoma,
part of trichome, AJG 1175, Guzmania laxa. x 500.



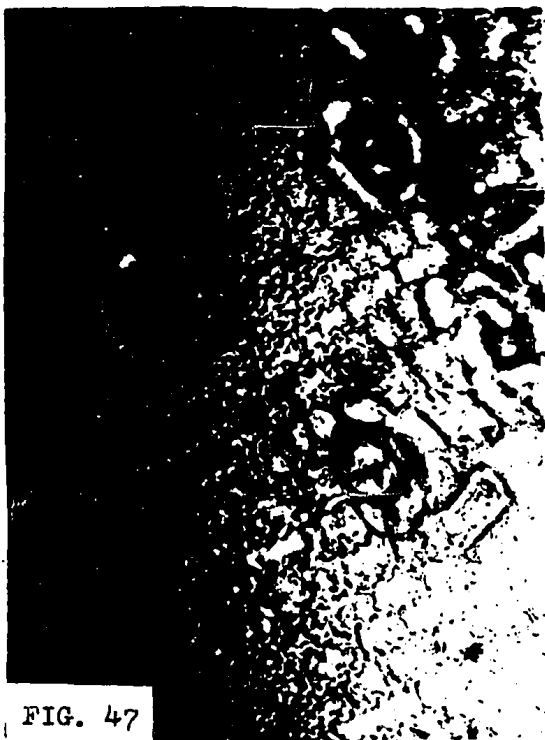
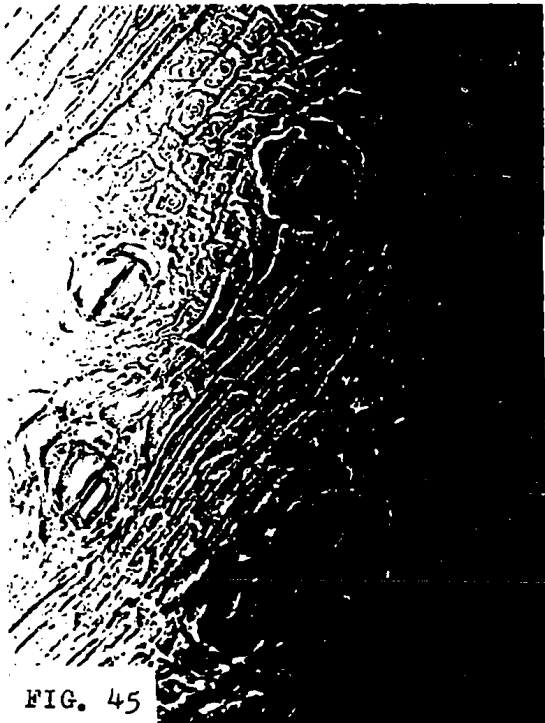
FIGURES 37-40. (Appendix B)

Figure 41.--three stomata, two trichomes, epidermal cells with conspicuous silica bodies, AJG 1056, Guzmania hitchcockiana. x 500; Figure 42.--several trichomes, AJG 1062, Guzmania fosteriana. x 500; Figure 43.--a trichome from the inflorescence and pollen grain, AJG 1056, Guzmania hitchcockiana. x 500; Figure 44.--trichome, AJG 1066, Aechmea angustifolia. x 500.



FIGURES 41-44. (Appendix B)

Figure 45.--five stomata, epidermal cells with silica bodies, Camp 4704, Greigia sodiroana. x 500; Figure 46.-- filamentous trichomes over stomata, Camp 4704, Greigia sodiroana. x 450; Figure 47.--three stomata, Ronnbergiana species from Colombia, supplied by Marnier Lapostolle. x 500; Figure 48.--one stoma, epidermal cells with silica bodies, AJG 1067, Aechmea angustifolia. x 500.



FIGURES 45-48. (Appendix B)

INTRODUCTION TO THE KEYS AND DESCRIPTIONS
FOR THE ECUADORIAN BROMELIACEAE

Keys to the identification of the known species of Ecuadorian Bromeliaceae have been constructed here with a view to aiding the field botanist in particular. To this end, points that may appear hazy to the nonspecialist are illustrated by diagrammatic drawings accompanying each key. In addition, 102 of the some 275 species are illustrated by photographs from within various specific circumscriptions.

During the course of this work it became necessary to describe several new taxa. These have been published in *Phytologia*, volume 16, number 2, and include 8 previously undescribed species and 10 previously undescribed varieties.

The methods by which this alpha taxonomic work was conducted are discussed in detail elsewhere. Suffice it to say that both classical and numerical taxonomic methods have been used.

The format follows Smith's Bromeliaceae of Colombia (Smith, 1957) for the most part. Synonymy includes only those names considered most necessary for an alpha taxonomic work.

In addition to the literature citations following the names of taxa, a bibliography with as complete bibliographic information as was possible to obtain follows the descriptions at the end of the keys and descriptions.

Six maps are included. The first map is of all of

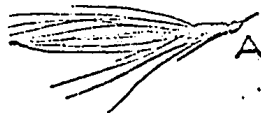
Ecuador with major rivers, provincial boundaries, and indicates the division of the country into four sections. A sixth map is of the Galapagos Islands. Accompanying the maps is a list of some of the more commonly collected sites in Ecuador with the approximate longitudes, latitudes and the names of the provinces.

Family BROMELIACEAE

Bromeliaceae J. St. Hil., 1805 (Expos. Fam. vol. 1) pp. 122-125, pl. 19.

Herbs, rarely shrubby, mostly but not always epiphytic; leaves usually rosulate, simple, bearing trichomes of peltate scales; inflorescence simple or compound, bracts often brightly colored; flowers perfect (in Ecuadorian species) or imperfect in a few species, sepals free or united, petals free or united, stamens 6 in 2 series; style usually 3-parted, ovary 3-celled, superior to inferior; placentae axile; fruit capsular or baccate; seeds winged, or plumose or naked; embryo small, situated at base of usually copious endosperm.

KEY TO THE SUBFAMILIES OF THE BROMELIACEAE



- A 1. Seeds plumose (A)*, leaves entire, ovary superior.
 : Subfamily TILLANDSIOIDEAE, p.



1. Seeds NOT plumose but naked (AA), or with appendage entire (B), or (C); leaves usually conspicuously spinose-serrate; ovary superior or inferior.



2. Seeds naked (AA), fruit baccate, fleshy to coriaceous, ovary inferior in Ecuadorian species, stomata round in surface view and

*

Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

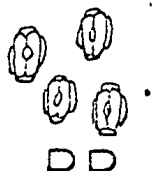


scattered (D), cotyledon remaining inconspicuous in young seedling (E)

. : Subfamily BROMELIOIDEAE, p.



2. Seeds with appendage entire (B), or (C) (in all Ecuadorian species), fruit capsular, ovary variable, stomata elliptic in surface view and densely disposed (DD), cotyledon conspicuous in young seedling (EE)



. : Subfamily PITCAIRNIOIDEAE, p.



Subfamily PITCAIRNIOIDEAE

Pitcairnioideae Harms, 1930 (Engler and Prantl, Pflanzenfam, ed. 2, vol. 15 a) p. 102; Smith, 1957, pp. 5-6.

Leaves usually spinose-serrate; sepals coriaceous, ecarinate; ovary superior to inferior; fruit a capsule in Ecuadorian species; seeds with appendages entire, not plumose; stomata elliptic in surface view, densely disposed in longitudinal rows; cotyledon of young seedling remaining conspicuous for several months.

KEY TO THE ECUADORIAN GENERA OF PITCAIRNIOIDEAE



1. Seeds winged (A)*, ovary usually wholly superior, petals naked (B), strongly twisted together after anthesis.
 : Genus PUYA, p.



1. Seeds with single entire appendage (AA), ovary inferior at least in part, petals often with nectar scales (BB), petals NOT strongly twisted together after anthesis
 : Genus PITCAIRNIA, p.



*
 Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

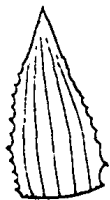
PUYA

Puya Molina, 1782 (Sagg, Chile) pp. 160, 351.

Plant terrestrial with leaves conspicuously spiny-margined, coriaceous or subcoriaceous in texture. Flowers always polystichous on the rhachis. Sepals free from each other, coriaceous, totally ecarinate. Petals often twisted after anthesis and petals naked. Ovaries totally superior to 1/3 inferior. Stamens always included, one series nearly as long as the petals. Fruit a capsule, seeds winged. Stomata elliptic in surface view and densely disposed in distinct longitudinal rows. Some Ecuadorian species have the local names, achupalla and cabuya.

KEY TO THE ECUADORIAN SPECIES OF PUYA

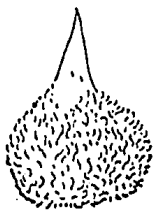
A



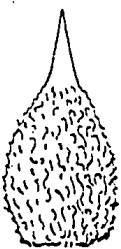
B

1. Inflorescence dense (A)*, globose or subglobose if compound, flowers in definite fascicles; if simple or appearing simple then densely flowered and the flowers less than 4 mm apart.
2. Primary bracts with margins serrate (B), or if simple, floral bracts with serrate margins, marginal spines apparent to the naked eye.
3. Floral bracts dull, not nitid, primary bracts completely obscuring the mature flowers.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



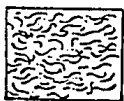
CC



C



BB

1mm
D

4. Sepals to 2.0 cm long, primary bract sheaths (CC), wider than long, 4.0-4.5 cm long by 5.0-5.5 cm broad. : 2. P. fastuosa.
4. Sepals ca. 3 cm long, primary bract sheaths longer than wide (C), 6.0-6.5 cm long by 4.0-4.5 cm broad. : 1. P. vestita.
3. Floral bracts nitid, not dull, primary bracts small relative to flowers and exceeded by the calyx or petals.
5. Inflorescence 3-5 cm long, densely globose, pseudosimple. : 3. P. eryngioides.
5. Inflorescence at least 20 cm long and obviously compound. . . : 4. P. parviflora.
2. Primary bracts with margins entire (BB), or at least appearing entire to the naked eye (not applying to the scape-bracts), if inflorescence is simple then the floral bracts with margins entire.
6. Indumentum of the inflorescence of long hairs, villous (D), lanate or flocculose, rubbing off easily, not adhering tightly to the surface, trichomes stellate.
7. Plant height, including scape and inflorescence less than 50 cm, flowers few, scape diameter with scape-bracts nearly as great as inflorescence

diameter. : 5. P. pycmaea.

7. Plant height, much exceeding 50 cm, often 1-2 meters or more, scape-diameter much less than that of the inflorescence.

8. Leaf blade just below each marginal spine conspicuously dark spotted (E), scape and inflorescence 60-100 cm, primary bracts flexible, the apices not reflexed : 6. P. maculata.



E

8. Leaf blade just below each marginal spine not conspicuously dark spotted (EE), scape and inflorescence more than 1.5 m, primary bracts coriaceous or flexible and papery when dry and the apices reflexed.



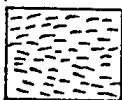
EE

9. Floral bracts coriaceous, 2.0-2.5 cm long, sepals ca. 3.5 cm long, scape-bracts imbricate below only, not at all or scarcely so near the inflorescence base : 9. P. lanata.

9. Floral bracts papery in texture, 3 cm or more long, sepals to 2.8 cm long.

10. Leaves 20-35 cm long, spines, narrow, base of spine 2-3 mm broad or less, sepal margins crenulate, floral bracts 4.0-5.0 cm. . . : 8. P. clava-herculis.

10. Leaves 60-100 cm long, spines with broad base, 5-7 mm wide, sepal margins not crenulate, floral bracts 3.0-4.0 cm. . . . : 7. P. hamata.



DD

6. Indumentum of the inflorescence of short, usually stiff hairs (DD), not villous, adhering tightly to the surface, reddish in color.

11. Inflorescence nodding, leaves less than 2.0 cm wide, 15-30 cm long, leaf-blade marginal, spines slender, less than 3 mm long : 10. P. nutans.

11. Inflorescence not distinctly nodding, leaves 2 cm wide or more, 35-60 cm long, spines not slender, and mostly more than 3 mm long : 11. P. glomerifera.

1. Inflorescence lax, not densely flowered, globose (AA), if compound then having definite branches which are at least 2 cm apart; if simple, flowers at least 6 mm apart.



AA

12. Flowers less than 1 cm distant (i.e. those directly above and below one another), sessil or if pedicellate then the pedicel hidden by the

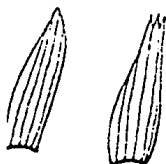
imbricate floral bracts.

13. Spikes 2.5-3.0 cm broad, plant not more than 1 m tall, inflorescence densely lanate, indumentum rubbing off easily, the floral bracts reddish brown, nitid when dry and in vivo
 : 4. P. parviflora.
13. Spikes at least 4 cm wide, plant at least 1.5 cm tall, inflorescence appressed-dense-lepidote, the indumentum not rubbing off easily, floral bracts dull . . .
 : 12. P. sodiroana.
12. Flowers 1-2 cm distant (i.e. those directly above and below one another), pedicels often very conspicuous.
14. Sepals with apex rounded (F), NOT acute or dentate, 1.5-2.6 cm long, if longer, then inflorescence simple and floral bracts not exceeding 9 mm in length.
15. Floral bracts 1.7 cm or more long, reflexed, exceeding the pedicels, no transverse fold



F

- : 13. P. pichincae.
15. Floral bracts 1.5 cm or less in length, not reflexed, having a transverse fold.
16. Indumentum of the inflorescence ferruginous, dense, floral bracts 12-14 mm long
- : 14. P. roseana.
16. Indumentum of the inflorescence cinereous lepidote, subglabrous in fruit, floral bracts 0.6-1.0 cm long.
17. Sepals to 2 cm long, capsules to 2 cm. . . . : 15. P. westii.
17. Sepals ca. 3.0 cm long, capsule to 3.0 cm and inflorescence simple. . . . : 16. P. obconica.
14. Sepals with apex acute or attenuate and dentate or retuse (FF), 2.5 cm or more long.
18. Flowers erect and sessile or subsessile
- : 17. P. thomasiana.
18. Flowers spreading and definitely pedicellate.
19. Floral bracts 0.5-1.0 cm



FF

long, if longer still not
reaching the calyx base

. . . : 18. P. aequatorialis.

19. Floral bracts at least to
2.2 cm long with attenuate
apices which always reach
at least the base of the
calyx : 19. P.
aequatorialis var. albiflora.

1. PUYA VESTITA André, 1888 (Énumération Bromél.) p. 5;
André, 1889, p. 37, pl. 12b; Smith, 1957, p. 18.

PLANT poorly known as a whole; INFLORESCENCE bipinnate, dense, densely lanate; PRIMARY BRACTS 0.6-1.0 cm long, with serrate margins, 4.0-4.5 cm wide, acuminate apex; FLORAL BRACTS 3.0-3.5 cm long by ca. 1.3 cm wide, densely woolly on outer surface; SEPALS ca. 3.0 cm long, apex broad-acute, densely woolly on abaxial surface; FLOWER ca. 4.5 cm long, petals twisted after anthesis; distance between flowers ca. 3-6 mm.

MATERIAL EXAMINED: André 3739 (K, TYPE; US, photo) Mt. Corazon, Prov. Pichincha, ca. 3300 m, June 1876.

COLOMBIA.

2. PUYA FASTUOSA Mez, 1906 (Fedde Repert. Nov. Spec. vol. 3) p. 12; Mez, 1935, p. 302.

FIG. 1

PLANT 2.0-3.0 m tall including inflorescence by ca. 2 m in diameter, terrestrial; LEAVES 40-60 cm long, blades 2.5-3.0 cm wide, flat, texture pliable to subcoriaceous, spiny-margined throughout the blade, silvery-green, narrowly triangular, glabrous above, densely lepidote below, erect to spreading, spines 6-8 mm long; SCAPE erect, 2.5-3.0 cm in diameter; SCAPE-BRACTS 10-12 cm by 1 cm, not imbricate, reflexed; INFLORESCENCE ca. 40-45 cm long by 10-12 cm in diameter, erect, cylindric to thyrsoïd, brown woolly, bipinnate, dense; PRIMARY BRACTS 4.0-4.5 cm long, a few up to 8 cm long including the long acuminate apex, by 5.0-5.5 cm broad, erect, black when dry, rotund, serrate, densely brown woolly toward the base; SPIKES 3.0-8.0 cm long by ca. 2 cm wide, fasciculate; FLORAL BRACTS 3.0-3.5 cm long by 1.0-1.5 cm wide, erect, elliptic-obovate, densely brown woolly, soon turning glabrous, margins serrulate, scarcely nerved, papery; SEPALs to 2.0 cm long by ca. 1.0-1.3 cm wide, apex rotund to subrotund, elliptic; PETALS exceeding the sepals by ca. 1.7 cm, distance between flowers less than 2 mm.

MATERIAL EXAMINED: AJG 1103 (US) páramo, very common, km 63, Ambato-Cuenca, Prov. Tungurahua, 3350 m, 8 August 1965, in bud.

TYPE: Weberbauer 4069 (B) not seen.

3. PUYA ERYNGIOIDES André, 1888 (Énumération Bromél.) p. 5; André, 1889, p. 32, pl. 10; Mez, 1934, p. 304-305, fig. 72.

PLANT 30-40 cm tall by 20-25 cm in diameter including inflorescence, growing in clumps; LEAVES 14-20 cm long, blades 0.8-1.5 cm wide, slightly involute, spiny throughout, narrowly triangular, apex attenuate, coriaceous, nearly glabrous; SCAPE to 38 cm long by ca. 4 mm in diameter, erect; SCAPE-BRACTS 1.0-8.0 cm, imbricate, green, erect to spreading, margins serrate; INFLORESCENCE 3.0-4.5 cm long by ca. 3.0-5.0 cm in diameter, dense, grossly appearing simple, actually bipinnate, erect, globose, subglabrous; PRIMARY BRACTS 1.3-1.5 cm long by 7-9 mm wide, erect, ovate, glabrous, margins serrate, apices acuminate; FLORAL BRACTS 5-7 mm long by 4-6 mm wide, margins entire, surface shiny, apex acute, coriaceous, ecarinate, strongly nerved, lepidote within; SEPALs 1.0-1.5 cm long by 5.0-8.0 mm wide, apex acute, ovate, ecarinate, strongly nerved; CAPSULE 1.0-1.4 cm long by ca. 9 mm wide, about 3 flowers per fascicle, distance between flowers less than 2 mm.

MATERIAL EXAMINED: André 4542 (K, TYPE; US, photo) between Riobamba and Loja, Prov. Azuay, 2800 m, August 1876; Fosberg & Giler 23124 (US) the divide between Quebrada Jipirú and the east fork of the Río Zamora 4° S; 79° 6' W, Prov. Loja, 2700 m, 19 February 1945; Espinosa E 1029 (GH) Hortanaque, "together with others these are the dominants of the altitude," Prov. Loja, 3100-3800 m, 9 November 1946.

4. PUYA PARVIFLORA L. B. Smith, 1949 (Contrib. U. S. Nat. Herb. vol. 29) p. 316, fig. 36.

FIG. 2

PLANT 50-100 cm tall by ca. 50 cm in diameter, terrestrial, underground stem 2.0-6.0 cm in diameter, very tough; LEAVES to 45 cm long, blades 2.2 cm wide, pale green, flat, narrowly triangular, margins with spines throughout, spines 3-4 mm, blade densely lepidote above, apparently glabrous below; sheath 3.0 cm by 3.5 cm wide, castaneous; SCAPE ca. 1.1 cm in diameter, rust-red, curved; SCAPE-BRACTS imbricate, serrate margins, 3.5-18 cm long by 1.4 cm wide, red, erect, not strict; INFLORESCENCE 20-70 cm long by 8.0-18 cm in diameter, bipinnate, lax, red, ellipsoid, white-flocculose, having ca. 18 spikes; PRIMARY BRACTS 3.0-4.5 by 2-3 cm, red, apex attenuate, margins minutely serrulate, ovate, glabrous; SPIKES 5.0-13 cm long by 3.0 cm wide spreading, stipe 7-8 mm long, no sterile bracts; FLORAL BRACTS 2.0-2.4 cm long by 1.4 cm wide, shiny, apex attenuate, glabrous within, papery, ecarinate, slightly nerved; SEPALS 1.8-2.1 cm long by 4 mm wide, erect, ovate, flocculose, coriaceous, apex acute to retuse, ecarinate; PETALS 25 mm long, green to blue-green; distance between flowers 2 mm or less; fruit not known; in flower July and August.

MATERIAL EXAMINED: Espinosa E-2052 (US, TYPE) north of Zaruma, Hacienda Ambocas, Prov. El Oro, 2200-2900 m, 30 August 1947; Harling 5724 (US) road from Loja to Catamayo

"stem creeping, ca. 0.5 m long with scales, 5.0-6.0 cm in diameter," Prov. Loja, 2500 m, 9 July 1959; AJG 1134 (US) km 4 Loja-Zamora, common locally, growing at roadside on nearly bare slope, soil of clay-like consistency, plants 0.5-1.0 meter apart from each other but connected by very tough underground stem, Prov. Loja, 2150 m, 11 August 1965.

5. PUYA PYGMAEA L. B. Smith, 1952 (Memoirs N. Y. Bot. Gard. vol. 8, no. 1) pp. 27, 28, fig. 1, g-i.

PLANT ca. 30 cm tall with shallow root system, ca. 14 cm in diameter, plants solitary, scattered, high páramo; LEAVES ca. 20 cm long, blades 1.3 cm wide, narrowly triangular, minutely spiny throughout the blade, glabrous and shiny above, dense-lepidote below, leaves mostly erect, subcoriaceous, sheath ovate, pale straw colored when dry; SCAPE ca. 28 cm long including inflorescence, by 5-7 mm in diameter, erect; SCAPE-BRACTS 4.0-9.0 cm long by 2.3 cm wide, erect, foliaceous and totally imbricate; INFLORESCENCE 3.5-5.5 cm long by 3.0-3.5 cm in diameter, erect, dense-appearing although the flowers are ca. 6 mm apart, grey flocculose, simple; FLORAL BRACTS 2.9-3.1 cm long by 1.1-1.4 cm wide, ovate-elliptic, papery, ecarinate, strongly nerved, glabrous within, reddish, apex acute; SEPALS 1.6-1.8 cm long by 0.7-0.9 cm wide, erect, free, ovate-elliptic, ecarinate, apex obtuse, strongly nerved, glabrous within, densely grey flocculose without, the indumentum remaining throughout capsule maturity, flowers 2.0-3.0 cm long, petals exceeding calyx by ca. 1.5 cm; CAPSULE 1.7 by 1.5 cm long, seeds winged, 3.2 mm across, distance between flowers ca. 6 mm; in flower March, in fruit by August.

MATERIAL EXAMINED: Camp E-2236 (US, TYPE) Páramo de Tenajillas, 30-50 km south of Cuenca, 3700-4000 m, Prov. Azuay, 17 March 1945; AJG 1114 (US) on pebbly slope, plants scattered

but abundant, however only one found in maturity, the others purely vegetative, air temperature at 1530 hrs., 10°C, soil temperature at 5 cm depth same time, 10°C, km 48, Cuenca-Loja, Prov. Azuay, 3300 m, 9 August 1965.

6. PUYA MACULATA L. B. Smith, 1952 (Memoirs N. Y. Bot. Gard. vol. 8, no. 1) pp. 25-26, fig. 1, a-d.

PLANT to 1 m tall, terrestrial; LEAVES 25-45 cm long, blades ca. 2.6 cm, narrowly triangular, spiny throughout, spines 0.7-1.0 cm long by 5 mm broad at the base, dark brown and the portion of the leaf blade just subtending each spine also dark brown, apparently blade glabrous on both surfaces, sheath ca. 4.5 cm long by 4.0 cm wide, dark brown nitid above, concolorous with blade below, elliptic; SCAPE 60-100 cm long including inflorescence, by 1.0-1.2 cm in diameter; SCAPE-BRACTS 8.0-13 cm long by 2.5 cm wide, erect not strict, imbricate throughout, not serrate above, foliaceous and serrate below; INFLORESCENCE 10-15 cm long by 6.0 cm in diameter, club shaped, moderately dense-pale-brown - tomentose, bipinnate, dense; PRIMARY BRACTS 3.0-5.0 cm long by 1.5-2.8 cm wide, erect, triangular, SPIKES ca. 5.0 cm long, fasciculate, erect; FLORAL BRACTS ca. 3.0 cm by 1.1 cm, erect, ovate, apex acute to acuminate, texture papery, moderately nerved, ecarinate; SEPALS ca. 1.8 cm long by 6 mm wide, erect, dark brown when dry, oblong, curving to side, apex retuse or tridentate, glabrous; PETALS 3.1-3.3 cm long by 1 cm wide, erect, dark blue, none of the petals twisted; OVARY superior, some with separate carpels; FRUIT a capsule, distance between flowers less than 3 mm; in flower by March.

MATERIAL EXAMINED: Camp E-4882 (US, TYPE) trail between Sevilla de Oro and Mendez, Prov. Azuay, 3800-4000 m, 17 March 1945.

7. PUYA HAMATA L. B. Smith, 1949 (Contrib. U. S. Nat. Herb. vol. 29) p. 314, fig. 35; Smith, 1957, pp. 26-27, fig. 10.

PLANT 2.0-4.0 m tall including inflorescence, in northern Ecuador in association with Espeletia; LEAVES 70-100 cm long, blades ca. 2.5-3.5 cm wide, coriaceous, with very dark curving spines these to 1.0 cm long and curving forward or back and broad-based, apparently glabrous above and finely appressed lepidote below; SCAPE ca. 2.0 cm in diameter, erect; SCAPE-BRACTS 14-16 cm long by 3.5-4.0 cm wide, imbricate throughout, with serrate margins, erect; INFLORESCENCE to 80 cm long by 20 cm in diameter, dense, globose-cylindric, bipinnate, white-lanate; PRIMARY BRACTS 4.5-7.0 cm long or more by 2.0-5.0 cm wide, margins entire; SPIKES fasciculate, 5.0 cm long by ca. 5.0 cm wide, sessile, erect to spreading, ca. 1.5 cm apart; FLORAL BRACTS 3.0-3.8 cm long by 2.0-3.0 cm wide, ovate, papery, apex attenuate, ecarinate, not nerved, glabrous within; SEPALS 2.2-2.5 cm long by 0.7-1.2 cm wide, free, ovate, apex acute to subacute, papery, ecarinate, glabrous within densely lanate without; PETALS 3.5-4.0 cm long by 0.9-1.1 cm wide, not lobed strongly, naked, blue, erect, pedicels 1-4 mm long; OVARY superior, 1.2-1.5 cm long by 0.5 cm in diameter; STAMENS included, one series 1 mm shorter than the petals the other series 4-6 mm shorter than the petals, distance between flowers 2-3 mm.

MATERIAL EXAMINED: Hitchcock 20915 (US) páramo, 19 km west of Tulcañ, Prov. Carchi, 3300 m, 10 August 1923; Rose,

Pachano & Rose 23023 (US) near Nabón, Prov. Azuay, 25 September 1918; Rose & Rose 22778 (US) near Azogues, Prov. Cañar, just below the páramo, 16-17 September 1918; Wiggins 10648 (GH) margins of the páramo and in the páramo along road from Tulcañ to El Pun, Prov. Carchi, 3500-4000 m, 18 August 1944; Drew E-483 (US) páramo, northeast of Tulcañ, along highway to El Pun, Prov. Carchi, 3800 m, 18 August 1944; Asplund 7118 (US) Páramo del Angel, Prov. Carchi, 3400 m, 21 June 1939; Camp E-2082 (US) Páramo de Tinajillas and surrounding area, 30-40 km south of Cuenca, Prov. Azuay, 3300-3500 m, 7 March 1945; Foster 2604 (US) km 42, Cuenca-Oña, "plant solitary," Prov. Loja, 4200 m, 4 December 1948, in fruit; Rauh & Hirsch E 224 (US) Páramo del Angel, growing with Espeletia, Prov. Carchi, 4100 m, 7 September 1954; Asplund 16997 (US) Páramo del Angel, Prov. Carchi, 3400 m, 22 July 1955.

COLOMBIA.

8. PUYA CLAVA-HERCULES Mez and Sodiro, in Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 863; Mez, 1935, p. 307.

FIG. 3

PLANT 1.5-3.0 m tall including inflorescence, terrestrial; SCAPE ca. 1.5 cm in diameter, erect; SCAPE-BRACTS to 12 cm long by 2.0-2.5 cm wide; LEAVES 20-30 cm long, blades 2.0-3.0 cm, spiny throughout the margin, spines, 5-9 mm long, dark; INFLORESCENCE 12-16 cm long by 6.0-12.0 cm in diameter, bipinnate, club-shaped, dense, tomentose, tan to brown; SPIKES 2.5-7.0 cm long by 3.0-4.0 cm wide, nearly erect, fasciculate, spikes ca. 2.5 cm apart; PRIMARY BRACTS 9.0-12.0 cm long by 3.0-4.0 cm wide, erect but apex reflexed at least in part, margins entire; FLORAL BRACTS ca. 4.0-5.0 cm long by 8 mm to 1.5 cm wide, ovate to ovate-linear, densely woolly lepidote, papery, slightly nerved, apex attenuate, ecarinate; SEPALS 1.8-2.5 cm long by 5.0-8.0 mm wide, ovate, apex acute to attenuate, densely tomentose, ecarinate, nerved; PETALS 3.5-4.0 cm by ca. 6 mm, bluish; OVARY more than 1/2 superior, stamens included; CAPSULE 2.3-2.8 cm long by ca. 2 cm in diameter; seeds winged, triangular, 5 by 4 mm; distance between flowers less than 2 mm.

MATERIAL EXAMINED: Sodiro P-3 (B, TYPE; US, photo) near Montaña Huamavi, Prov. Pichincha; September 1900; Barclay & Pedro Juajibioy 8665 (US) near Páramo de Patococha between Gualacéo and Limón, Prov. Azuay, 3500 m,

6-7 August 1959; Drew & Wiggins 26 (US) "dominant in a Blechnum-Puya association, covering the floor of a once glaciated valley, probably burned over in the past," north slopes of Volcán de Cayambe, Prov. Imbabura, 4000-4500 m, 14 July 1944; Rauh E-130 (US) páramo, Prov. Imbabura, 4000-4200 m, 5 May 1957.

COLOMBIA.

9. PUYA LANATA (H.B.K.) Schult., 1830 (Systema Veg. Roemer & Schult. vol. 7) pp. 1233-1234.

FIG. 4

PLANT ca. 3 m tall, terrestrial; LEAVES 45-75 cm long, blades 2.5-3.5 cm wide, narrowly triangular to linear, with margins spiny throughout, reflexed, white-lepidote below; SHEATHS dark brown, orbicular; SCAPE at least 130 cm long by ca. 1.3 cm in diameter, erect; SCAPE-BRACTS ca. 4.0 cm long by 1.5 cm wide, margins serrate, not at all imbricate above, imbricate below, erect to spreading; INFLORESCENCE ca. 20-30 cm long by 4.0-8.0 cm in diameter, cylindrical, simple, moderately lepidote, dense, having ca. 80 flowers or more, flowers pedicellate, pedicels ca. 1.5 cm long and triangular in outline to obconical; FLORAL BRACTS 2.0-2.5 cm long by ca. 1.4 cm wide, spreading, ovate, tomentose, glabrous inside, coriaceous, apex acute to attenuate, ecarinate, not nerved, margins light colored, remainder dark when dry; SEPALs 2.5-3.5 cm long by ca. 1.2 cm wide, spreading, ovate, tomentose, glabrous within, apex attenuate to retuse, very inconspicuously carinate, not nerved, coriaceous; PETALS 3.0-3.5 cm long, light green; distance between flowers less than 2 mm; in flower June, July, in capsule September - December.

MATERIAL EXAMINED: Humbolt & Bonpland 3713 (P, TYPE; US, photo; B, ISOTYPE; US, photo) Peru; Rose & Rose 22801 (US) vicinity of Azogues, Prov. Cañar, 17 September 1918; Acosta Solis 7803 (US) near Las Chinchas, Prov. Loja, 2260 m, 12

April 1944; Espinosa E-1615 (US) "dominant in the region," between San Pedro and Las Chinchas, 50 km west of Loja, 1600-2000 m, 11 July 1947; Foster 2606 (US) km 0-100 Cuenca-Loja, Oña valley, Prov. Azuay, 3 December 1948; AJG 1116 (US) valley of Río Oña, km 101 Cuenca-Loja, 2000 m, Prov. Azuay, very common on steep rocky slopes growing in clumps of individuals which are ca. 1/2 m apart, 9 August 1965.

PERU.

10. PUYA NUTANS L. B. Smith, 1952 (Memoirs N. Y. Bot. Gard. vol. 8) p. 27, fig. 1, e-f.

PLANT 50-80 cm tall, terrestrial, very abundant in the páramo; LEAVES 15-30 cm long, blades ca. 1.7 cm wide, with spines throughout, massive base forming a thick stalk with old, still attached leaves, this base ca. 12 cm long by 12 cm in diameter; SCAPE 1.0-1.5 cm in diameter, erect; SCAPE-BRACTS mostly imbricate throughout, 5.0-7.0 cm in diameter; INFLORESCENCE simple, nodding, dense, densely red-lepidote, with ca. 22 flowers; FLORAL BRACTS 3.5-4.0 cm long by 2.0-3.0 cm wide, apex acute to acuminate, texture papery, having dense reddish indumentum of short, stiff hairs, which disappears by capsule maturity, slightly nerved, ecarinate, glabrous within; SEPALS 1.8-2.2 cm long by 1.8 cm wide, erect, dark red-brown when dry, elliptic to obovate, densely lepidote, indumentum without is retained through capsule-maturity, coriaceous, glabrous within, apex obtuse, surface rugose, not much nerved; PETALS 4.0-4.5 cm long, exceeding the calyx by 1.8 cm at anthesis, green, pedicels ca. 5 mm long, distance between flowers 2-3 mm or less; in flower in March, in fruit around December.

MATERIAL EXAMINED: Camp E-2291 (US) Páramo de Tinajillas, 30-50 km south of Cuenca, 3800-4000 m, Prov. Azuay; very abundant, few plants in flower, 17 March 1945; Foster 2607 (US) rocky slopes, road from Cuenca to Oña, Prov. Azuay, 4000-4200 m, 3 December 1948.

11. PUYA GLOMERIFERA Mez & Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 630; Mez, 1935, pp. 299-300; Smith, 1964, p. 475, fig. 2.

Puya asplundii L. B. Smith, 1959 (Phytologia vol. 6, no. 8) pp. 439-440, pl. 2, figs. 14, 15.

FIG. 5

PLANT 2.0-3.0 m or more in height including inflorescence, terrestrial, growing in clumps of many individuals; LEAVES 40-60 cm long, blades 2.5-3.5 cm wide, linear to narrowly triangular, apparently glabrous above, densely appressed white lepidote below, margins spiny throughout, spines 4-7 mm long, base of spine 5-7 mm wide; SCAPE 1.5-1.9 cm in diameter, erect; SCAPE-BRACTS ca. 8.0-10 cm by 2.0-3.0 cm wide at the sheath and the blade 4-8 mm wide, imbricate, margins serrate; INFLORESCENCE ca. 20-30 cm long by ca. 10-14 cm in diameter, dense, rhachis completely hidden, distance between branches ca. 1.0-1.5 cm, bipinnate, globose, dense reddish brown tomentum, indumentum loose; PRIMARY BRACTS 3.0-5.0 cm long by 3.0-4.0 cm wide, spreading to reflexed, apex acute to acuminate, ovate to orbicular, densely lepidote, subcoriaceous, margins entire or very minutely serrate and not obvious to naked eye; SPIKES 3.0-6.0 cm long by 3.5-4.5 cm wide, erect to spreading, sessile, having 6 to 9 flowers, fasciculate; FLORAL BRACTS 2.0-3.0 cm long by ca. 1.5-2.4 cm wide, obovate, papery, glabrous within, densely brown tomentose without, the tomentum soon falling toward the apices, apex acute to apiculate, ecarinate; SEPALS 2.0-2.5 cm long by

1.0-1.3 cm wide, coriaceous, apex obtuse, obovate, erect, glabrous within, ecarinate, densely tomentose without; PETALS 3.5-4.0 cm long, blue to blue-green, flowers sessile; OVARY ca. 10 mm long by 3-4 mm in diameter, nearly totally superior; CAPSULE ca. 2.0 cm by 1.8 cm, seeds including wing 4 x 4 mm, distance between flowers less than 2 mm.

MATERIALS EXAMINED: Sodiro P/2 (B, TYPE; US, photo) Prov. Pichincha, no date; Hitchcock 21646 (US) between Oña and Cuenca, Prov. Azuay, 2700-3300 m, 9-10 September 1923; Hitchcock 21675 (US) between Cuenca and Huigra, 2700-3000 m, Prov. Azuay, 12-13 September 1923; Firmin 280 (US) near waterfall of Batán-Guápulo, Prov. Pichincha, 2800 m, 15 November 1927; Firmin 412 (US) Cruz Verde, in a quebrada, Prov. Pichincha, est. 3000 m, 12 January 1928; Penland & Summers 74 (GH) along Río Pastaza near Baños, Prov. Tungurahua, 1740 m, March-August 1939; Benoist s. n. (P) no location, ca. 1931; Camp E-2349 (US) páramo de Chasqui, Prov. Azuay, ca. 4000 m, 16 April 1945; Foster 2648 (US) between Quito and Santo Domingo, Prov. Pichincha, ca. 4000 m, ca. 1948; Asplund 10093 (US) near Lloa, Prov. Pichincha, ca. 3000 m, date (?); Asplund 20222 (US, TYPE of P. asplundii L. B. Smith) rocky slope, Cuicocha, Prov. Imbabura, 3150 m, 10 April 1956; AJG 1097 (US) cleared land, very common, near cultivated fields, km 50, Ambato-Baños, Prov. Tungurahua, 2000 m, 7 August 1965.

I am reducing P. asplundii to taxonomic synonymy with P. glomerifera Mez and Sodiro for the following

reasons: Smith (1964) distinguished these two entities in his key by the relative sizes of the floral bracts and the sepals, P. glomerifera falling under the lead, "floral bracts nearly equaling to or exceeding the sepals" and P. asplundii falling under the lead "floral bracts exceeded by the sepals."

Examination of the foregoing listed specimens indicates that the relative lengths of the sepals and floral bracts is variable within the same individual. Additionally, while the type description of P. glomerifera states that the primary bracts are minutely serrulate, examination of the type photo showed them to be either entire or so minutely serrulate as not to evidence the serrulations. The type specimen of P. asplundii has the primary bracts strictly entire. However, Hitchcock 21675, a collection from between Huigra and Cuenca in the Ecuadorian southern Andes which fits P. asplundii otherwise very well does have very minutely serrulate primary bracts. Therefore, I am reducing P. asplundii to taxonomic synonymy with P. glomerifera noting that the species is variable as to margins of the primary bracts, the sepal size and noting also that in maturity the pedicels may become apparent.

12. PUYA SODIROANA Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) pp. 630-631; Smith, 1964, p. 473.

PUYA GUMMIFERA Mez & Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 863; Mez, 1935, p. 300; Smith, 1964, p. 463.

PLANT 2-3 mm tall including inflorescence, terrestrial; LEAVES 60-100 cm long, blades 3.0-4.0 cm wide, narrowly triangular to linear, margins spiny throughout, with spines spreading, 6-8 mm long and ca. 2.0-3.0 cm apart, apparently glabrous both surfaces, but actually covered by membrane of coalesced scales on upper surface, sheath orbicular, conspicuous; SCAPE ca. 3.0 cm in diameter; SCAPE-BRACTS 6.0-9.0 cm long by 1.0 cm wide, not imbricate; INFLORESCENCE 14-16 cm in diameter, lax, bipinnate, slightly lepidote, globose or short cylindrical in shape, distance between strobilate spikes to 2.5 cm; PRIMARY BRACTS 3.0-5.0 cm long by 2.2-2.6 cm wide, apex attenuate, spreading, margins serrulate, subglabrous; SPIKES 7.0-8.0 cm long by 4.5 cm wide, spreading, ovate, ca. 20 flowers per spike, sterile stipe 0.6-1.8 cm, no sterile bracts; FLORAL BRACTS 10-14 mm long by 12-14 mm wide, erect, orbicular, obviously nerved, ecarinate, apex acute to acuminate, papery, glabrous within; SEPALS 2.0-2.5 cm long by 0.9-1.1 cm wide, erect, elliptic-obovate, apex shortly mucronate or obtuse, coriaceous, ecarinate, free, strongly nerved, PETALS 4.0-4.5 cm long by 1.2-1.5 cm wide, naked, yellow to yellow-green, flowers sessile; OVARY about

1/2 superior, style more than 2 times ovary length, stigma tripartite, in some flowers exceeding the stamens in others not exceeding the stamens, anthers included within the corolla by 12 mm, distance between the flowers less than 2 mm; in flower in March, in fruit by December.

MATERIAL EXAMINED: Sodiro P-4 in part (B, TYPE of P. gummifera; US, photo) Ecuador, no date, no locality but probably Prov. Pichincha; Sodiro P-5 (B, TYPE of P. sodiroana; US, photo) near Paluguillo, Prov. Pichincha, est. 3000 m; Camp 2202 (US) along the Río Cumbe, 25-30 km south of Cuenca, Prov. Azuay, 3000-3400 m, 17 March 1945; Camp E 5198 (US) quebrada leading into the Rio Collay, 3-8 m north of Sevilla de Oro, Prov. Azuay, 2200-2800 m, 3 September 1945; Foster 2605 (US) km 28-35 Cuenca-Oña, Prov. Azuay, 2000 m, 3 December 1945.

I am reducing Puya gummifera to taxonomic synonymy with P. sodiroana for the following reasons: These two entities had been distinguished previously, by the length of the stipe and by the length of the sepals. Examination of the type photo of P. sodiroana indicates that the sepals rather than being 40 mm long as stated in the type description, do not exceed 2.6 cm at most. The spike stipes of the type specimens of both these entities are 12-18 mm long. Therefore, since it has been impossible to distinguish the two type specimens, Puya gummifera Mez has been reduced to synonymy with P. sodiroana Mez & Sodiro.

13. PUYA PICHINCHAE Mez & Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) pp. 633-634.

PLANT poorly known as a whole; LEAVES 40-50 cm long, blades 2.5-3.0 cm wide, narrowly triangular to linear, marginal spines distant, curving, up to 6-7 mm long; SCAPE at least 1.6 cm in diameter; SCAPE-BRACTS imbricate; INFLORESCENCE 50-70 cm long by 10-15 cm wide, bipinnate; PRIMARY BRACTS 4.0-6.0 cm apart, ovate-elliptic, with serrate margins, much shorter than the spikes; SPIKES 10-15 cm long by 5.0-7.0 cm wide, suberect to spreading, ca. 20-30 flowers per spike; FLORAL BRACTS 1.8-2.1 cm long by 1 cm wide, reflexed, apex acute to attenuate, ecarinate; SEPALs 2.1-2.6 cm long by 0.7-1.0 cm wide, erect, free, apex obtuse, ecarinate; flowers ca. 4 cm long, petals twisted, ovary superior, pedicels of flowers 8-9 mm long, distance between flowers 9-10 mm or more.

MATERIAL EXAMINED: Sodiro P-4 in part (B, TYPE; US, photo) near Paluguillo, Prov. Pichincha, no date.

14. PUYA ROSEANA L. B. Smith, 1961 (Phytologia vol. 7) p. 421, pl. 1, fig. 13.

PLANT as a whole poorly known; INFLORESCENCE bipinnate, lax, densely reddish lepidote; PRIMARY BRACTS less than 4 cm long; SPIKES ca. 15 cm long by 5.0 cm wide, with stipe ca. 4.0 cm long; FLORAL BRACTS 1.0-1.4 cm long by 0.8-1.0 cm wide, spreading, red, ovate, densely red-lepidote, papery to sub-coriaceous, glabrous within, densely lepidote without, apex acute, ecarinate, not obviously nerved, pedicels ca. 0.7-1.0 cm long; SEPALS 1.8-2.0 cm long by 1.0 cm wide, erect, free, apex obtuse to retuse, coriaceous, glabrous within, ecarinate, not conspicuously nerved; CAPSULE 1.5-1.8 cm long by 1.5-1.6 cm wide, distance between flowers 6-9 mm. The distinguishing character of this species is the very definitely rust-red indumentum, which is retained on the inflorescence through capsule maturity.

MATERIAL EXAMINED: Rose & Rose 23210-a (US, TYPE)
Ecuador, no other habitat data available.

15. PUYA WESTII L. B. Smith, 1961 (Phytologia vol. 7) p. 421, pl. 1, fig. 13.

FIG. 6

PLANT at least 2 m tall including inflorescence, terrestrial; LEAVES to 50 cm long, blades 2.0-2.3 cm wide, linear to narrowly triangular, very stiff-coriaceous, blade spiny throughout, with dark or reddish-orange spines, glabrous above, densely pale lepidote below, erect to spreading; SCAPE ca. 2 m long by 2.0 cm in diameter, dark when dry; SCAPE-BRACTS caducous early; INFLORESCENCE ca. 1 m long by ca. 60 cm in diameter, lax, distance between branches ca. 2.0-4.0 cm, bipinnate, elliptic, slightly curving, glabrous to subglabrous; SPIKES 20-30 cm long by 4.0-6.0 cm wide, spreading to ascending, elliptic with 20-22 flowers per spike, ca. 8-10 spikes, stipe ca. 7.0 cm long, no basal sterile bracts, the spike's terminal 5-9 floral bracts are sterile and forming an inconspicuous mass ca. 1.2 cm long by 0.5 cm wide; FLORAL BRACTS 5-9 mm long by 7 mm wide, ovate, spreading to reflexed, lepidote without, glabrous within, a conspicuous lateral fold near the middle of the bract, coriaceous, apex broadly acute, margins not serrate, ecarinate; SEPALS 1.5-1.8 cm long by 5-6 mm wide, erect, all free, elliptic-oblong, nerved, apex obtuse, naked; PETALS ca. 3 cm long, pedicels 0.9-1.1 cm, 2 mm wide at the base and broadening to 4-5 just below the flower; OVARY almost totally superior; CAPSULE 1.5-1.7 cm long by 1.3-1.5 cm in diameter,

seeds including wing 4 mm by 2 mm; distance between flowers 0.6-2.0 cm; in fruit by August.

MATERIAL EXAMINED: West 8353 (US, TYPE; US, photo) Peru rocky slopes, near Huamachuco, Dept. Libertad, ca. 3400 m, 26 November 1936; AJG 1108 (US) moderately common, growing in clumps of several individuals, in open, grassy, gently sloping area near base of cliff; km 11, Cuenca-Loja, Prov. Loja, 2600 m, 9 August 1965.

PERU.

16. PUYA OBCONICA L. B. Smith, 1948 (Lloydia vol. 11, no. 4)
pp. 306-307, fig. 5, a-c.

PLANT poorly known as a whole; LEAVES ca. 55 cm long, blades 2.4 cm wide, lower surface densely appressed velvety white-lepidote, upper surface apparently glabrous, margins spiny throughout, spines 4-6 mm long, some recurved, apex attenuate; INFLORESCENCE ca. 1 m long by 5.5-6.5 cm in diameter, pedicels 1.5-2.0 cm long by 1.0-1.2 cm in diameter, obconic, bipinnate, lax; FLORAL BRACTS 0.8-1.0 cm long always much shorter than the pedicel and not conspicuous, with tranverse fold; SEPALS 3.0 cm long by 0.9-1.1 cm wide, coriaceous, apex obtuse; CAPSULE ca. 2.9 cm long by 2.5 cm in diameter, in fruit in October.

MATERIAL EXAMINED: Steiermark 54806 (GH, TYPE; US, photo and fragments) ca. 7 km south of Yangana, Nudo de Sabanilla, 4°, 36' S; 79° 10' W, Prov. Loja, 2000-3000 m, 19 October 1943.

17. PUYA THOMASIANA André, 1888 (Énumération Bromél.) p. 5;
André, 1889, pp. 34-35, pl. 11-d.

FIG. 7

PLANT 2-4 m tall, terrestrial, ca. 1 m in diameter, growing in large loose clumps, open country; LEAVES 60-100 cm long, blades 5.0-6.0 cm, yellow-green, flat, triangular, (apparently glabrous above, pale glaucous below), margins with spines which are 3.0-6.0 mm long and turning mostly forward throughout; SCAPE at least 1.5 cm in diameter, slightly curved to erect-straight; SCAPE-BRACTS serrate margined; INFLORESCENCE ca. 1.5 m long by 60 cm in diameter, bipinnate, laxly branched, not at all dense, with ca. 33 branches, which are 15-40 cm long, branch stipes naked; PRIMARY BRACTS ca. 3.5 cm long by 2.0 cm wide, spreading, ovate, slightly tomentose, apex acuminate-attenuate, papery, serrate margined; SPIKES 15-40 cm long by 4.0-6.0 cm wide, spreading, linear, red, stipe to 6.5 cm, tomentose, approximately 1.0-2.0 cm or more distant, an inconspicuous terminal group of sterile bracts on the spikes, the group of bracts ca. 1.0 cm long by 1.5 cm wide, very inconspicuous; FLORAL BRACTS 1.2-1.5 cm long by 1.4-1.7 cm wide, spreading, apex acute, densely lepidote, ovate, slightly nerved, ecarinate, apex papery but base stiff-coriaceous, margins entire; FLOWERS subsessile; SEPALS 2.8-3.0 cm long by 8-10 mm wide, free, densely lepidote, glabrous inside to subglabrous, apex acute, ovate-oblong, stiff-coriaceous; PETALS 4.0-5.0 cm long

by 1.0 cm wide, naked, twisted and green after anthesis, free; STAMENS 4-5 mm exceeded by the petal blades, filaments free from the petals; OVARY ca. 7 mm long by 3 mm in diameter, trilobed, ovules winged; distance between flowers ca. 5 mm; in flower, August. (NOTE: the ovary is partially inferior, in AJG 1130.)

MATERIAL EXAMINED: André 3191 (K, TYPE; André drawing, André, 1889) Colombia, 1900 m, May 1886; AJG 1130 (US) sandy, ashy soil, common, km 22 Catamayo-Loja, between the dwarf forest and the páramo, 2000 m, Prov. Loja, 10 August 1965.

COLOMBIA.

18. PUYA AEQUATORIALIS André, 1888 (Énumération Bromél.)

p. 5; André, 1889, p. 37, pl. 12 a; Smith, 1952, p. 25.

PLANT ca. 2 m tall including inflorescence, terrestrial; SCAPE ca. 1.5 m long including inflorescence, scape diameter 1.5 cm; SCAPE-BRACTS not known; LEAVES to 50 cm long, blades 1.0-2.0 cm wide, texture coriaceous, blade margins armed with recurved spines throughout, apex attenuate, pale green; INFLORESCENCE 20-50 cm long by 4.5-5.5 cm in diameter, lax, bipinnate; SPIKES to 50 cm long by 4.0-7.0 cm wide, having at least 26 flowers per spike, stipe minimal, no sterile bracts; FLORAL BRACTS 0.5-2.2 cm long by ca. 5 mm wide, triangular or with setaceous blades, reflexed-spreading, subglabrous, margins entire, ecarinate; SEPALs 2.5-2.8 cm long by 0.7-9.9 cm wide, elliptic, glabrous, free, apex acute to retuse, stiffly coriaceous, ecarinate, nerved, glabrous within; PETALS 4.5-5.0 cm long, blades 8-9 mm wide, green, naked, pedicels 0.2-1.5 cm long; OVARY superior, distance between flowers ca. 8 mm.

18. PUYA AEQUATORIALIS var. AEQUATORIALIS

Flower pedicels 2-6 mm long, floral bracts not exceeding base of calyx, to 1.0 cm long.

FIG. 8

MATERIAL EXAMINED: André 3564 (K, TYPE; US, photo) on rocks of deep narrow valley of Río Chota, near equatorial line, Prov. Pichincha, 2080 m, ca. 1886; Rose, Pachano and Rose 22954 (US) near Cumbe, Prov. Azuay, ca. 2600 m, 24 Sept.

1918; Foster 2608 (US) rocky slopes, km 130 Cuenca-Oña-Saraguro, Prov. Loja, 3000-3800 m, Dec. 1948; AJG 1084 (US) near roadside, km 15 Quito-Otavalo, moderately common, Prov. Pichincha, ca. 2200 m, 6 Aug. 1965; Benoist 3915 (P) Pifo, Prov. Pichincha, 19 Feb. 1936.

19. PUYA AEQUATORIALIS var. ALBIFLORA André, 1888 (Énumération Bromél.) p. 5; André, 1889, p. 36; Baker, 1889, p. 126.

Flower pedicels 0.9-1.5 cm long, floral bracts exceeding base of calyx, floral bracts to 2.2 cm long, setaceous, inflorescence nearly glabrous.

MATERIAL EXAMINED: Camp E-2322 (US) rocky hillsides and ravines, dry cliffs, valley of Río Paute, between Paute and Cuenca, Prov. Azuay, ca. 2200-3000 m, 1945.

PITCAIRNIA

Pitcairnia L' Hérit., 1788 (Sert. Angl.) p. 7.

Plant often with flexible leaves and a pronounced midrib. Leaves generally serrate at the sheath margins or, when a petiole is present, along its margins. Inflorescence compound or simple. Floral bracts always ecarinate. Often the flowers supported by a slender pedicel. Petals conspicuous (always more than 3.5 cm long at anthesis in Ecuadorian species) sometimes tending toward zygomorphy. Stamens always included within the corolla though usually nearly as long as the petals. Seeds usually single-appendaged at both ends. Stomata usually in dense longitudinally oriented rows and elliptic in surface view. Growing in Ecuador from near sea level to 3000 m.

KEY TO THE ECUADORIAN SPECIES OF PITCAIRNIA

1. Inflorescence compound (A)*.



A

2. Flowers NOT more than 5 per branch
 : 1. Pitc. poortmanii.
2. Flowers at least 10 per branch, usually more.
3. Flowers nodding on 4.0-6.0 cm long pedicels
 : 2. Pitc. ferruginea.
3. Flowers NOT nodding and pedicels less than
 1.0 cm long.

*

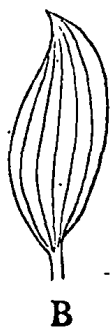
Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

4. Branch rhachis mostly glabrous, more than 1/2 of branch length with flowers, floral bracts 0.4-1.0 cm long.
5. Leaf-blade 4.0-5.0 cm wide, petals 4.0-4.5 cm long, sepals rounded : 3. Pitc. lehmannii.
5. Leaf-blade to 2.5 cm wide, petals 3.5-4.0 cm long, sepals acute : 4. Pitc. devansayana.
4. Branch rhachis tomentose, 1/2 or less of branch length with flowers, floral bracts 3-7 mm long : 5. Pitc. dendroidea.



1. Inflorescence simple (AA).

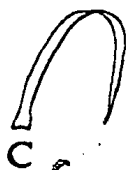
6. Leaf-blade width more than 4.0 cm, blade elliptic (B), or lingulate.



7. Inflorescence less than 25 cm long, leaf-blade 4.0-10 cm wide.

8. Sepals and flowers not obscured by floral bracts, leaf-blades ca. 10 cm broad, sepals obtuse : 6. Pitc. elliptica.

8. Sepals and flowers mostly obscured by floral bracts.

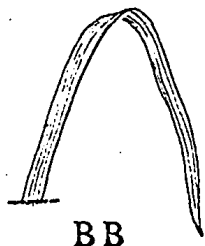


9. Sepals 5.0-6.0 cm long, leaves homomorphic (C), sepals acute-attenuate

- : 7. Pitc. macranthera.

9. Sepals 2.5-3.5 cm long, leaves dimorphic (CC).

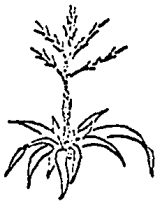
10. Floral bracts with dark base and deciduous along transverse line
. . . : 9. Pitc. pulchella var. xanthopetalon.
10. Floral bracts NOT with dark base, NOT deciduous along transverse line.
. . . : 8. Pitc. pulchella var. pulchella.
7. Inflorescence more than 25 cm long, to 60 cm or more, leaf-blades to 25 cm wide.
11. Floral bracts 5.0-6.0 cm long, sepals 3.0-4.5 cm long. : 10. Pitc. brongartiana.
11. Floral bracts to 8.0 cm long, sepals ca. 5.0 cm long. : 11. Pitc. arcuata.
6. Leaf-blade less than 4.0 cm wide, or, if more, then linear (BB), and ca. 1 m long or more.
12. Scape very short or apparently none.
13. Seeds naked, leaf-blades NOT deciduous : 12. Pitc. aphelandriflora.
13. Seeds appendaged, leaf-blades dimorphic, the larger deciduous.
. : 13. Pitc. heterophylla.
12. Scape apparent and seeds appendaged.
14. Sepals less than 1.2 cm long, inflorescence more than 1.2 cm long.
15. Scape-bracts imbricate throughout, flowers on drooping pedicels.
. : 14. Pitc. reflexiflora.



15. Scape-bracts NOT imbricate at least above,
inflorescence 20-50 cm long.
16. Petals 2.5 cm long, sepals retuse.
. : 16. Pitc. trianae var. retusa.
16. Petals 3.5 cm long, sepals obtuse.
17. Inflorescence ca. 6.0-7.0 cm in diameter,
scape-bracts densely imbricate and folia-
ceous below, only uppermost distant.
. : 15. Pitc. trianae var. trianae.
17. Inflorescence ca. 3.0 cm in diameter, scape-
bracts all distant.
. : 17. Pitc. brevicalycina.
14. Sepals more than 1.5 cm long.
18. Inflorescence dense (D), floral bracts all
imbricate.
19. Floral bracts 4.5-8.5 cm long.
20. Floral bracts reflexed toward apex of each
bract, corolla white to green.
. : 18. Pitc. brunnescens.
20. Floral bracts totally erect, corolla red or
orange.
21. Leaf-blades ca. 2.5 cm wide, petals ca. 4.0
cm long, sepals acute
. : 19. Pitc. hitchcockiana.
21. Leaf-blades to 6.0 cm or more wide, petals
7.0-8.0 cm long, sepals obtuse.



- : 20. Pitc. bakeri.
19. Floral bracts less than 4.0' cm long.
22. Pedicels 1.0-1.5 cm long, sepals 1.8 cm long. : 21. Pitc. unilateralis.
22. Pedicels to 5 mm long, sepals to 2.6 cm long.
23. Leaves 20-50 cm long, inflorescence tending to secund, sepals ecarinate.
- : 22. Pitc. sodiroi.
23. Leaves to 100 cm long, inflorescence not secund, sepals carinate.
- : 23. Pitc. nobilis.
18. Inflorescence, lax (DD), or if dense then floral bracts arching-spreading, floral bracts NOT densely imbricate.
24. Leaves 2-3 m long, petiole to 40 cm long : 24. Pitc. sceptrigera.
24. Leaves to ca. 1 m long at most, petiole, if present, 15 cm long or less.
25. Leaves 20-45 cm long.
26. Plant caulescent, leaves definitely petio- late.
27. Sepals to 3.4 cm long, pedicels not more than 6-7 mm long . . : 25. Pitc. erratica.
27. Sepals to 2.8 cm long, pedicels to 1.6 cm long. : 25. Pitc. riparia.



DD

26. Plant NOT caulescent, leaves NOT or scarcely petiolate.
28. Scape-bracts foliaceous and imbricate throughout, pedicels usually falling with flowers.
29. Outermost leaves consisting mostly of sheath, to 2.5 cm long.
 : 27. Pitc. violascens.
29. Outermost leaves with spinose blades to 7.5 cm long. : 28. Pitc. pavonii.
28. Scape-bracts NOT foliaceous and NOT imbricate throughout.
30. Floral bracts 1.0-1.5 cm long, petals naked. : 30. Pitc. oblongifolia.
30. Floral bracts 2.5-3.3 cm long, petals with basal scale. : 29. Pitc. pungens.
25. Leaves 50-100 cm long or more.
31. Leaves linear, 40-60 cm long or more by 0.8-1.6 cm wide at blade, floral bracts not exceeding 2.0 cm in length, sepals not exceeding 3.0 cm in length.
32. Inflorescence glabrous, sepals 3.0 cm long : 31. Pitc. aequatorialis.
32. Inflorescence lepidote, sepals less than 2.2 cm long. : 32. Pitc. lutescens.

31. Leaves at least 2.0 cm wide at blade, floral bracts 2.0-6.5 cm long, sepals 3.5 cm long or more.
33. Pedicels present, tricostate, petals greenish white, sepals 4.5 cm long, leaf-blade width to 2.5 cm. : 33. Pitc. costata.
33. Pedicels if present not tricostate, petals yellow-purple or orange, sepals 3.4-3.6 cm long.
34. Pedicels to 2.5 cm long, petals orange. : 34. Pitc. harlingii.
34. Flowers sessile, petals yellow and purple : 35. Pitc. nigra.

1. PITCAIRNIA POORTMANII André, 1888 (Énumération Bromél.)
p. 4; André, 1889, pp. 26-27, pl. 9b; Smith, 1957, p. 43,
fig. b.

PLANT ca. 1.5 m tall; LEAVES to 80 cm long, blade linear, apex acuminate, margins densely serrulate; SCAPE-BRACTS narrowly triangular, imbricate; INFLORESCENCE 25-30 cm long by 15 cm in diameter, bipinnate, lax, pyramidal; SPIKES 6.0-10.0 cm long, distance between spikes 2.0-3.0 cm, spikes with 3 to 5 flowers each; PRIMARY BRACTS 6-8 mm long with apices acuminate; BRANCHES 6.0-10.0 cm long by 3.5-4.0 cm wide exclusive of petals; FLORAL BRACTS 7-8 mm long tending to be secund as are the flowers; PEDICELS ca. 8 mm long, pilose; SEPALS 3.0-3.5 cm long, ecarinate, pilose; PETALS 6.0-7.0 cm long by 6-7 mm wide, red, having basal scale; OVARY 3/4 superior.

MATERIAL EXAMINED: André 1314 (K; US, photo) Ecuador.

COLOMBIA.

2. PITCAIRNIA FERRUGINEA Ruiz & Pavon, 1802 (Flora Peruviana, vol. 3) p. 36; Mez, 1935, pp. 247-248, fig. 61; Smith, 1936, pp. 526-527.

Puya echinotricha André, 1888 (Énumération Bromél.) p. 5.

PLANT to 1.5 m tall, caulescent; LEAVES to 2 m long by 3.0-5.5 cm wide at blade, marginal spines to 1.5 cm long; SCAPE-BRACTS imbricate, margins serrate; INFLORESCENCE 1 m long or more by 50 cm in diameter, bipinnate, lax, pyramidal, covered with brown tomentum; BRANCHES to 50 cm long by 5.0 cm in diameter, 20 to 30 flowers per spike; FLORAL BRACTS ca. 2.0 cm long, wide-ovate; PEDICELS ca. 6.0 cm long, flowers nodding; SEPALS to 5.0 cm long, subobtuse; PETALS twice as long as sepals, greenish-white, with 2 basal scales; OVARY ca. 2/3 superior; distance between flowers 1.5-4.0 cm; in flower April-June.

MATERIAL EXAMINED: André 7019 (K, TYPE of Puya echinotricha) western slopes of Chimborazo, at San Jose, Prov. Chimborazo, 2700 m, July.

PERU.

3. PITCAIRNIA LEHMANNII Baker, 1881 (Journ. Bot. vol. 19)
p. 273; Smith, 1957, pp. 44-45, fig. 14.

Pitcairnia orgyalis Baker, 1881 (Journ. Bot. vol. 19)
p. 273.

PLANT 1-2 m tall; LEAVES 100-120 cm long, blades 4-5 cm wide, petiolate, petiole 3-24 cm long, sheath with margins conspicuously serrate; SCAPE erect, ca. 8-9 mm in diameter, red; SCAPE-BRACTS mostly imbricate, erect; INFLORESCENCE 25-35 cm long by 15-20 cm in diameter, bipinnate, glabrous; SPIKES 15-35 cm long by 3.0 cm wide exclusive of petals, ascending, one half or more of branch length with 30 to 60 flowers, elliptic, glabrous; PRIMARY BRACTS much shorter than sterile base of branch, no sterile bracts on the 7-9 cm long stipe; FLORAL BRACTS 3-7 mm long by 2 mm wide, green, glabrous, all shorter than pedicels except near branch apex, apex obtuse, ecarinate; PEDICELS 0.6-1.2 cm long; SEPALS 1.3-1.5 cm long by 3-4 mm wide, linear, strongly nerved, apex rounded, red, glabrous; PETALS 4.0-4.5 cm long by 3 mm wide, red, with 2 basal scales, these ca. 5 mm long; OVARY ca. 3/4 superior; distance between flowers 4-7 mm.

MATERIAL EXAMINED: Lehmann s. n. (K, TYPE; US, photo) Colombia; Asplund 19355 (US) roadcut, midway between Mera and Cashurco, Prov. Napo Pastaza, 1200 m, 13 Feb. 1956; Spruce 5399 (K, TYPE of Pitc. orgyalis Baker; US, photo) Ecuador.

COLOMBIA.

4. PITCAIRNIA DEVANSAYANA André, 1888 (Énumération Bromél.)
p. 4; André, 1889, p. 25, pl. 8, fig. g.

PLANT poorly known as a whole; LEAVES ca. 60 cm long, blades 1.5-2.5 cm wide, subglabrous, leaf-sheath margins and basal portion of the leaf-blade margins with curved spines, subpetiolate; SCAPE ca. 8-10 mm in diameter; SCAPE-BRACTS imbricate; INFLORESCENCE bipinnate with branches ca. 5.0 cm apart; BRANCHES to 25 cm long, few, suberect; FLORAL BRACTS 6-10 mm long, always slightly shorter than the pedicels, wide-ovate, apex acute; PEDICELS 7-12 mm long; SEPALS 1.2-1.5 cm long, ecarinate, apex acute; PETALS ca. 3.5-4.0 cm long by 5 mm broad with a basal scale; OVARY ca. 6 mm long, nearly totally superior, flowers in July-Sept.

MATERIAL EXAMINED: André 4700 (K, TYPE) no specimen or type photo seen, examined André, 1889, illustrations; south of Mt. Chimborazo, Prov. Chimborazo, ca. 2000 m.

5. PITCAIRNIA DENDROIDEA André, 1888 (Énumération Bromél.)
p. 4; Smith, 1957, p. 43.

Pitcairnia commixta L. B. Smith, 1949, (Contrib. U.S.
Nat. Herb. vol. 29) p. 303.

Pitcairnia orgyalis sensu André ex Mez, 1896, p. 412.

PLANT 1-2 m tall; LEAVES 100-140 cm long, blade 3-5 cm wide, pale green, subpetiolate, apparently glabrous below, loose scales above, sheath-margins serrulate; SCAPE ca. 1.0 cm in diameter; INFLORESCENCE 30-50 cm long by 28 cm wide, bipinnate, pyramidal, flocculose; BRANCHES 15-20 cm long by 3-5 cm wide, ascending, 25 to 40 flowers densely disposed on apical third or less of branches; PRIMARY BRACTS 3-5 cm long, ascending, margins entire to serrulate; FLORAL BRACTS 3-6 mm long by 1-2 mm wide, linear-ovate, lepidote but turning glabrous soon, not nerved, apex obtuse; PEDICELS 4-7 mm long; SEPALs 1.6-1.8 cm long by 3-4 mm wide, linear-ovate, nerved, ecarinate, coriaceous toward apex; PETALS 3.5-4.0 cm long by 4-5 mm wide, yellow or orange with two scales 4-6 mm long; OVARY 1/2 to 3/4 superior; distance between flowers less than 2 mm.

MATERIAL EXAMINED: André 3361 (K; TYPE; US, photo)
Colombia; André 3747 (K, TYPE of Pitc. commixta L. B. Smith;
US, photo) Montaña Corazon, along Río Silante, Prov. Pichincha,
2500 m, June; Asplund 8665 (US) Saloya, 7 km toward Quito,
Prov. Pichincha, 2500 m, 11 Sept. 1939; Asplund 16169 (US)
below San Juan towards Chiriboga, west of Quito, Prov.

Pichincha, 2300 m, 3 May 1955; Foster 2647 (US) road between Quito and Santo Domingo, on rocks, Prov. Pichincha, 2600 m, 8 Dec. 1948; Rauh, Hirsch E159 (US) above Santo Domingo, Prov. Pichincha, 2000 m, 9 Sept. 1954; Acosta Solís 14023 (F) Saloya, Prov. Pichincha, ca. 3000 m, 13 Sept. 1949; Sodiro 171/9 (GH) Montaña El Corazon, along Río Silante, Prov. Pichincha, ca. 2500 m, no date; Naundorff s. n. (Bromél. Soc. Inc., photo) Tandapi, Pilatoñ Valley, Prov. Pichincha.

COLOMBIA.

NOTES: The taxa, Pitcairnia dendroidea André and Pitcairnia commixta L. B. Smith, which are based on the type specimens, André 3361 and André 3747 respectively are to me indistinguishable. Therefore, since Pitcairnia dendroidea André was published in 1888 this is the correct name for the species. The type is André 3361 from Colombia rather than André 3747, the type of Pitcairnia commixta, nomen nova for the illegitimate name, Pitcairnia orgyalis sensu, André ex Mez, 1896.

6. PITCAIRNIA ELLIPTICA Mez & Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 624.

PLANT as a whole poorly known, base of plant forming a pseudobulb 7.5 cm long; LEAVES with pronounced elliptical blade, blade 19 cm long by 10 cm wide with an apiculate apex, petioles ca. 40 cm long by ca. 8 mm wide; SCAPE erect; SCAPE-BRACTS distant, not at all imbricate, margins entire; INFLORESCENCE to 11 cm long by 2.0-2.5 cm in diameter, dense with ca. 30 flowers, simple; FLORAL BRACTS ca. 5 mm long, erect to spreading, apex acute; PEDICELS to 5 mm long; SEPALS 1.2 cm long, obtuse, not carinate; PETALS pale red or yellow in dry specimen, no basal scales; OVARY ca. 3/4 superior.

MATERIAL EXAMINED: Sodiro 171/14 (B, TYPE; US, photo) along Río Toachi, Prov. Pichincha, 800-1200 m.

7. PITCAIRNIA MACRANTHERA André, 1888 (Énumération Bromél.)
p. 5; André, 1889, p. 29, pl. 9, fig. f; Smith, 1957, pp.
62-63.

PLANT ca. 1 m tall, caulescent; LEAVES 50-100 cm long, blades 5.0-10.0 cm wide, homomorphic, petiole pronounced, to 25 cm long with its margins strongly serrate, spines 2-4 mm long, apex of blade acuminate; SCAPE ca. 80 cm long, erect; SCAPE-BRACTS imbricate, strict, green; INFLORESCENCE 15-20 cm long by 3-5 cm in diameter, axis lepidote, simple, lax; FLORAL BRACTS 4-5 cm long with serrulate margins; PEDICELS short and slender; SEPALS 5.5 cm long by 1.8 cm wide, apex acute; PETALS 10-12 cm long, white, with a single scale at the base; OVARY nearly totally superior, distance between flowers ca. 1.0 cm.

MATERIAL EXAMINED: André 2593 (K, TYPE; US, photo)
Colombia; Acosta Solis 12552 (F) Prov. Pichincha.

COLOMBIA.

PITCAIRNIA PULCHELLA Mez, 1896 (Monogr. Phaner. vol. 9)
p. 459.

PLANT ca. 50 cm tall; LEAVES up to 45 cm long, petiole pronounced, 8-15 cm long by 2 mm wide, gradually transcending into blade, blade 15-30 cm long by 4-7 cm wide; SCAPE erect, ca. 25 cm long by 8 mm in diameter; SCAPE-BRACTS imbricate throughout, 2-16 cm long with soft spines on margins; INFLORESCENCE 8-15 cm long by 3.5-4.5 cm in diameter, simple, dense; FLORAL BRACTS 3-4 cm long by 0.9-1.5 cm wide, erect, deciduous or not, papery, apex attenuate; SEPALs 3.0-3.5 cm long by 0.9-1.0 cm wide, slightly carinate; apex attenuate; PETALS 5-6 cm long, with basal scales; OVARY nearly completely superior, in flower in May.

8. PITCAIRNIA PULCHELLA var. PULCHELLA

Leaf blades to 6 cm wide, floral bracts concolorous, not deciduous, to 1.5 cm wide.

MATERIAL EXAMINED: Lehmann 4466 (K, TYPE; US, photo) Ecuador; Couthouy s. n. (GH) Quitensian Andes, 1855; Steyermark 52770 (GH) "rich woods on forested slopes bordering Río Patul," between Sanguinand and Chacanceo, Hacienda Yacopiana, Prov. Azuay, 1150 m, 30 May 1943.

9. PITCAIRNIA PULCHELLA var. XANTHOPETALON Gilmartin var. nov.

A var. pulchella bracteis florigeris angustioribus, deciduis; laminis latioribus differt.

This variety differs from the variety pulchella in the

somewhat wider leaf blades and in the floral bracts having a conspicuous dark base with a transverse line near the base along which the bracts are deciduous. This latter character shows that the new variety also has some affinity to Pitcairnia ferreyrae L. B. Smith. However, the majority of its characteristics indicate that this variety, var. bobetalon, is most closely allied to Pitcairnia pulchella.

MATERIAL EXAMINED: Penland and Summers 230 (GH, TYPE) along Canelos trail near Hacienda Victoria, Prov. Tungurahua, 1230 m, March-August, 1939.

10. PITCAIRNIA BRONGNIARTIANA André, 1888 (Énumération Bromél.)
p. 5; Smith, 1957, p. 64.

Pitcairnia brongniartiana var. latifolia L. B. Smith,
1959 (Phytologia vol. 6) p. 438.

PLANT ca. 1.0-1.5 m tall; LEAVES 60-80 cm long with
blade 6-15 cm wide, a distinct petiole spiny toward the base;
SCAPE erect, at least 1 cm in diameter; SCAPE-BRACTS imbricate,
strict; INFLORESCENCE 30-70 cm long by 10-14 cm wide, dense,
simple; FLORAL BRACTS 5-6 cm long by ca. 2.5 cm wide, spreading
after anthesis, nerved, apex attenuate; SEPALS 3.5-4.5 cm long
by ca. 10 mm wide, acute; PETALS 7-8 cm long, white; OVARY
nearly totally superior; CAPSULE not exceeding the sepals.

MATERIAL EXAMINED: André 3394 (K, TYPE; US, photo)
Colombia; Asplund 18408 (US) epiphytic, forest near Mangayacu,
Mera, Prov. Napo Pastaza, ca. 1100 m, 14 Nov. 1955; Asplund
18474 (US) epiphytic, forest towards Puyo, Mera, Prov. Napo
Pastaza, ca. 1000 m, 17 Nov. 1955.

COLOMBIA.

11. PITCAIRNIA ARCUATA (André) André, 1888 (Énumération Bromél.) p. 5; Smith, 1957, p. 67.

Neumannia arcuata André, 1886 (Revue Hortic., vol. 58) p. 108, pl.

PLANT to 1 m tall, short-caulescent; LEAVES to 1 m long with blade ca. 25 cm wide, apex acute to acuminate, petiole distinct with serrate margins toward the base; SCAPE at least 1 cm in diameter; SCAPE-BRACTS to 25 cm long, imbricate; INFLORESCENCE to 30 cm long by 2.5-3.0 cm in diameter, dense, cylindric, simple, rhachis with brown indumentum; FLORAL BRACTS 8.0 cm long by 3.0 cm wide, papery, lepidote, apex acute to attenuate, elliptic, red; PEDICELS to 10 mm long; SEPALS 5.0 cm long by 1.2 cm wide, coriaceous, carinate, dark brown in dry specimen, red when alive; PETALS ca. 7.5 cm long, with two very obvious scales; OVARY nearly totally superior, flowers in March to May.

MATERIAL EXAMINED: André 3803 (K, TYPE; US, photo) Colombia; AJG 619 (US) terrestrial, rainforest 3 km from Puyo, Prov. Napo Pastaza, ca. 600 m, 6 March 1962.

COLOMBIA.

12. PITCAIRNIA APHELANDRIFLORA Lem., 1869 (Illust. Hortic. vol. 16) p. 90; Mez, 1935, pp. 221-222; Smith, 1952, p. 28.
Pepinia aphelandriflora André, 1870 (Illust. Hortic. vol. 17) p. 32, pl. 5.

PLANT ca. 30 cm tall; LEAVES ca. 30 cm long, blades 0.7 cm wide, narrow, linear, homomorphic, not deciduous, apex long acute to caudate, minutely serrulate; INFLORESCENCE to 10 cm long, dense, simple; SCAPE very short, not apparent; FLORAL BRACTS wide-ovate, serrulate, apex acute; SEPALS to 1.5 cm long, ecarinate, ovate-elliptic; PETALS to 5.3 cm long, naked, exceeded by the stamens; OVARY ca. 1/2 superior, seeds naked.

MATERIAL EXAMINED: Camp E-1238 (NY; US, photo) flood plain of Río Itzintza, Cordillera Cutucú, Prov. Zamora, 1100-1200 m, ca. Nov.-Dec. 1944.

BRAZIL.

13. PITCAIRNIA HETEROPHYLLA (Lindl.) Beer, 1857 (Bromeliaceen)
p. 68; Smith, 1957, pp. 46-47, fig. 15.

FIG. 9

Puya heterophylla Lindley, 1840 (Bot. Reg. vol. 26) pl.
71.

PLANT 5-10 cm tall, growing in tight clumps of many individuals; LEAVES 60-70 cm long, blades 1.0-1.5 cm wide, pale-flocculose beneath but becoming glabrous, drooping, heteromorphic, outer leaves reduced to very sharply spinose blades, these to ca. 12 cm long, long leaves deciduous at transverse line just above the base, sheaths dark castaneous; SCAPE to 4.0 cm long by 3.0-4.0 cm wide, dense, simple, erect, red, subglabrous, with 3 to 12 flowers; FLORAL BRACTS ca. 2.5 cm long by 1.3 cm wide, erect, ovate, red, apex attenuate, loose brown scales on outer surface towards margins, nerved, ecarinate; PEDICELS ca. 3 mm long; SEPALS 3.0-4.0 cm long by 4 mm wide, erect, narrowly triangular, carinate, nerved, apex sharp-attenuate, surface brown-lepidote; PETALS 5.5-6.0 cm long by ca. 5 mm wide, erect, with two basal scales; OVARY ca. 1/2 superior, 8-9 mm long; stigma exceeding anthers, distance between flowers less than 2 mm, flowers June-August.

MATERIAL EXAMINED: Steiermark 52880 (GH) steep forested slopes bordering Río Norcay between Río Gamolotal and Río Norcay, Prov. Azuay, 1095-1370 m, 7 June 1943; AJG 926 (US) ca. km 100 Guayaquil-Cuenca, road-cut, common, plant with flowers but no long leaves collected July, leaves appeared

early the next year, Prov. Cañar, ca. 1800 m, July 1963; AJG 1168 (US) km 128 Cuenca-Guayaquil, terrestrial, moderately common, Prov. Cañar, 2000 m, 13 Aug. 1965; Hitchcock 20681 (US) between Huigra and Naranjapata, Prov. Chimborazo, 600-1200 m, 17 July 1923; Camp E-3888 (US) Cañon of the Río Chanchan between Naranjapata and Huigra, rocky outcrops, Prov. Chimborazo, 600-1000 m, 19 June 1945; Rose & Rose 22155 (US) Hacienda de Licay, near Huigra, Prov. Chimborazo, ca. 1000 m, 17 Aug. 1918; Acosta Solis 5395 (F) Hacienda La Carmela, Sibambe, Prov. Chimborazo, 2000 m, 18 Aug. 1943; Asplund 18136 (US) slope towards Portovelo, between San Pedro and Portovelo, Prov. Loja, 2300 m, 13 Oct. 1955; Harling 6136 (US) terrestrial, between San Pedro and Zaruma, Prov. Loja, 29 July 1959; Espinosa E-1888 (US) just up from Güishagüiña, east of Zaruma, Guapacasa, Prov. Loja, 1180 m, 30 Aug. 1947; Espinosa 595 (GH) Catacocha, Prov. Loja, 4 July 1946; Haught 3421 (US) epiphyte just south of Mocoa, Prov. Manabí, 120 m, 23 July 1942; Steyermark 53846 (GH) wooded slopes, bordering Quebrada Nudillo and Quebrada Tambillo, northeast of Curtincapa, Prov. El Oro, 1615-1890 m, 13 Aug. 1943.

SOUTHERN MEXICO TO PANAMA, VENEZUELA, COLOMBIA, PERU.

NOTES: The specimen collected on the coast by Haught in the Province of Manabí is suspected of having been spread by Ecuadorians visiting from the sierra. Haught has not indicated this in any way, but I have strong suspicions that it may have arrived in Manabí with the conscious help of man. It is an

exceedingly attractive plant both when in flower and without leaves as well as when in leaf without flowers. I have successfully grown it in Guayaquil with almost no care.

14. PITCAIRNIA REFLEXIFLORA André, 1888 (Énumération Bromél.)
p. 4; André, 1889, pp. 18-19, pl. 8, fig. b.

PLANT as a whole poorly known; LEAVES to 80 cm long, blades 2.5-3.0 cm wide, homomorphic, petiole to ca. 10 cm long, margins entire; SCAPE erect; SCAPE-BRACTS imbricate, having filiform apices; INFLORESCENCE 10-15 cm long, dense, simple; FLORAL BRACTS 1.5-2.0 cm long, apex acute to attenuate, linear; PEDICELS 5-9 mm long, drooping; SEPALS 1.0 cm long, obtuse, sublinear; PETALS ca. 2.5 cm long, naked; OVARY ca. 3/4 superior, flowers July-September.

MATERIAL EXAMINED: André 4334 (K, TYPE; US, photo) south of Riobamba, Prov. Cañar.

PITCAIRNIA TRIANAE André, 1888 (Énumération Bromél.) p. 4;
André, 1889, pp. 17-18, pl. 8 a; Smith, 1957, pp. 23-24.

PLANT to 2 m tall; LEAVES to 120 cm long by ca. 4.0 cm wide at blade, sheaths dark castaneous, blades linear, base spinose, subpetiolate; SCAPE erect; SCAPE-BRACTS strict, narrowly triangular, upper bracts not imbricate; INFLORESCENCE 30-50 cm long, 6.0-7.0 cm in diameter, dense, simple, with rhachis lepidote; FLORAL BRACTS 0.7-1.5 cm long, lanceolate, apex acute; PEDICELS 0.8-1.0 cm long, slender; SEPALS 0.8-1.1 cm long, apex obtuse to retuse; PETALS 2.5-4.5 cm long, white or yellow, naked; OVARY ca. 3/4 superior; distance between flowers 0.5-1.0 cm.

15. PITCAIRNIA TRIANAE var. TRIANAE

Sepal apex obtuse, petals 3.5-4.5 cm long.

MATERIAL EXAMINED: André 2069 (K; US, photo) Colombia.

16. PITCAIRNIA TRIANAE var. RETUSA L. B. Smith, 1948 (Lloydia vol. 11, no. 4) p. 305.

The variety retusa differs from the variety trianae in the apex of the sepals being retuse and the size of the petals which are not longer than 25 mm.

MATERIAL EXAMINED: Steyermark 54461 (GH, TYPE; US, photo) between Tambo Cachiyacu and Nudo de Sabinillas, Prov. Loja, 2500-3500 m, 7 Oct. 1943.

17. PITCAIRNIA BREVICALYCINA Mez, 1919 (Fedde, Repert spec. nov. vol. 16) p. 9; Mez, 1935, pp. 257-258, Smith, 1936, p. 522.

FIG. 10

PLANT to over 1 m tall; LEAVES 80-130 cm long, blades 3.5-5.0 cm wide, margins entire or with soft, pliable spines; SCAPE to 120 cm long by 1.1-1.2 cm in diameter, erect; SCAPE-BRACTS much shorter than the internodes, margins spiny; INFLORESCENCE 20-40 cm by ca. 3.0 cm in diameter exclusive of petals, erect, cylindric, simple, with ca. 75 flowers; FLORAL BRACTS 5-9 mm long by 2 mm wide, spreading, not nerved; PEDICELS ca. 6-8 mm long, slender; SEPALS ca. 10 mm long by 4 mm wide, erect, apex obtuse, ecarinate; PETALS ca. 3.5 cm long, naked; OVARY more than 3/4 superior; CAPSULE 1.2 cm by 1.0 cm; the apical 3.0 cm of the inflorescence with the flowers drooping early and not producing capsules; distance between flowers 6-9 mm; in capsule in August.

MATERIAL EXAMINED: Weberbauer 6825 a (B, TYPE; US, photo) Peru; AJG 1137 steep slopes, rocks and loose dirt, rainforest, moderately abundant, km 25 Loja-Zamora, Prov. Loja, 2600 m, 11 Aug. 1965.

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18. PITCAIRNIA BRUNNESCENS L. B. Smith, 1959 (Contrib. U.S. Nat. Herb. vol. 29) p. 300, fig. 22; Smith, 1957, pp. 63-64.

PLANT 1 m tall or more with branched stem; LEAVES to 150 cm long, blades 4.0-7.0 cm wide, linear, homomorphic, petiolate to subpetiolate, petiole bearing dark spines ca. 5 mm long, sheath 0.9-1.0 cm broad, reddish brown with serrate margins; SCAPE ascending; SCAPE-BRACTS densely imbricate, the lower foliaceous, the upper elliptic, apex acute, serrate, pale-flocculose, INFLORESCENCE 20-35 cm long by 7.0-9.0 cm in diameter, dense, simple; FLORAL BRACTS 7.5-8.5 cm long by 2.5-3.0 cm wide, erect, imbricate, apices spreading to reflexed at anthesis, bases brown-flocculose; PEDICELS very short and inconspicuous; SEPALs 4.0-4.5 cm long, triangular, attenuate, glabrous, green except for the dark brown apex; PETALS 9.0-10.0 cm long by ca. 2 cm wide, white to green, naked; OVARY nearly totally superior; flowers ca. November-February.

MATERIAL EXAMINED: Foster & Foster 2010 (US, TYPE) Colombia; Asplund 9722 (US) between Garretas and bridge below Garretas over the Río Pilatón, Prov. Pichincha, 2200-2400 m, 7 Nov. 1939; Asplund 19060 (US) between El Paso and El Volante, road between Chiriboga and Santo Domingo, on a cliff, Prov. Pichincha, ca. 2200 m, 20 January 1956.

COLOMBIA.

19. PITCAIRNIA HITCHCOCKIANA L. B. Smith, 1954 (Phytologia, vol. 5, no. 2, pp. 44-46, pl. 6, figs. 1-3.

PLANT 50-60 cm tall; LEAVES ca. 80 cm long, blades entire, linear and ca. 2.5 cm wide, sheath 3.0-4.0 cm long, brown, petiole ca. 1.0 cm wide, channeled; SCAPE ca. 5 mm in diameter; SCAPE-BRACTS imbricate, erect, foliaceous; INFLORESCENCE ca. 10 cm long by 3.0 cm in diameter, simple, dense, ellipsoid; FLORAL BRACTS 4.5-5.0 cm long by ca. 2 cm wide, elliptic, apex acute, red, imbricate, ecarinate, nerved; PEDICELS ca. 2 mm long, obconic; SEPALS ca. 1.8 cm long, acute, brown-flocculose, the two posterior carinate; PETALS ca. 4.0 cm long, red, with white margins, having basal scales; OVARY nearly totally superior, in flower November-February.

MATERIAL EXAMINED: Hitchcock 21816 (US, ISOTYPE) eight hours walk east of Baños, between Baños and Cashurco, Pastaza river valley, Prov. Tungurahua, 1300-1800 m, 25 Sept. 1923.

Not seen: Prescott 494 (NY) on moist cliff, 12 km east of Baños, above Río Pastaza, Prov. Napo Pastaza, 15 Feb. 1953.

20. PITCAIRNIA BAKERI (André) Mez, 1896 (DC Monogr. Phaner. vol. 1) p. 460; emend Smith, 1948 (Caldasia no. 5) p. 4, fig; Smith, 1957, pp. 67-68, fig. 22.

Quesnelia bakeri André, 1888 (Énumération Bromél.) p. 4; André 1889, p. 16, pl. 7.

PLANT caulescent, 1.8-2.4 m tall, stem ca. 2 cm in diameter, prostrate; LEAVES to 1.2 m long, blade ca. 8.0 cm in width, petioles 0.5-1.3 cm wide, spiny; SCAPE 1.0-1.5 cm in diameter, erect; SCAPE-BRACTS densely imbricate; INFLORESCENCE 17-35 cm long by 6.0-7.0 cm in diameter, simple, dense; FLORAL BRACTS 5.0 cm long by 2.5-3.0 cm wide, rugose in transverse bands, flowers sessile; SEPALs 4.0 cm long by 1.5-2.0 cm wide, obtuse; PETALS 7.0-8.0 cm long, cucullate, orange, having a basal scale; OVARY ca. 1/2 superior, flowers around Nov. to Feb.

MATERIAL EXAMINED: André 3391 (K, TYPE; illustrations in) (André 1889) Colombia; Asplund 10309 (US) near Urcusiqui, Cordillera Guacamayo, Prov. Napo Pastaza, 1500-2000 m, 10 Jan. 1940; Asplund 18676 Mera, in forest near Mangayacu, epiphytic in Miconia tree, Prov. Napo Pastaza, 1100 m, 28 Nov. 1955.

COLOMBIA.

21. PITCAIRNIA UNILATERALIS L. B. Smith, 1961 (Phytologia vol. 8, no. 1) pp. 11-12, pl. 1, figs. 21-23.

PLANT ca. 60 cm tall, growing in pendent clumps; LEAVES ca. 110-200 cm long, blades 2.2 cm wide, margins entire, glabrous above, covered below with whitish membrane of coalesced scales; SCAPE unknown; INFLORESCENCE ca. 50 cm long by 3.0 cm in diameter exclusive of petals, simple, having ca. 100 flowers; FLORAL BRACTS ca. 1.5 cm long by 4 mm wide, secund on the axis, triangular; PEDICELS 1.0-1.5 cm long, slender; SEPALS ca. 1.8 cm long, narrowly triangular, acute, carinate toward base; PETALS ca. 6.0 cm long, yellow, with crenate scale at base; OVARY less than 1/2 superior, flowers around April.

MATERIAL EXAMINED: Harling 4785 (US, ISOTYPE) river-side rocks, pendent in large clumps, along the Río Daule, Hacienda Santa Barbara, Prov. Guayas, ca. 50 m, 18-26 April 1959.

22. PITCAIRNIA SODIROI Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 622; Mez, 1934, p. 238.

PLANT 60-100 cm tall; LEAVES 30-50 cm long, blades 1.5-2.0 cm wide, petioles ca. 8 cm long by 4 mm wide, serrate, sheath dark, blade entire; SCAPE ca. 4 mm in diameter; SCAPE-BRACTS 4.0-7.0 cm long with serrate margins, imbricate throughout, strict; INFLORESCENCE 10-15 cm long by 3.0 cm in diameter, simple, dense, slightly lepidote, approaching secund; FLORAL BRACTS 1.4-2.0 cm long by 8-9 mm wide, triangular, pale; PEDICELS to 5 mm long; SEPALS 2.0-2.5 cm long by ca. 4 mm wide, ecarinate, attenuate; PETALS 6.0-7.0 cm long, red-orange, with two basal scales; OVARY ca. 3/4 superior; distance between flowers 4-7 mm; stamens scarcely included in the petals, in flower ca. July-August.

MATERIAL EXAMINED: Sodiro 171/10 (B, TYPE; US, photo) several localities given, Corazon, Puluahua and Mt. Pichincha, Prov. Pichincha, no date; Acosta Solís 11005 (US) Ecuador; Acosta Solis 14024 (F) Saloya, Prov. Pichincha, ca. 3000 m, 13 Sept. 1949; Asplund 16715 (US) Guarumal, steep shrubby slope, Prov. Pichincha, 2150 m, 1 July 1955.

23. PITCAIRNIA NOBILIS Mez & Sodiro ex Mez, 1904 (Bull. Herb. Boiss, series 2, vol. 4) p. 623; Mez, 1934, pp. 238-239.

PLANT probably ca. 80 cm tall; LEAVES to 100 cm long, blades ca. 2.0 cm wide, margins entire, petiole ca. 20 cm long; SCAPE unknown; SCAPE-BRACTS imbricate; INFLORESCENCE ca. 30 cm long by 4.0 cm in diameter exclusive of petals, having ca. 25 flowers, axis densely tomentose; FLORAL BRACTS 1.8 to 3.0 cm long, apex attenuate; PEDICELS not exceeding 5 mm in length; SEPALS ca. 2.6 cm long, triangular, acute, subcoriaceous, carinate; PETALS ca. 7 cm long, with basal scale; OVARY ca. 3/4 superior.

MATERIAL EXAMINED: Sodiro 171/11 (B, TYPE; US) near Pangor, northwest of Guamote, Prov. Chimborazo, Oct. 1886.

24. PITCAIRNIA SCEPTRIGERA Mez, 1906 (Fedde Repert., vol. 3) p. 7; Mez, 1935, p. 276.

Pitcairnia campii L. B. Smith, 1952 (Memoirs N. Y. Bot. Gard. vol. 8, no. 1) p. 28, fig. 1, j-k.

FIG. 11

PLANT ca. 3 m tall; LEAVES to 3 m long, blades 5.0 cm wide, dimorphic, petiole to 40 cm long, its margins spiny, sheath 20 cm long; SCAPE erect to 2.0 cm in diameter; SCAPE-BRACTS imbricate, erect, spiny margined; INFLORESCENCE 2.0-3.0 cm in diameter, cylindric, simple, flocculose; FLORAL BRACTS to 6.0 cm long, apex acute to attenuate, erect or spreading slightly at apex; FLOWERS sessile; SEPALS ca. 2.8 cm long, narrowly ovate, ecarinate; PETALS ca. 7.0 cm long, yellow, naked; OVARY nearly totally superior, distance between flowers ca. 1.0 cm, in flower June-August.

MATERIAL EXAMINED: Eggers 16061 (F, ISOTYPE) El Recreo, Prov. Manabí, 50 m, 4 Aug. 1893; Camp E-3661 (US, TYPE of Pitc. campii L. B. Smith) steep banks and cliffs, near Bucay, near junction of 4 Provinces probably in Prov. Guayas, 300-400 m, 15-18 June 1945; Foster 2646 (US) Quito-Santo Domingo road, Prov. Pichincha, ca. 1000 m, 8 Dec. 1948.

NOTES: Pitcairnia campii was distinguished from Pitcairnia sceptrigera on the basis of the former possessing serrate petioles. Mez's description of Pitcairnia sceptrigera indicates that the petioles are entire. However examination of

the photograph of the type specimen of Pitc. sceptrigera shows that the petioles are serrate. It does not seem possible to distinguish the type specimens of these two species. Therefore, I am reducing Pitc. campii L. B. Smith to taxonomic synonymy under the earlier Pitc. sceptrigera Mez.

25. PITCAIRNIA ERRATICA L. B. Smith, 1948 (Lloydia vol. 11)
p. 305, fig. 3.

PLANT 35-45 cm tall, caulescent, stem or stolon ca. 1.0 cm in diameter; LEAVES 25-30 cm long, blades 1.5-2.5 cm wide, dimorphic, short spiny leaves persistent, longer leaves petiolate and deciduous along a transverse line just above the petiole; SCAPE slender ca. 3 mm in diameter, erect, white flocculose; SCAPE-BRACTS imbricate, strict, with margins entire; INFLORESCENCE 9.0 cm long by 3.2 cm in diameter exclusive of petals, simple, cylindric, with ca. 8 flowers; FLORAL BRACTS 2.0-2.4 cm long, apex attenuate, ovate; PEDICELS 4-7 mm long, slender; SEPALS 3.3-3.4 cm long, glabrous, eciliate; PETALS 6.5 cm long, naked, red; OVARY 3/4 superior, distance between flowers ca. 9 mm.

MATERIAL EXAMINED: Steiermark 54599 (US, ISOTYPE) epiphytic on tree trunk, wooded slopes along Río Valladolid, between Quebrada Honda and Tambo Valladolid, Prov. Zamora, 2000-3000 m, 12 Oct. 1943.

26. PITCAIRNIA RIPARIA Mez, 1913 (Fedde Repert. spec. nov. vol. 12) p. 416.

FIG. 12

PLANT to 50 cm tall, caulescent; LEAVES 25-40 cm long, blades 2.0-3.0 cm wide, dimorphic, the short persistent leaves, spiny and to 5 cm long, the long leaves deciduous along a transverse line above the petiole; SCAPE 3-4 mm in diameter, curved to erect; SCAPE-BRACTS erect, imbricate; INFLORESCENCE 9.0-12.0 cm long by 3.0-3.4 cm in diameter exclusive of the petals, flowers tending to be secund; simple, cylindric; FLORAL BRACTS 2.0-2.8 cm long by 0.9-1.2 cm wide, ecarinate, strongly to obscurely nerved, ovate, red; PEDICELS 0.8-1.5 cm long; SEPALS 2.7-2.8 cm long by 4-5 mm wide, strongly nerved, ecarinate, acute to attenuate, linear-elliptic; PETALS to 7.5 cm long, red, naked; OVARY at least 3/4 superior, distance between flowers 0.5-1.5 cm, flowers January-April.

MATERIAL EXAMINED: Weberbauer 6156 (B, TYPE; US, photo) by Río Tabacoñas, 900-950 m, Peru; Harling 3845 (US) Choco, at Río Quijos, along trail, Prov. Napo Pastaza, near Borja, 700 m, 15-26 Jan. 1959; Harling 3881 (US) along trail, near Borja, by Río Quijos, epiphytic, ca. 700 m; Vidal-Sénége s. n. (P) "humid region" Ecuador, Feb. 1877; AJG 1099 on steep cliffs above Río Negro, very common, just south of Baños, Prov. Tungurahua, 1600 m, 7 Aug. 1965, in capsule.

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27. PITCAIRNIA VIOLASCENS L. B. Smith, 1959 (Phytologia vol. 6, no. 8) p. 439, pl. 2, fig. 12.

PLANT 60-70 cm tall, having erect leaf-rosette; LEAVES 36-43 cm long, blades 1.6 cm wide, linear, apex attenuate, leaves dimorphic, outermost consisting of very spiny short, to 2.5 cm long, narrow blades from dark sheaths; subpetiolate; sparsely lepidote on lower surface; scape 3-5 mm in diameter, erect, glabrous; SCAPE-BRACTS erect, longer than the internodes but because of narrowness of blade exposing the scape; INFLORESCENCE ca. 26 cm long by 9 cm in diameter, lax, ca. 16 flowers per inflorescence, simple; FLORAL BRACTS 33-36 mm long by 12-14 mm wide, nerved, spreading, apex acute to attenuate; PEDICELS ca. 2.0 cm long, slender; SEPALS 2.7 cm long by 4 mm wide, nerved, acute; PETALS 7.5-8.5 cm long, lobed, and 0.9-1.0 cm wide, naked; OVARY 6-7 mm long, 3/4 superior; distance between flowers 8-12 mm; flowers in February.

MATERIAL EXAMINED: Asplund 15471 (S, TYPE; US, photo and flower fragments) steep rocky slopes below the town of Huigra, Prov. Chimborazo, ca. 1000 m, 20 Feb. 1955.

28. PITCAIRNIA PAVONII Mez, 1896 (DC Monogr. Phaner., vol. 9)
p. 386.

FIG. 13

PLANT ca. 40 cm tall with a pseudobulbous base 5.5 cm by 5.5 cm; LEAVES 20-40 cm long, blades 2.0-3.0 cm wide, dimorphic, the outer short, persistent, leaves spiny and ca. 7.5 cm long, the long leaves deciduous along a transverse line just above the sheath, sheath light brown; SCAPE 3-5 mm in diameter, erect; SCAPE-BRACTS 2.5-17.0 cm long, imbricate throughout, erect but not strict; INFLORESCENCE 12-25 cm long, simple, 2.5-3.0 cm in diameter, densely tomentose at anthesis, erect, with 20-30 flowers; FLORAL BRACTS 2.0-3.0 cm long by 0.6-1.0 cm wide, ecarinate, obviously nerved, densely tomentose within, apex attenuate, green; PEDICELS 3-7 mm long, falling with the flowers; SEALS ca. 2.5 cm long by 5-6 mm wide, carinate, strongly nerved, apex attenuate; PETALS ca. 5.5 cm long by 6 mm wide, red, with a scale which reaches 5-6 mm from the petal base; OVARY superior, distance between flowers 5-7 mm, stigma in surface view definitely elliptic.

MATERIAL EXAMINED: Pavón s. n. (B, TYPE; US, photo) "near Guayaquil"; Firmin 387 (US) Quebrada near Cruz Verde, Prov. Pichincha, 2700 m (altitude interrogated by collector) 12 January 1928; Asplund 8178 (US) valley of Río Llangama near Guaranda, cliff face, Prov. Bolívar, 2800 m, 12 August 1939; Jameson s. n. (US) Ecuador; Camp E-2172 (US) near Giron, pass between headwaters of the Ríos Tarqui (Atlantic drainage)

and the Giron (Pacific drainage) nudo de Portete, Prov. Azuay, ca. 3000 m, 10 March 1945; Fosberg & Giler 22601
Cañon of Río Sibambe, affluent of Río Chanchan, Prov. Chimborazo, 2460-2550 m, 28 January 1945; AJG 1169 (US) road-cut, growing with ferns and grasses, km 128 Cuenca-Guayaquil, Prov. Cañar, 2000 m, 13 August 1965.

29. PITCAIRNIA PUNGENS H. B. K., 1816 (Nova Genera et Species Plantarum, vol. 1) pp. 294-295; Smith, 1957, pp. 48-49, fig. 16.

FIG. 14

PLANT 35-45 cm tall with a pseudobulbous base ca. 5.0 cm by 2.5 cm; LEAVES 30-40 cm long, blades 1.2-2.0 cm wide, dimorphic, the outer, short, spiny leaves ca. 3.5 cm long, persistent, long leaves deciduous along transverse line above the sheath; SCAPE ca. 3 mm in diameter, erect to curving slightly; SCAPE-BRACTS 2.5-4.0 cm long, scarcely if at all imbricate, strict; INFLORESCENCE 7.0-9.0 cm long by 2.0-2.5 cm wide exclusive of the petals, simple, tending to be secund, tomentose; FLORAL BRACTS 2.5-3.3 cm long, spreading to ascending, mostly glabrous on outer surface but densely tomentose on inner surface, ecarinate, obscurely nerved; PEDICELS 0.3-1.0 cm long, ascending, usually retained on the rhachis, even after flowers drop; SEPALS 2.2-2.5 cm long by 4 mm wide, red, linear-ovate, glabrous, slightly carinate; PETALS ca. 5.0 cm long by 7 mm wide, red to red-orange, with basal scale, apex of scale 5-6 mm from petal base; OVARY nearly totally superior, 8 mm long, stamens 4-5 mm shorter than the petal apices, distance between flowers 5 mm, stigma round in surface view, not elliptic.

MATERIAL EXAMINED: Humboldt & Bonpland s. n. (B, TYPE; US, photo) near Pasto, Colombia, ca. 2200 m; Rivet 913 (P), Chillacocha, probably northern Ecuador, 3500 m, Feb. 1904;

Townsend 991 (US) sides of banks, between San Pedro and Colaisaca Prov. Loja, 25 Nov. 1910; Rose & Rose 23214 (US) vicinity of Las Juntas, Prov. Loja, 28 Sept. 1918; Holmgren 358 (US) along river near Baños, Prov. Tungurahua, 23 Feb. 1920; Hitchcock 21473 (US) between Loja and San Lucas, 2100-2600 m, Prov. Loja, 6 Sept. 1923; Rose, J. N. 22234 (US) no data. E. W. D. & Mary Holway 951 (US), Quito, Prov. Pichincha, 29 Aug. 1929; Benoist 3916 (P) Pifo, Prov. Pichincha, ca. 2500 m, 19 Feb. 1931; Firmin 387 (GH) at equator just north of Quito, Prov. Pichincha, 2700 m, 12 Jan. 1928; Mexia, Ynes 7548 (US) rocky cliff, between Ibarra and Río Pasquasa, Prov. Imbabura, 2800 m, 21 July 1935; Asplund 8356 (US) cliff, at Tamboloma, Prov. Bolívar, 2050 m, 15 Aug. 1939; Penland & Summers 735 (GH) Lake Cuicocha, Prov. Imbabura, 3200 m, 27 May 1939; Haught 3179 (US) Hacienda Yunguilla, northwest of Calacali, Prov. Pichincha, 2700 m, 19 March 1942; Acosta Solís 5469 (F) Hacienda La Carmela, Sibambe, Prov. Chimborazo, 2400-2800 m, 20 Aug. 1943; Foster 2587 (US) near Loja on ledges, Prov. Loja, 2200 m, 11 Nov. 1948; Foster 2595 (US) road to Cachicaran, on rocks, Prov. Loja, ca. 700 m, 30 Nov. 1948; Acosta Solís 5385 (F) Hacienda La Carmela, Sibambe, ca. 2600 m, 18 Aug. 1943; Johansen 9 (US) Baños, Prov. Tungurahua, ca. 2500 m, 6 March 1945; Camp E-4085 (US) rocky outcrops, near El Tambo, Prov. Chimborazo, ca. 3000 m, 6-9 July 1945; Espinosa 78 (GH) Las Juntas, north of Loja, Prov. Loja, ca. 2500 m, 6 April 1946; Fosberg &

Giler 22873 (US) paso de Cajanuma, 9 km south of Loja, Prov. Loja, 9 Feb. 1945; Espinosa 2033 (US) north of Zaruma, Chepel and Ambocas, Prov. El Oro, 2950 m, 30 Aug. 1947; Asplund 20144 (US) cliff, Agoyán, Prov. Tungurahua ca. 1600 m, 5 April 1956; Fagerlind & Wibom 1527 Lago Cuicocha, Prov. Imbabura, Nov. 1952; Dodson and Thien 1065 (US) on side of cliff, km 46 Quito-Santo Domingo, Prov. Pichincha, 2000 m, 22 Oct. 1961; Dodson and Thien 1461 (US) km 45-51, Loja-Zamora, Prov. Zamora, 1400-1600 m, 21 Nov. 1961; AJG 835 (US) rocky cliffs at side of river, ca. 140 km south of Cuenca between Río Oña and Río Paquishapa, Prov. Loja, 2100 to 2200 m, common, 20 Feb. 1963.

COLOMBIA, PERU.

30. PETCAIRNIA OBLONGIFOLIA L. B. Smith, 1959 (Phytologia vol. 6, no. 8) pp. 438-439, pl. 2, figs. 9-11.

PLANT ca. 50 cm tall, stemless probably; LEAVES to 30 cm long, blades 3.0 cm wide, not petiolate; sheaths ca. 3.0 cm long, serrate, blades entire, glabrous above, covered with rufescent scales beneath; SCAPE 3-4 mm in diameter, erect; SCAPE-BRACTS erect but not strict, only the lowermost imbricate, the upper bracts remote; INFLORESCENCE 22 cm long by ca. 4.0 cm in diameter exclusive of petals, lax, simple, glabrous; FLORAL BRACTS 1.0-1.5 cm long by 7-8 mm wide, broadly ovate; PEDICELS 1.2-15.0 cm long, slender; SEPALS to 2.1 cm long, narrowly triangular, ecarinate; PETALS more than 3.5 cm long, red, naked; OVARY nearly totally superior, distance between flowers 0.8-2.5 cm.

MATERIAL EXAMINED: Asplund 15850 (S, TYPE; US, photo) cliff, below Piñas, Prov. El Oro, ca. 750 m, 20 March 1955.

31. PITCAIRNIA AEQUATORIALIS L. B. Smith, 1936 (Contrib.

Gray Herb. vol. 114) p. 6, pl. 1, fig. 3.

PLANT to 100 cm tall; LEAVES ca. 80 cm long, blades ca. 1.4 cm wide, dimorphic, outermost short and spiny, longer leaves deciduous along a transverse line, not petiolate; SCAPE erect, slender, glabrous; SCAPE-BRACTS erect, imbricate below but not so above; INFLORESCENCE 40 cm long, glabrous, lax, simple; FLORAL BRACTS ca. 2 cm long, apex acuminate; PEDICELS ca. 2.0 cm long; SEPALS 3.0 cm long, ecarinate, narrowly triangular, yellow; PETALS ca. 7.0 cm long, pale yellow; OVARY $\frac{3}{4}$ superior.

TYPE: Rose (GH), Ecuador, not seen; species described from material that flowered at the New York botanical garden.

32. PITCAIRNIA LUTESCENS Mez & Sodiro, 1904 (Bull. Herb.

Boiss, series 2, vol. 4) p. 626; Mez, 1935, p. 265.

PLANT to 50 cm tall; LEAVES 40-60 cm long, blades 0.7-1.4 cm wide, dimorphic, outermost spiny and short, longer leaves deciduous but still present when plant in flower; SCAPE 2-3 mm in diameter, erect; SCAPE-BRACTS 3.5-4.5 cm long, mostly imbricate, strict; INFLORESCENCE ca. 9.0 cm long by 2.0-2.5 cm in diameter, cylindric, lepidote, simple, having ca. 30 flowers; FLORAL BRACTS 1.5-1.6 cm long by 3-4 mm wide, linear-ovate, apex setiform, lepidote; PEDICELS 0.5-1.2 cm long; SEPALS 2.0-2.1 cm long by 3 mm wide, ecarinate, strongly nerved, triangular; PETALS 3.5-4.5 cm long, yellow, no basal scale; OVARY nearly totally superior, distance between flowers 5 mm.

MATERIAL EXAMINED: Rose & Rose 22235 Prov. Chimborazo (US).

33. PITCAIRNIA COSTATA L. B. Smith, 1948 (Caldasia, no. 5)
p. 7, fig., Smith, 1957, p. 73.

PLANT probably ca. 100 cm tall, stemless; LEAVES to 150 cm long, blades 2.0-2.4 cm wide, margins completely entire, sheaths pale; SCAPE ca. 5 mm in diameter; erect; SCAPE-BRACTS 3.0-12.0 cm long by 1.9 cm wide, lowermost imbricate, the upper two or three slightly shorter than internodes; INFLORESCENCE 15-20 cm long by 8.0-9.0 cm in diameter, glabrous or subglabrous, erect, cylindric, simple, lax; FLORAL BRACTS 2.0-2.5 cm long by ca. 9 mm wide, spreading, ovate, obscurely lepidote on outer surface toward apex and glabrous or subglabrous within; PEDICELS 2.0 cm long, slender, tricostate with the base of ovary; SEPALS 4.5 cm long by 7-9 mm wide, ecarinate, obovate, subacute; PETALS 6.0 cm long, greenish white, with basal scale; OVARY 1/2 superior; distance between flowers 1.8-2.2 cm, in flower around June-July.

MATERIAL EXAMINED: Foster & Foster 2150 (US) above El Diviso, Colombia, ca. 600 m; Acosta Solis 12279 (F) Lita, Prov. Imbabura, 501 m, 25 April 1949.

COLOMBIA.

34. PITCAIRNIA HARLINGII L. B. Smith, 1961 (Phytologia vol. 8, no. 1) p. 11, pl. 1, figs. 18-20.

PLANT probably at least 1 m tall; LEAVES 150 cm long, blades 5.0 cm wide subpetiolate, laxly serrulate throughout, glabrous above, covered with pale ferruginous appressed scales beneath; SCAPE ferruginous-lanate, red; SCAPE-BRACTS imbricate, ovate, entire, ferruginous-lanate, the lower ones with caudate apices; INFLORESCENCE ca. 40 cm long, lax, ferruginous-lepidote, simple; FLORAL BRACTS ca. 5.5 cm long, triangular-ovate; PEDICELS to 2.5 cm long, slender; SEPALS ca. 3.5 cm long, slightly carinate toward base, red; PETALS ca. 7.0 cm long, orange, with basal scale; OVARY 1/3 superior.

MATERIAL EXAMINED: Harling 3426 (US, ISOTYPE) in a thicket near the river, El Topo, Prov. Napo Pastaza, 1250 m, 28 Nov. 1958.

35. PITCAIRNIA NIGRA (Carr.) André, 1888 (Énumération Bromél.)
p. 5; Smith, 1957, p. 69.

Neumannia nigra Carr., 1881 (Revue Hortic., vol. 53) p.
390, pl.

PLANT caulescent, ca. 60 cm tall; LEAVES to 70 cm long, trimorphic, outermost leaves short with spinose-serrate blades, others with small lanceolate entire blades and the larger with petiole ca. 30 cm long and blades 30-37 cm long by 10-14 cm wide, these entire; SCAPE ca. 6-7 mm in diameter, erect or ascending; SCAPE-BRACTS 8.0-14.0 cm long by 2.0 cm wide, erect, imbricate throughout, margins serrate, red; INFLORESCENCE 10-50 cm long by 8.0-9.0 cm in diameter, cylindric, simple; FLORAL BRACTS to 6.5 cm long, arching-spreading, carinate toward apex, red, glabrous; FLOWERS sessile; SEPALs 3.6 cm long, nerved; PETALS ca. 10 cm long, dark purple, yellow below; with basal scale; OVARY almost totally superior, distance between flowers 2 mm or less.

MATERIAL EXAMINED: Drew E638 (US) epiphyte, lower Intag Valley, above Río Halguayaco, below Magnolia, Prov. Imbabura, ca. 1300 m, 17 Sept. 1944; Heinrichs 537 (B; US, AJG, photos) near Río Saloya, probably southeast of Chiriboga, Prov. Pichincha, ca. 1900 m, 29 Nov. 1933; Asplund 20040 (US) Río Verde Grande, Prov. Tungurahua, ca. 1500 m, 30 March 1956.

COLOMBIA.

Subfamily TILLANDSIOIDEAE

Tillandsioideae Harms, 1930 (Engler and Prantl, Pflanzenfam. ed. 2) vol. 15 a) p. 115; Smith, 1956, p. 91.

Leaves always entire, plants mostly epiphytic, ovary superior or nearly so; fruit capsular, seeds plumosely appendaged, indumentum obviously of peltate scales, i.e. lepidote; cotyledon in young seedling remaining inconspicuous.



A



B



C

KEY TO THE ECUADORIAN GENERA OF TILLANDSIOIDEAE

1. Seed appendage basal, straight at capsule maturity, flowers polystichously or distichously disposed (A)*, sepals mostly symmetric (B), or asymmetric and distichously flowered.

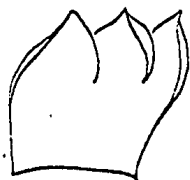
2. Petals free (C), if slightly joined then corolla tube deeply included within the calyx; spikes distichous-flowered (A), or simple.

. . . : Genera TILLANDSIA and VRIESEA p.

2. Petals joined (CC), or closely agglutinated, flowers always polystichously disposed, seed appendage usually brown.

*

Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



CC



D



DD



AA



BB

- 3. Petals naked, i.e. NOT with nectar scales
(D) : Genus GUZMANIA, p.
- 3. Petals with 2 nectar scales on inner sur-
face (DD), one Ecuadorian species.
. : Genus MEZOBROMELIA, p.
- 1. Seed appendage apical, flowers polysti-
chously disposed (AA); sepals strongly
asymmetric (BB), leaf-blades lingulate,
often with translucent quality.
. : Genus CATOPSIS, p.

Genera TILLANDSIA and VRIESEA

Tillandsia L., 1753 (Sp. Pl.) p. 286; L., 1754 (Genera Plantarum ed. 5) p. 138.

Vriesea Lindley, 1843 (Bot. Reg. vol. 29) p. 10 (published as Vriesia); Beer, 1857 (Bromeliaceen) pp. 91-92, corrected spelling, (orthog. et nom. consv.).

Leaves rosulate or fasciculate or cauline, lingulate to narrowly triangular or linear to subulate; inflorescence usually compound of distichous-flowered branches or spikes, or secund, or simple and polystichously flowered; flowers perfect; petals free, with or without basal scales on inner surface of limb; stamens included or exserted; ovary superior; capsule septicidal, seeds with straight, white to cream basal plumose appendage.

KEY TO THE ECUADORIAN SUBGENERA OF TILLANDSIA AND TO VRIESEA



A

1. Petals NOT with basal scales (A)*, inflorescence simple, digitate, bi- to quadripinnate, floral bracts conspicuous or inconspicuous, petals white, violet, yellow, or rarely green.



B

2. Stamens deeply included and style short (B).
3. Flowers with conspicuous petal-blades (C)
 : Subgenus PHYTARRHIZA, p.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



C



CC



D



DD



BB



EE



E



AA

3. Flowers with INconspicuous petal-blades
(CC).

4. Inflorescence minute, 5-10 mm long,
always simple, 1-5 flowered, sepals
symmetric (D)
. : Subgenus DIAPHORANTHEMA, p.

4. Inflorescence large, at least several
cm long, sepals asymmetric (DD)
. : Subgenus PSEUDO-CATOPSIS, p.

2. Stamens NOT deeply included and style
elongate (BB).

5. Leaf-sheaths usually with some purple,
stamens usually included (E), leaf-
blades of most species lingulate.
. : Sub-
genera ALLARDTIA and ANOPLOPHYTUM, p.

5. Leaf-sheaths NOT purple, but dark
brown or red-brown, stamens much
exserted (EE), leaf-blades of most
species narrowly triangular.
. : Subgenus TILLANDSIA, p.

1. Petals with basal scales (AA), inflores-
cence simple, digitate or bipinnate, floral
bracts conspicuous and enfolding floral
base, petals white, green or violet.
. : Genus VRIESEA, p.

TILLANDSIA subgenus PHYTARRHIZA

Tillandsia subgenus Phytarrhiza Baker, 1887 (Jour. Bot. vol. 25) pp. 212 and 214.

Flowers distichous, petal-blades conspicuous, stamens deeply included, style short, no longer than ovary, leaves often narrow, thin, stoma in surface view often appearing round.

KEY TO THE ECUADORIAN SPECIES OF
TILLANDSIA subgenus PHYTARRHIZA

1. Floral bracts large, 4.0 cm long or more, inflorescence always simple, flowers at least 6.0 cm long.
2. Floral bracts erect to spreading at anthesis, NOT concealing rhachis, leaves to 60 cm long. : 1. T. pretiosa.
2. Floral bracts erect at anthesis, concealing rhachis, leaves to 45 cm long.
3. Floral bracts at least slightly nerved, sepals membranaceous, glabrous within, petals blue with white spot, 5 to 6 flowers per inflorescence.
. : 2. T. umbellata.
3. Floral bracts NOT at all nerved, sepals coriaceous, lepidote within, inflorescence having at least 8 flowers.

- 4. Scape not including inflorescence to 29 cm long, inflorescence exclusive of petals 8.0-9.0 cm wide, elliptic. : 5. T. cyanea var. elator.
- 4. Scape not including inflorescence 4.0-17.0 cm long, inflorescence exclusive of petals ca. 7.0 cm wide, oblong.

- 5. Petals blue with white spot toward base of blade. . . : 4. T. cyanea var. tricolor.
- 5. Petals blue throughout blade, NOT with white spot toward base of blade. : 3. T. cyanea var. cyanea.

- 1. Floral bracts small, 1.1-3.5 cm long, inflorescence simple or compound, flowers to 4.5 cm long.

- 6. Inflorescence compound.

- 7. Spike rhachis mostly obscured by imbricate floral bracts (A)*. : 6. T. hamaleana.

- 7. Spike rhachis NOT at all obscured by floral bracts (AA).

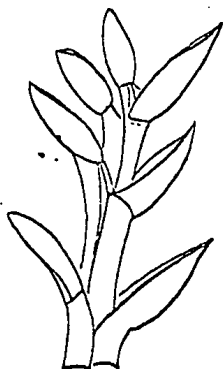
- 8. Spike rhachis strongly alate giving webbed appearance between floral bracts (B). : 7. T. platyrhachis.



A



AA



B

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



BB



C



CC



D

8. Spike rhachis NOT strongly alate (BB).

9. Sepals strongly nerved (C), diameter of inflorescence 4.0-5.0 cm. : 8. T. straminea.

9. Sepals NOT or scarcely nerved (CC), diameter of inflorescence ca. 8.0-20.0 cm.

10. Spike width 4.4-6.0 cm exclusive of capsules, floral bracts ca. 3.2-3.4 cm long. : 9. T. dyeriana.

10. Spike width 3.0-4.0 cm exclusive of capsules, floral bracts 1.4-2.1 cm long. : 10. T. nubis.

6. Inflorescence simple.

11. Floral bracts 2.5-3.4 cm long and to 1.7 cm wide, plant 40-70 cm tall, rhachis often strongly geniculate (D).

12. Floral bracts spreading sharply at anthesis, leaves 15-20 cm long, scape-bracts imbricate below, scarcely so above. : 9. T. dyeriana.

12. Floral bracts erect to spreading at anthesis, leaves 32-45 cm long, scape-bracts imbricate throughout with caudate, spreading apices. : 11. T. acosta-solisii.



11. Floral bracts 1.0-2.2 cm long, rhachis flexuous or undulate (DD), NOT geniculate.

13. Capsules to 3.5 cm long, floral bracts narrow, not more than 7 mm wide when unrolled.

14. Flowers blue, 3 to 8 per inflorescence, distance between flowers 1.3-1.6 cm. : 12. T. caerulea.

14. Flowers white or yellow, 10 to 40 per inflorescence, distance between flowers 4-8 mm.

15. Inflorescence 0.4-1.0 cm wide exclusive of capsules, floral bracts consistently erect, petals ca. 1.6 cm long. : 13. T. triglochinos.

15. Inflorescence 2.5-3.0 cm wide exclusive of capsules, floral bracts consistently spreading, petals ca. 2.4 cm long. : 14. T. narthecioides.

13. Capsules 4.0 cm long or more, floral bracts 8 mm to 1.2 cm wide or more when unrolled.



16. Floral bracts ovate with margins curved (E), spreading at nearly 90° angle with rhachis, inflorescence having up to 40 flowers.

. : 15. T. scaligera.



16. Floral bracts ovate but with margins nearly straight (EE), spreading at 45° angle or less with rhachis, inflorescence having ca. 12 to 24 flowers.



17. Sepals extending beyond floral bracts (F), leaves to 24 cm long, blades 0.5-1.0 cm wide, floral bracts unicarinate : 16. T. monadelpha.



17. Sepals included within floral bracts (FF), leaves to 60 cm long, blades 1.2-1.6 cm wide, floral bracts ecarinate. : 17. T. cornuta.

1. TILLANDSIA PRETIOSA Mez, 1919 (Fedde Repert. Spec. Nov. vol. 16) p. 78; L. B. Smith, 1951, p. 485.

PLANT ca. 55 cm tall; LEAVES 45-60 cm long, blades ca. 1.5-2.0 cm wide, in a slender rosette, blade linear-triangular, sheath ca. 5 cm long; SCAPE ca. 0.8-1.0 cm in diameter; SCAPE-BRACTS 4.0-14.0 cm long, by ca. 1.3 cm wide, imbricate throughout, lowermost with long, nearly filiform blade, erect; INFLORESCENCE ca. 20 cm long by 11.5 cm wide, simple, lax, distichous with ca. 20 flowers; FLORAL BRACTS 5.5 cm long by estimated 2.4 cm wide at anthesis, in bud 4.5 cm wide, coriaceous, not nerved, glabrous, spreading at anthesis at nearly 90° angle with rhachis, and not imbricate, in bud floral bracts imbricate; SEPALS 4.5 cm long, concealed by floral bracts, carinate, margins membranaceous; PETALS probably ca. 8.0 cm long, blades large and spreading, blue when dry.

MATERIAL EXAMINED: Sodiro 171/39 (B, TYPE; US, photo) near Mindo, probably along Río Mindo, Prov. Pichincha, ca. 1000 m, Jan. 1886; Heinrichs 588 (Munich; US, AJG photo) Pilatón zone, near Río Toachi, Prov. Pichincha, 900 m, 18 Dec. 1933.

2. TILLANDSIA UMBELLATA André, 1886 (Revue Hortic.) p. 60, pl.; André, 1888, p. 8; André, 1889, pp. 97-98; Smith, 1951, pp. 494-495, fig. 62.

PLANT ca. 35 cm tall with scape much shorter than leaves; LEAVES 25-35 cm long, blades 1.5 cm wide, narrowly triangular, appear glabrous; SCAPE with inflorescence ca. 24 cm long, 2 mm in diameter; SCAPE-BRACTS ca. 3.5 cm long, erect, imbricate; INFLORESCENCE ca. 7.0 cm long by 3.0-5.0 cm wide exclusive of petals, simple, with 5 to 6 flowers, distichous, dense; FLORAL BRACTS 4.0 cm long by ca. 1.6 cm wide, apex acute, elliptic, erect, imbricate, papery, glabrous without and within; SEPALs 3.0-3.5 cm long, glabrous without and within, margins membranaceous; PETALS ca. 7.0 cm long, blades ca. 2.5 cm wide, deep blue with white eye at base; CAPSULES unknown, distance between flowers ca. 1.2 cm.

MATERIAL EXAMINED: André K-317 (K, TYPE; US, photo) a cultivated specimen probably descended from living material of Poortman 469, between Cisne and Ambocas, 1882, Prov. Loja; Acosta-Solís 7853 (F) La Hamaca, Catacocha, Prov. Loja, 2200-2400 m, 15 April 1944.

TILLANDSIA CYANEA Linden ex Koch, 1867 (Wochenschrift vol. 10) p. 140; Smith, 1951, pp. 489-590, fig. 61.

T. Lindeni Morren, 1869 (Belg. Hort. vol. 19) p. 321, pl. 18.

PLANT 25-35 cm tall; LEAVES 25-40 cm long, blades 1.0-1.8 cm wide, finely appressed-lepidote, blade linear-triangular, sheaths 4.0-6.0 cm long by ca. 3.0 cm wide, elliptic, distinct; SCAPE 7.0-40.0 cm long with inflorescence, ca. 6 mm in diameter, mostly erect; SCAPE-BRACTS 3.0-6.0 cm long by ca. 1.2 cm wide, apices attenuate, erect; INFLORESCENCE 7.0-17.0 cm long by 6.0-9.0 cm wide exclusive of petals, simple, distichous, dense, elliptic to oblong with up to 20 flowers; FLORAL BRACTS 4.5-5.5 cm long by ca. 2.5 cm wide, erect, imbricate, coriaceous, sharply carinate, not nerved, apex acute, glabrous without, lepidote within; SEPALs 3.5-4.0 cm long by 9 mm wide, obovate, coriaceous, posteriorly carinate, not nerved, acute; PETALS ca. 8.0 cm long, blades 2.0-2.5 cm wide and blue throughout or with white spot toward base; OVARY 7 mm long by 3 mm wide, distance between flowers ca. 5 mm.

3. TILLANDSIA CYANEA var. CYANEA

FIG. 37

Inflorescence elliptic, ca. 7.0 cm wide exclusive of petals, scape to 10 cm long exclusive of inflorescence, petal blade, blue throughout.

MATERIAL EXAMINED: Rose and Rose 22617 (US) near Huigra, Hacienda de Licay, Prov. Chimborazo, estimate 1500 m, 8 Sept. 1918; Hitchcock 21304 (US) between Portovelo, gold mine near Zaruma and El Tambo, Prov. El Oro, 600-1000 m 2 Sept. 1923; AJG 703 3 km from Manglaralto near base of Cerro Colorado in scrubby area at roadside, Prov. Guayas, ca. 50 m, 2 May 1962; AJG 889 (US) near rainforest but in somewhat dry area on outskirts of forest, abundant, epiphytic, km 85 Duran (other side of river from Guayaquil) El Tambo, Prov. Cañar, ca. 600 m, 22 March 1964.

4. TILLANDSIA CYANEA Linden ex Koch var. TRICOLOR (André)
L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29,
no. 10) p. 491.

T. lindeni Morren var. tricolor André, 1877 (Illustr.
Hortic.) p. 190.

PLANT like T. cyanea var. cyanea in habit and most
dimension and shapes. The inflorescence is somewhat more
oblong than elliptic and the petals are like T. umbellata
in having a white spot at the base of the blue petal blades.

MATERIAL EXAMINED: André 4040 (K, TYPE of T. lindeni)
along Río de Cristal between Pisagua and Sabanetas, ca.
60 m, Prov. Los Ríos.

5. Tillandsia cyanea Linden ex Koch var. elatior L. B. Smith, 1955 (Phytologia vol. 5, no. 5) p. 181.

FIG. 38

Plant habit and most of the dimensions and shapes like T. cyanea var. cyanea. The scape is elongate, to 29 cm long exclusive of inflorescence and the inflorescence is 8.0-9.0 cm wide exclusive of petals.

MATERIAL EXAMINED: Fagerlind and Wibom 1947 (S, TYPE; US, photo) ca. km 27 Chiriboga-Santo Domingo, Prov. Pichincha, ca. 2000 m, Dec. 1952; Sodiro s. n. (Quito; AJG photo) Valle Mindo, Prov. Pichincha, 900-1000 m, date(?).

NOTES: It is interesting to note that capsules are rarely found upon any of the noncultivated specimens of any of the varieties of T. cyanea. Capsules have not been mentioned in the literature. It would seem that reproduction is largely vegetative. This would possibly explain the comment of Smith (1951, p. 490) in regard to his comparison of cultivated plants and wild ones. "After a lapse of over 80 years it is still impossible to see any difference between the cultivated material cited above and the specimens that have come directly from their natural habitat." Because sexual reproduction is not the rule with this species there is much less variation than might have occurred were crossings to take place frequently. While there is no real evidence that

the populations are largely apomictic, there is strong likelihood that this is the case. At any rate, the distribution in Ecuador of such elegantly beautiful plants must have for some time been at least in part due to man. Very likely plants have been picked up and carried to other regions simply because of their attractiveness. If the new locality were at all suitable they would continue growing and producing offshoots.

W. A. Schulz Jr. (1967, personal communication) of Polk Nursery Company, Florida collected a large number of Tillandsia cyanea vars. (?) in Ecuador in September 1967. Of 41 plants which had flowered he found only 4 with capsules and even here capsules were few, from 1 to 4 capsules per inflorescence. This is the first observation to my knowledge of T. cyanea producing capsules in its natural habitat.

6. TILLANDSIA HAMEALEANA Morren, 1869 (Gardener's Chron. vol. 2) p. 460.

Wallisia hamaleana Morren, 1870 (Belgic. Hortic. vol. 20) p. 97, pl. 5.

PLANT 25-35 cm tall, erect rosette of leaves; LEAVES 15-25 cm long, blades 2.0-3.5 cm wide, lingulate, pale green, apex acute to apiculate; SCAPE 3-4 mm in diameter, erect; SCAPE-BRACTS 4.0-6.0 cm long, imbricate below, not so above, strict; INFLORESCENCE 8.0-11.0 cm long by 8.0-10.0 cm wide, bipinnate with 3 to 6 spikes, dense, slightly lepidote, distance between spikes 1.0-1.2 cm; PRIMARY BRACTS 3.0-4.0 cm long by 1.2-1.4 cm wide, erect to spreading, ovate; SPIKES ca. 5.0 cm long by 2.5-3.0 cm wide, divergent; FLORAL BRACTS 2.1-2.4 cm long by 1.4 cm wide, ecarinate, strongly nerved, apex acute, slightly lepidote without, glabrous within, papery, imbricate; SEPALS 1.9-2.1 cm long by 0.8 cm wide, obovate-elliptic, papery, ecarinate, broadly acute, glabrous without and within, free; PETALS 3.0-3.2 cm long with conspicuous blades to 1.5 cm wide, purple; CAPSULES not known, distance between flowers 3-4 mm, flowering time around July-September.

MATERIAL EXAMINED: Sodi 171/39b (B; US, photo) Vulcan Guanaxa, Prov. Pichincha probably; Steyermark 54153 (GH) between Paccha and Puente Grande, 3° 35' south, 79° 38' west, Prov. El Oro, ca. 1500 m; Steyermark 53859

(GH) wooded slopes, bordering Quebrada Nudillo and Quebrada Tambillo, tributary to Río Luis, Prov. El Oro, 1610-1890 m, 13 Aug. 1943; Penland and Summers 1171 (GH) epiphytic, near Chinche between San Pedro and Zaruma, Prov. Loja, 2000 m, March-August 1939; Hitchcock 21344 (US) epiphytic, between El Toma and La Toma, 1000-2200 m, 3 Sept. 1923; Hitchcock 21159 (US) between La Chorita and Portovelo, gold mine near Zaruma, Prov. El Oro, 1000-2000 m, 28 Aug. 1923; Camp E-3898 (US) on dry rock, canyon of Río Chanchan from Naranjapata to below Huigra, Prov. Chimborazo, 800-1100 m; Espinosa 1914 (US) epiphytic, near Zaruma, Cordillera de Güishagüiña, Prov. El Oro, 2000 m, 29 Aug. 1947; Teuscher s. n. (US) Monte Cajamina, Prov. El Oro, ca. 3000 m, 1951.

COLOMBIA.

7. TILLANDSIA PLATYRHACHIS Mez, 1896 (DC. Monogr. Phaner. vol. 9) p. 848; Smith, 1957, p. 140.

FIG. 39

PLANT 50-80 cm tall by ca. 40 cm in diameter; LEAVES 50-70 cm long, blade 3.5-6.0 cm wide, lingulate, apex acute, subglabrous above, densely appressed lepidote below, sheath ca. 18 cm long by 10-12 cm wide, elliptic, dark brown above when dry; SCAPE 1.0-1.2 cm in diameter, erect, slightly exceeding leaf-rosette; SCAPE-BRACTS 3.5-9.0 cm long by ca. 2.5 cm wide, strictly erect, apex acute, completely obscuring scape; INFLORESCENCE ca. 30 cm long by 20 cm in diameter, bipinnate, lax, glabrous; PRIMARY BRACTS 3.0-4.0 cm long by 2.0 cm wide, apex acute, erect to spreading, much shorter than spikes; SPIKES 9.0-14.0 cm long by 4.0-7.5 cm wide, spreading to arching recurved, ca. 7 to 10 per inflorescence, distance between spikes 2.5-4.5 cm, rhachis strongly alate giving webbed appearance between floral bracts, stipe to 2.4 cm long, no sterile bracts, ca. 9 to 19 flowers per spike; FLORAL BRACTS 2.3-3.0 cm long by 1.3 cm wide, apex acute to obtuse, subcoriaceous, carinate, faintly nerved, glabrous without, slightly lepidote within, erect to spreading, subimbricate at anthesis, strikingly creamy-white when alive, showing up from a good distance, turning dark brown when dry; SEPALs 2.8-3.1 cm long by ca. 6-7 mm wide, exceeding floral bracts, obtuse, oblong-elliptic, ecarinate, strongly

nerved, coriaceous, glabrous without and within, free; PETALS with blades ca. 1 cm long, deep violet, stamens deeply included within corolla; OVARY ca. 8 mm long by 3-4 mm in diameter; CAPSULE ca. 4.0 cm long, seeds light red-brown; distance between flowers 5-8 mm, in flower around April to May.

MATERIAL EXAMINED: Schimpff 714 (Zurich; US, AJG, photo) near Río Pastaza, Prov. Napo, 1400 m, 4 Feb. 1934; AJG 1139 (US) epiphytic ca. 2 m from ground, tank full of water, not common, rain forest, km 45 Loja-Zamora, Prov. Zamora, ca. 1500 m, 11 Aug. 1965.

PERU.

NOTES: This species when alive is very conspicuous for the white appearance of the inflorescence from a distance. The floral bracts are creamy-white when alive.

8. TILLANDSIA STRAMINEA H. B. K., 1816 (Nova Genera et Species, vol. 1) p. 292.

FIGS. 40, 41

PLANT to 60 cm tall; LEAVES to 30 cm long, blades 1.2 cm wide, silvery-green, narrowly triangular with filiform apices, sheath 2.0 cm long by 2.2 cm wide, surface of leaf densely moderately spreading-lepidote, velvety to touch; SCAPE with inflorescence to 55 cm long, 1 mm in diameter, erect to slightly curved; SCAPE-BRACTS to 15 cm long by 1.2 cm wide, imbricate throughout, blades caudate, erect, sheath clasping scape; INFLORESCENCE 6.0-9.0 cm long by 4.0-5.0 cm in diameter, bipinnate, lavender, glabrous with 4 to 6 spikes, lax; PRIMARY BRACTS to 2.8 cm long, erect to spreading, lavender, elliptic, glabrous; SPIKES 4.0-6.5 cm long by 3.0 cm wide, with 4 to 6 flowers, terminal bract sterile, distance apart 0.6-1.0 cm; FLORAL BRACTS 1.8-2.1 cm long by 1.0 cm wide, spreading at about 45° angle, not imbricate, strongly nerved, ecarinate, papery, glabrous without and within, lavender, apex acute; SEPALS ca. 1.8 cm long by 8 mm wide, elliptic, acute, posteriorly connate for 2 mm, ecarinate, papery, strongly nerved; PETALS 2.0-2.2 cm long, blades 0.8-0.9 cm wide, conspicuous, erect, white with lavender tip; STAMENS deeply included; OVARY ca. 3 mm long by 2-3 mm in diameter, style shorter than ovary; CAPSULE 6.6-7.0 cm long; flowers fragrant, distance between flowers 4-5 mm.

MATERIAL EXAMINED: Humboldt, Willdenow 3496 (B, TYPE; US, photo) Peru; Hitchcock 21351 (US) between El Tambo and La Toma, epiphytic, Prov. Loja, 1000-2200 m, 3 Sept. 1923; Wiggins 10875 (US) cliffs and steep slopes 7 km south of Loja, road to Malacatos, Prov. Loja, ca. 2500 m, 4 Oct. 1944; Espinosa E 456 (US) on rocks, Prov. Loja, 2200 m, 31 May 1946; Foster 2586 (US) epiphytic, outskirts of Loja, Prov. Loja, ca. 2500 m, 28 Nov. 1948; Asplund 18126 (US) epiphytic and terrestrial, Chincha, above San Pedro, Prov. Loja, ca. 2400 m, 13 Oct. 1955; AJG 1120 (US) dry slopes, epiphytic on Prosopis and small shrubs, km 23, Loja-Cotamayo, ca. 2000 m, 10 Aug. 1965.

PERU.

NOTES: Although Mez (1935, pp. 531-532) placed Tillandsia straminea H. B. K. in the subgenus, Allardtia; its short style and conspicuous petal blades would preclude its membership in Allardtia and justify its inclusion in the subgenus, Phytarrhiza. Therefore, I am including T. straminea with the subgenus, Phytarrhiza.

9. TILLANDSIA DYERIANA André, 1888 (Énumération Broméél.)
p. 8; André, 1889, pp. 98-99, pl. 32.

PLANT 45-70 cm tall by ca. 20 cm wide; LEAVES 15-30 cm long, blades ca. 2.0 cm wide, 15-20 in a campanulate rosette, lingulate, apex acute, spotted purple; SCAPE ca. 68 cm long with inflorescence, 3-4 mm in diameter; SCAPE-BRACTS 3.0-6.0 cm long by ca. 1.4 cm wide, imbricate below, scarcely so above, erect; INFLORESCENCE 16-18 cm long by 18-20 cm in diameter, simple or bipinnate with ca. 3 spikes, lax, erect; PRIMARY BRACTS 3.0-4.0 cm long by ca. 1.4 cm wide, spreading, apices acute; SPIKES 9.0-17.0 cm long by 5.5-6.0 cm wide, spreading, distance between to 1.5 cm; FLORAL BRACTS 3.2-3.4 cm long by ca. 1.7 cm wide, apex acute, nerved, carinate, not imbricate, subglabrous, spreading at nearly 90° angle with rhachis at anthesis; SEPALs 2.1-2.3 cm long, acute, spreading, not nerved or scarcely so, minutely lepidote; PETALS ca. 3.1 cm long by 5 mm wide at lobes, white; stamens included by 5-6 mm; CAPSULES 5.0-5.5 cm long; flowers 5-7 mm apart.

MATERIAL EXAMINED: André 4256 (K, TYPE; US, photo)
Prov. El Oro, ca. 100 m.

Not seen: Lehmann 7646 (B) Santa Rosa, Prov. Loja.

NOTES: I have not seen the Lehmann specimen. However, Lyman B. Smith tells me that it has a simple inflorescence and belongs with T. dyeriana André.

10. TILLANDSIA NUBIS Gilmartin, spec. nov.

A T. dyeriana André, cui affinis, partibus omnibus minoribus, spicis angustioribus, bracteis florigeris sepalis non superatis differt.

FIG. 42

PLANT to 45 cm tall; LEAVES at least to 24 cm long, blades ca. 3.0-4.5 cm wide, lingulate, apex acute to apiculate, sheath ca. 9.0 cm long by 4.5-5.5 cm wide, pale brown, blade and sheath often with some purple when living; SCAPE 35-48 cm long with inflorescence, 3-4 mm in diameter; SCAPE-BRACTS 5.0-7.0 cm long, strict, imbricate below, scarcely so above; INFLORESCENCE ca. 24 cm long by ca. 13 cm in diameter, mostly bipinnate, may be partly tripinnate, lax, pyramidal, glabrous; PRIMARY BRACTS 2.5-4.0 cm long by 0.9-1.0 cm wide; SPIKES 6.0-9.0 cm long by ca. 3.0-4.0 cm wide, ascending, with stipe 1.4-3.0 cm long, no sterile bracts, having 8 to 14 flowers, spike-rhachis nearly straight, distance between spikes 2.0-4.0 cm; FLORAL BRACTS 1.4-2.1 cm long by 8 mm wide, spreading at 75°-90° angle with rhachis at anthesis, carinate nerved, apex acute, apparently glabrous without and within, papery, not imbricate; SEPALs 1.5-1.8 cm long by 5-7 mm wide, about equaling floral bracts, broadly elliptic, coriaceous, glabrous without and within, acute to attenuate, not nerved, ecarinate; PETALS to 4.5 cm long, blades ca. 1.2 cm wide, violet; OVARY 2-3 mm long by 1.2

mm wide, style 1.0-1.5 mm long, shorter than stamens, distance between flowers 4-6 mm, probable flowering time March-June.

MATERIAL EXAMINED: Naundorff s. n. (US, TYPE) Tandapi, "palma de pais," cultivated by Marnier-Lapostolle no. 55, Prov. Pichincha, ca. 1500 m, 22 March 1966; AJG 1186 (US) cloud forest, road between Guayaquil and El Tambo, Prov. Cañar, ca. 920 m, 14 Aug. 1965.

NOTES: The resemblance to T. dyeriana André is strong and especially so if one does not take into consideration the dimensions of the floral parts. The spikes, for example, of T. dyeriana are at least 5.5 cm wide at anthesis and the spikes of T. nubis AJG are not more than 3.0 cm wide at anthesis. An additional feature which distinguishes these two is the relative lengths of the sepals and floral bracts. The floral bracts of T. dyeriana conspicuously over-reach the sepals; the floral bracts of T. nubis equal or are exceeded by the sepals. The collection area for T. dyeriana is coastal Ecuador. The collection sites for T. nubis are the Andes from ca. 900-2000 m altitude.

Lehmann 26 (B) which was determined by Mez to be T. dyeriana (Mez, 1935, p. 576) and collected from near Quito may also be a representative of this species. I have not had the opportunity to examine this Lehmann specimen.

11. TILLANDSIA ACOSTA-SOLISII Gilmartin, spec. nov.

A T. cornuta Mez et Sodiro, cui affinis, bracteis florigeris longioribus, erectis; sepalis nervatis.

FIG. 43

PLANT 40-65 cm tall by ca. 25 cm in diameter, leaf-rosette elongate-erect, growing in clumps of several individuals; LEAVES 32-45 cm long, blades 1.0-2.0 cm wide, flat, papery when dry, narrowly triangular, apex attenuate to filiform, densely appressed-lepidote; sheath 3.0-7.0 cm long by 2.0-3.5 cm wide, concolorous with blade below, dark brown above; SCAPE 3-4 mm in diameter, erect; SCAPE-BRACTS 4.0-15.0 cm long by 1.0-1.2 cm wide, erect, sheaths clasping scape, caudate apices spreading, imbricate throughout; INFLORESCENCE 12-14 cm long by ca. 2.0 cm wide, simple, distichous, erect, linear-elliptic, glabrous, having 10-15 flowers, rhachis strongly geniculate; FLORAL BRACTS 2.5-3.0 cm long by 1.2-1.6 cm wide, erect in bud, erect to spreading after anthesis, ovate, glabrous without, pale lepidote within, apex acute, subcarinate, slightly nerved; SEPALs 2.4-2.7 cm long by 6 mm wide, erect to spreading, acute, ovate with margins nearly straight, equally connate for 3-4 mm, posteriorly carinate, slightly nerved, glabrous without, lepidote within; PETALS 4.0-4.5 cm long, blades ca. 1.4 cm wide, erect, white; CAPSULES to 6.5 cm long, distance between flowers 0.9-1.2 cm.

MATERIAL EXAMINED: Teuscher cultivated, Montreal 2275-56 (US, TYPE) east of Cuenca, Dec. 1958; Acosta Solis 6139 (F) Charquiyacu, Prov. Bolivar, ca. 600 m, 4 Oct. 1943; AJG 1178 (US) Soroche, between El Tambo and Guayaquil, ca. 90 km from Guayaquil, epiphytic 7-8 m from ground, cloud forest, Prov. Cañar, ca. 900 m, 14 Aug. 1965.

NOTES: Tillandsia acosta-solisii Gilmartin differs from T. cornuta Mez and Sodiro to which it bears the most resemblance, in the following ways: T. acosta-solisii has its 2.5-3.0 cm long floral bracts erect to spreading, its inflorescence 12-14 cm long and its sepals 2.4-2.7 cm long. T. cornuta Mez and Sodiro has its 1.8 cm long floral bracts spreading at ca. 45° angle with the rhachis, its inflorescence is 10-12 cm long and its sepals are 1.8-2.1 cm long.

12. TILLANDSIA CAERULEA H. B. K., 1816 (Nova Genera et Species, vol. 1) p. 292; Smith, 1935, pp. 182-183, pl. 4, figs. 3-4.

FIG. 44

PLANT to 35 cm tall, growing in clumps of many individuals; LEAVES 10-15 cm long, blades 2 mm wide, densely tomentose-lepidote, spreading; sheaths 1.2 cm long by 7-8 mm wide; SCAPE with inflorescence to 30 cm long, reddish, 1 mm or less in diameter, curving; SCAPE-BRACTS 2.3-10.0 cm long, imbricate below, above not imbricate and exposing scape; INFLORESCENCE 5.0-12.0 cm long by 1.8 cm in diameter, simple, rhachis very slightly undulate, distichous, having 3 to 8 flowers, apical floral bract sterile; FLORAL BRACTS 1.4-1.6 cm long by 6 mm wide, ecarinate, papery, densely lepidote without, glabrous within, apex acute, strongly nerved; SEPALS 1.2-1.5 cm long by 4 mm wide, equally short-connate, lanceolate, acute; PETALS 2.0-2.5 cm long, blue; OVARY ca. 3-4 mm long, style no longer than ovary; distance between flowers 1.3-1.6 cm.

MATERIAL EXAMINED: Humboldt and Bonpland 3442 (B, TYPE; US, photo) Peru; Hitchcock 21334 (US) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, 3 Sept. 1923; Hitchcock 21585 (US) epiphytic, between Oña and Cuenca, Prov. Azuay, 2700-3300 m, 9-10 Sept. 1923; Steyermark 53724 (US) "dry rocky slopes bordering Río León toward Oña, north side of Río León," Prov. Azuay,

ca. 1900 m, 3 Aug. 1943; Foster 2615 (US) epiphytic, km 85-90 Cuenca-Oña, Prov. Azuay, ca. 1000 m, 3 Dec. 1948; Penland and Summers 1109 (GH) between Nabon and Oña, rock wall, Prov. Loja, 2600 m, 23 July, 1939; AJG 1119 (US) dry grassy slopes, epiphytic on Prosopis trees, km 101 Cuenca-Loja, Prov. Azuay, 2000 m, 9 Aug. 1965.

PERU.

NOTES: This species is superficially similar to T. recurvata (L.) L of the subgenus, Diaphoranthema. However, the greater size of the plant, wider leaf blades and larger number of floral bracts per inflorescence, usually at least 3, and lax inflorescence easily distinguish it from T. recurvata. Apparently the distribution ranges do overlap. While T. recurvata is cosmopolitan, T. caerulea has thus far been reported only from the area around Loja and the region between Loja and Cuenca. T. recurvata has also been reported from this same area. The flowering times seem to coincide.

13. TILLANDSIA TRIGLOCHINOIDES Presl, 1827. (Reliquiae Haenk. vol. 1) p. 125; Smith, 1951 pp. 505-506, fig. 69.

FIG. 45

PLANT 15-30 cm tall, leaves few in erect rosette; LEAVES 10-29 cm long, blades 0.6-0.9 cm wide, linear-triangular, outermost leaves broader and shorter than inner leaves, dense, spreading lepidote, velvety to touch, sheaths ca. 2.0 cm long by 1.2 cm wide, not conspicuous; SCAPE ca. 1 mm in diameter, curving limply; SCAPE-BRACTS 2.0-3.4 cm long by 0.5-0.7 cm wide, imbricate throughout, lowermost with caudate apices, upper bracts with apices acute; INFLORESCENCE ca. 13 cm long by 0.4-1.0 cm in diameter, simple, distichous, linear, rhachis slightly undulate, glabrous with ca. 10 to 20 flowers; FLORAL BRACTS ca. 1.4-1.9 cm long by 6-7 mm wide, ecarinate, strongly nerved, ovate, glabrous without, lepidote within, papery, apex acute, erect, scarcely or not at all touching, green, spotted with red when fresh; SEPALs 1.0-1.2 cm long by ca. 4 mm wide, erect, elliptic, ecarinate, very slightly nerved; PETALS ca. 1.6 cm long by 4-5 mm wide, white or yellow; CAPSULE 2.0-2.5 cm long, distance between flowers 5-8 mm, usually in flower around March-May.

MATERIAL EXAMINED: Hartweg 699 (P) near Samborandon, Prov. Guayas, ca. 50 m or less, 1841-1843; Hitchcock 21219 (US) epiphytic on tree near river, Portovelo, gold mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. to 1

Sept. 1923; Hitchcock 21246 (US) epiphytic, dry hill, Portovelo, gold mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. to 1 Sept. 1923; Asplund 15798 (US) epiphytic, "remnant wood in deforested ground," Santa Rosa, Prov. El Oro, near sea level, 18 March 1955; AJG 530 (US) epiphytic on Hippocrataceae shrub, summit of Cerro Azul, near Hacienda Barcelona, Prov. Guayas, ca. 400 m, 10 Dec. 1961; AJG 626 (US) on trail to summit of Cerro Azul, near Hacienda Barcelona, Prov. Guayas, ca. 300 m, 21 March 1962; AJG 632 (US) summit of Cerro Azul, near Hacienda Barcelona, Prov. Guayas, 400 m, 21 March 1962; AJG 636 (US) Cerro Azul, near Hacienda Barcelona, Prov. Guayas, 400 m, 21 March 1962; AJG 681 (US) Cerro Azul trail, near Hacienda Barcelona, Prov. Guayas, ca. 300 m, 21 April 1962; AJG 918a (US) near a finca, ca. km 70 Guayaquil-Manta, epiphytic, on "Jaboncillo," Prov. Manabí, ca. 200 m, 19 April 1964; AJG 924 (US) epiphytic on coffee bushes in old plantation, very common in limited area, 2 to 4 m from ground, ca. km 95 Guayaquil-Manta, Prov. Manabí, ca. 320 m, 19 April 1964; AJG 1052 (US) epiphytic on main trunk of tree, 1-3 m from ground, in capsule, km 80 Guayaquil-Quevedo, in Bombacaceae-mixed-"evergreen"-deciduous scrub, Prov. Guayas, ca. 50 m, 2 Aug. 1965.

NOTES: From the specimens collected to date, the range of this very distinct species seems to be coastal Ecuador not more than 100 km from the start of the rise of

the Andes or if more distant than on a Cerro and at elevations at least 200 m high. The specimens that have been collected generally seem to be fertile and seed production is copious. Where found, specimens are generally abundant. It is very common in cultivated land, especially on coffee and around fincas on such trees as the "Jaboncillo."

14. TILLANDSIA NARTHECIOIDES Presl, 1827 (Reliquiae Haenk. vol. 1) p. 125; Smith, 1951, pp. 512-513, fig. 72.

PLANT ca. 35 cm tall, rosette of leaves erect; LEAVES 16-40 cm long, blades 5-6 mm wide, narrowly triangular to linear, sheath 2.0 cm long by 1.5 cm wide; SCAPE to 40 cm long with inflorescence, 1-2 mm in diameter, curving; SCAPE-BRACTS 2.0-8.0 cm long, lowermost with long, twisting, caudate blade, uppermost with apex acute and barely imbricate; INFLORESCENCE 2.5-3.0 cm wide exclusive of capsules, simple with 12-24 flowers, rhachis flexuous, completely exposed; FLORAL BRACTS 1.1-1.4 cm long by 7 mm wide, strongly nerved, papery, slightly carinate, apex acute, ovate, spreading, not imbricate at all, slightly lepidote without, densely lepidote within; SEPALs 1.1-1.3 cm long by 4-5 mm wide, acute, strongly nerved, papery, subcarinate, glabrous without, lepidote within, equally connate for 1-2 mm; PETALS 2.4 cm long, white, turning yellow when dry; CAPSULE 3.0-3.5 cm long, usually in flower March-May, distance between flowers ca. 6 mm.

MATERIAL EXAMINED: Eggers 14277 (US) near Balao, Prov. Guayas, near sea level, Jan. 1892; Sodi-ro 171/41 (B; US, photo) near Guayaquil, Prov. Guayas; Hitchcock 20407 (US) epiphytic, Teresita, 3 km west of Bucay, Prov. Guayas, 270 m, 4-5 July 1923; Camp E3676 (US) epiphytic, foothills of western cordillera near Bucay, junction of Provs. Guayas, Cañar, Chimborazo and Bolívar, ca. 300 m,

8-14 June 1945; Fagerlind and Wibom 2644 (US) Clementina, a cerro and hacienda, Prov. Los Ríos, 100 m estimate, 30 March 1953; Teuscher cultivate Montreal 2110-56 "west of Ducur," Cuenca-Guayaquil road, Prov. Guayas, ca. 1000 m, Oct. 1958; Gilmartin 700 (US) epiphytic, common, Cerro Colorado ca. 6 km southeast of Manglaralto, Prov. Guayas, near sea level, 2 May 1962.

15. TILLANDSIA SCALIGERA Mez and Sodiro, 1905 (Bull. Herb. Boiss. series 2 vol. 5) p. 107; Smith, 1951, pp. 513-514, fig. 73.

PLANT 40-60 cm tall, leaf-rosette erect; LEAVES 20-30 cm long, blades 0.9-1.2 cm wide, linear, papery, sheath 2.5-3.0 long by 1.5 cm wide, inconspicuous; SCAPE 3-4 mm in diameter; SCAPE-BRACTS 2.0-12.0 cm long by 6-7 mm wide, blade caudate below, imbricate throughout, erect; INFLORESCENCE 3.0-3.5 cm wide exclusive of capsules, simple, distichous with up to 40 flowers; FLORAL BRACTS 1.8 cm long by ca. 1.2 cm wide, ovate, ecarinate, not nerved, or scarcely so, glabrous without, lepidote within, apex acute, margins curved, exceeded by calyx; SEPALs 1.4 cm long by 4 mm wide, elliptic, acute, not nerved, posteriorly carinate, free or nearly so, glabrous without, lepidote within; CAPSULES 3.5-4.0 cm long, distance between flowers 4-5 mm, usually in flower around Sept. to Dec.

MATERIAL EXAMINED: Sodiro 171/4 (B, TYPE; US, photo) "tropical forest" near Río Pilatón, Prov. Pichincha, estimate 800 m, Sept. 1890; Fagerlind and Wibom 393 (US) Las Americas, Prov. Guayas, ca. 100 m, 28-29 Sept. 1952; Levi-Castillo s. n. (US) epiphytic, Río Blanco, Prov. Guayas, near sea level, Nov. 1955; Espinosa 1176 (GH) road to Santa Rosa, Prov. El Oro, ca. 60-80 m, 26 Dec. 1946.

16. TILLANDSIA MONADELPHA (Morren) Baker, 1887 (Journ. Bot. vol. 25) p. 281; Smith, 1957, pp. 140-151.

Phytarrhiza monadelpha E. Morren, 1882 (Belgic. Hortic. vol. 32) p. 168, pl. 7.

PLANT to 35 cm tall; LEAVES to 24 cm long, blades 0.5-1.0 cm wide, linear, sheath 4.0-5.0 cm long by 2.5 cm wide; SCAPE ca. 3 mm in diameter, erect; SCAPE-BRACTS ca. 4.0 cm long, imbricate throughout, erect, apex caudate; INFLORESCENCE 6.0-13.0 cm long by 2.5-3.5 cm in diameter, simple, erect, distichous, with 15 to 20 flowers, these 0.7-1.0 cm apart, rhachis pulvinate; FLORAL BRACTS 1.8 cm long by 1.0-1.2 cm wide, ovate, margins tapering gradually to acute apex, unicarinate, glabrous without, lepidote within, nerved; SEPALS 1.7-1.9 cm long by 5 mm wide, glabrous without, lepidote within, acute, nerved, carinate; PETALS ca. 3.0 cm long, white usually; OVARY ca. 3 mm long by 1-2 mm in diameter, style ca. 1 mm long; CAPSULES 4.5-6.5 cm long; stamens included, distance between flowers 0.7-0.9 cm, in flower around May.

MATERIAL EXAMINED: Linden illustration of live plant introduction to European horticulture, origin unknown, Morren, (1882) pl. 7; Sodi 41 (Quito) Baba, Prov. Los Ríos, 1890; Sodi 171/42 (Quito) Balsapamba, Prov. Bolívar, 1890; Espinosa 1176 (GH) Prov. Loja, 1947; Eggers 15252 (US, photo) probably from Prov. Manabí, ca. 1883; Asplund 16455 (US) Timbre, epiphytic, Prov. Esmeraldas, ca. 100 m

or less, 24 May 1955; Gilmartin 761 (US) summit of Cerro Azul, near Hacienda Barcelona, abundant in capsule, Prov. Guayas, ca. 400 m, 24 July 1962.

17. TILLANDSIA CORNUTA Mez and Sodiro, 1905 (Bull. Herb. Boiss. series 2, vol. 5) p. 106; Smith, 1951, pp. 515-516, fig. 74.

FIG. 46

PLANT ca. 40 cm tall by ca. 16 cm in diameter, epiphytic; LEAVES 40-60 cm long, blades 1.2-1.6 cm wide, linear; sheath 2.5-3.0 cm long by 1.6 cm wide, not conspicuous; SCAPE including inflorescence ca. 40 cm long by 2 mm in diameter, erect; SCAPE-BRACTS 2.0-2.5 cm long by 1.2 cm wide, apex acute not at all caudate, imbricate, erect; INFLORESCENCE 10-12 cm long by 3.0 cm wide, simple, distichous with 12 to 25 flowers, distance between floral bracts 6-9 mm; FLORAL BRACTS 1.8 cm long by 1.0-1.2 cm wide, divergent, apex acute, ovate, glabrous without, lepidote within, backs smooth, neither nerved nor carinate; SEPALS 1.8 cm long, obscured by floral bracts, glabrous without, lepidote within, broad-acute to obtuse, not nerved, sides nearly straight, obovate to oblong, connate for 2-3 mm posteriorly; PETALS white; CAPSULE 5.5-6.0 cm long, distance between flowers 6-9 mm.

MATERIAL EXAMINED: Sodiro 171/42 (B, TYPE; US, photo) Prov. Bolívar, near Balsapamba, ca. 1800 m, Oct. 1890; Foster 2636 (US) "dense, moist jungle," Santo Domingo-Quito road, ca. 800 m, 9 Dec. 1948; AJG 1064 (US) epiphytic, ca. 2 m from ground, rare, 2 km northwest of Santo Domingo, La Mina de Toachi, well developed rain

forest, area being lumbered but collection from undisturbed portion of area, .5 km distant from active lumbering, Prov. Pichincha, ca. 600 m, 3 Aug. 1965.

TILLANDSIA subgenus DIAPHORANTHEMA

Tillandsia subgenus Diaphoranthema Baker, 1878 (Journ. Bot. vol. 16) p. 236.

Leaf-blades narrowly triangular or linear; inflorescence simple, 1-few-flowered; flowers distichous; petal-blades narrow and inconspicuous; stamens deeply included; style no longer than ovary.

KEY TO THE ECUADORIAN SPECIES OF TILLANDSIA

subgenus DIAPHORANTHEMA

1. Plants growing in spherical masses, stem NOT exceeding 10 cm, concealed by imbricate leaf-sheaths; scape terminal and always evident. : 1. T. recurvata.
1. Plants growing in pendent masses, stem to 8 m long and exposed; flowers solitary on short pseudo-axillary branches.
. : 2. T. usneoides.

1. TILLANDSIA RECURVATA (L.) L., 1762 (Species Plantarum ed. 2) p. 410; Smith, 1957, p. 142.

Renealmia recurvata L., 1753 (Specie Plantarum) p. 287.

FIG. 47

Plant usually epiphytic, with stems densely massed and forming spherical aggregations of stems 7.0-20.0 cm across; PLANT 10-20 cm long when extended; LEAVES 3.0-17.0 cm long, blades ca. 2 mm wide, linear-subulate, densely lepidote, scales spreading, sheath ca. 1.4 cm long by 5-6 mm wide with hyaline margins, subglabrous within, densely, spreading-lepidote without; SCAPE to 13 cm long by ca. 5 mm in diameter; SCAPE-BRACTS usually only one sometimes two, then remote, erect; INFLORESCENCE 5-10 mm long, simple, 1 to 5 flowers, dense, lepidote; FLORAL BRACTS ca. 8 mm long by 3 mm wide, erect, ovate, obviously nerved, papery, ecarinate, apex acute, usually about equaling the sepals; SEPALS ca. 8 mm long by 3 mm wide, erect, ovate, free, papery, strongly nerved, glabrous within, acute; PETALS with narrow blades, violet or white; CAPSULES 1.5-2.5 cm long, distance between flowers ca. 6 mm.

MATERIAL EXAMINED: Steiermark 53724a (GH) dry rocky slopes bordering Río Leon, towards Oña, on north side of Río Leon; Prov. Azuay, 1970 m, 3 Aug. 1943; AJG 833 (US) epiphytic on Prosopis ca. 90 km south of Cuenca, road to Loja, banks of Río Leon, Prov. Azuay, 1700 m, 20 Feb.

1963; Lehmann 646 (US) by Río Chota north of Ibarra, Prov. Carchi, 1200-2000 m, Jan. 1881; Acosta-Solís 12485 (F) "epífita del algarrobo," Salinas, Prov. Imabura, 1700 m, 25 May 1949; Acosta-Solís 12950 (F), Laguna de Yaguarcocha, just north of Ibarra, Prov. Imbabura, 2250 m, 5 June 1949; Asplund 10464 (US) Salinas, Prov. Imbabura 1650 m, 23 Jan. 1940; Fagerlind and Wibom (US) between Puerto Cayo and Joaz, Prov. Manabí, 13 Oct. 1952; Harling 5780 (US) epiphytic, Malacatos, Prov. Loja, 1400-1700 m, 11 July 1959; AJG 1128 (US) epiphytic on avocado, 2 km west of Catamayo, Prov. Loja, 1140 m, 10 Aug. 1965; Hitchcock 20839 (US) road from Otavalo to Malchingui, Prov. Pichincha, 2400-3000 m, 12 Aug. 1923; Benoist 3728 (P) Guayllabamba, Prov. Pichincha, 2200 m, 16 Jan. 1931; Acosta-Solís 11304 (F) Prov. Pichincha(?); Acosta-Solís 16284 (F) El Pisque near Guayllabamba, 1800 m, 30 March 1950; Acosta-Solís 16438 (F) "epífita de los naranjos," Prov. Pichincha, Puellaró, Prov. Pichincha, 2100 m, 16 April 1950; Asplund 6561 (US) epiphytic on dead tree trunk, Tumbaco, east of Quito, Prov. Pichincha, 2250 m, 29 May 1939; Asplund 7246 (US) Puente Guayllabamba, Prov. Pichincha, 1900 m, 20 Aug. 1939; Asplund 29292 (US) bridge below Perucho, cliff, east of Río Guayllabamba, Prov. Pichincha, 1550 m, 17 April 1956; Asplund 8153 (US) valley of Río Pillaro, perpendicular cliff, between Ambato and Pillaro, Prov. Tungurahua, 10 Aug. 1939; Acosta-Solís 8661 (F) between Ambato and

Pishilata, Prov. Tungurahua, 2500-2680 m, 25 Oct. 1944; Acosta-Solís 8938 (F) between Pelileo and La Tranquilla, Prov. Tungurahua, 2200-2500 m, 14 Nov. 1944; Acosta-Solís 9250 (F) between Guachi Bajo and Pishilata, Prov. Tungurahua, 2420-2700 m, 1 Dec. 1944.

Southeast UNITED STATES to northern ARGENTINA and CHILE.

NOTES: Tillandsia recurvata (L.) L. has been collected in Ecuador from near sea level to 2700 m altitude. For example, it has been observed growing on telephone wires near the city of Quito and epiphytically on the Santa Elena Peninsula on the coast. Although usually epiphytic it has been collected from steep cliffs where it was growing terrestrially. Capsule production is usually abundant and seeds also are abundant. It seems to flower nearly continuously.

2. TILLANDSIA USNEOIDES (L.) L., 1762 (Species Plantarum ed. 2) p. 411; Smith, 1957, pp. 143-144.

Renealmia usneoides L., 1753 (Species Plantarum) p. 287.

FIG. 48

Plant usually epiphytic, with long stems forming pendent masses; PLANT to 8 m long when extended; LEAVES ca. 5.0 cm long, blades linear-filiform, ca. 1 mm wide, densely, spreading-lepidote, sheaths ca. 8 mm long, elliptic; SCAPE lacking; INFLORESCENCE a single flower; FLORAL BRACTS 4-5 mm long, ovate, lepidote; SEPALs to 7 mm long, thin, nerved, narrowly ovate, glabrous, acute; PETALS 9-11 mm long, narrow, pale green or blue, stamens deeply included and exceeding the pistle; CAPSULES 1.3-2.5 cm long.

MATERIAL EXAMINED: Rose and Rose 22943 (US) sterile, near Cuenca, Prov. Azuay, 17-24 Sept. 1918; Steyermark 53720 (US) dry rocky slopes bordering Río Leon towards Oña on north side of Río Leon, sterile, Prov. Azuay, 1970 m, 3 Aug. 1943; Schimpff 868 (US) mostly sterile, valley of Rio Chimbo, Prov. Chimborazo, 2700 m, 20 March 1934; Fosberg and Giler 22587 (US) barely dry cliffs and talus at their base, Sibambe, Prov. Chimborazo, 2460-2550 m, 28 Jan. 1945; AJG 635 (US) Cerro Azul, Hacienda Barcelono, ca. 2/3 of way to top of Cerro, western slope, Prov. Guayas, ca. 300 m, 21 March 1962; Acosta-Solis 14979 (F)

"partidero a Chota y Juncal," "barba de viejo," Prov. Imbabura, 1500-1600 m, 30 Dec. 1949; Hitchcock 21325 (US) near Catamayo, Prov. Loja, 1000-2200 m, 3 Sept. 1923; Camp E-126 (US) Malacatos valley, ca. 25 km south of Loja, Prov. Loja, ca. 1520 m, 9 July 1944; Fosberg and Giler 23084 (US) south of Vilcabamba, Quebrada Amrilla, Hacienda Guaycopamba on Río Guaycopamba, flat, gravelly bottom of deep ravine, 4° 28' south, 79° 13' west, Prov. Loja, 1800-1850 m, 15 Feb. 1945; Acosta-Solís 14979 (F) Cerro de Hojas east of Montecristi, Prov. Manabí, 200 m, 20 June 1949; E. Little 6691 (US) Arenillas, epiphytic on "guayacan," Prov. El Oro, 22 June 1943; Asplund 7247 (US) Puente Guayllabamba, Prov. Pichincha, 1900 m, 20 Aug. 1939; Lehmann 875 (US) sterile, near Ambato, Prov. Tungurahua, 2500 m, Sept. 1881; AJG 1093 (US) sterile, km 45 Ambato-Baños, growing mixed with cryptogams, very abundant, Prov. Tungurahua, 2000 m, 7 Aug. 1965.

Southeastern UNITED STATES to central ARGENTINA and CHILE.

NOTES: Tillandsia usneoides (L.) L. has been collected in Ecuador from ca. 200 to 2700 meters altitude. Frequently during September and August in the Andes only vegetative portions are in evidence. Capsules when they are produced are not strikingly abundant. This is in contrast with T. recurvata (L.) L. which produces capsules copiously.

TILLANDSIA subgenus PSEUDO-CATOPSIS

Tillandsia subgenus Pseudo-Catopsis Baker, 1889 (Handbook Bromel.) p. 157.

Plants often growing in dry or windy areas, leaves moderately to densely lepidote; inflorescence mostly compound, bipinnate to quadripinnate, flowers distichous, sometimes turning secund; flowers inconspicuous, sepals usually asymmetric or at least obovate, style short, about as long as the ovary, stamens included; stoma usually round in surface view, exceptions are T. riocruexii and T. ropalocarpa.

KEY TO THE ECUADORIAN SPECIES OF

TILLANDSIA subgenus PSEUDO-CATOPSIS



A

1. Floral bracts nearly equal to or exceeding sepals at anthesis (A)*, (except T. tetrantha some varieties).

2. Plant 10-35 cm tall, leaf-blades not more than 1.0 cm wide, often involute at least in part.



B

3. Leaves definitely undulate-crisped throughout blade, sepals 5-8 mm long, NOT nerved, ecarinate (B) : 1. T. crispa.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



BE

3. Leaves NOT undulate-cripsed at all, sepals 4-5 mm long or ca. 1.1 cm long, nerved, carinate (BB).

4. Sepals ca. 4-5 mm long, floral bracts to 1.0 cm long by ca. 7 mm wide. : 2. T. pendulispica.

4. Sepals ca. 1.0 cm long, floral bracts 1.4-1.6 cm long by ca. 1.4 cm wide. : 3. T. seemannii.

2. Plant at least 40 cm tall, leaf-blades 1.5-8.0 cm wide, NOT involute.



C

5. Plant 1.5-3.0 m tall, leaves 45 cm to 1 m long, blades 3.0-8.0 cm wide.

6. Floral bracts with apex obtuse (C), to 1.6 cm long, inflorescence bipinnate. : 4. T. inconspicua.



CC

6. Floral bracts with apex acute to attenuate (CC), 0.7-1.4 cm long, inflorescence tripinnate.

7. Flowers densely disposed on spike-rhachis, 12-30 per spike, distance between flowers 3-5 mm, often turning upward. : 5. T. fraseri.

7. Flowers laxly disposed on spike-rhachis, 4-12 per spike, distance between flowers 0.8-1.3 cm, flowers

- NOT turning upward. . . . : 6. T. elegans.
5. Plant 40-120 cm tall, leaves 10-50 cm long, blades 1.5-4.0 cm wide.
8. Spike width at anthesis exclusive of petals or capsules 4-9 mm, inflorescence tripinnate-quadripinnate, branches spreading at least in part.
9. Primary bracts to 1.3 cm wide, spike-rhachis densely lepidote.
- : 7. T. pectinata.
9. Primary bracts 5-6 mm wide, spike-rhachis mostly glabrous.
10. Leaves with margins slightly to strongly undulate, plant 75-120 cm tall, flowers laxly disposed, 0.3-1.0 cm apart. : 8. T. pugiformis.
10. Leaves with margins NOT at all undulate, flowers densely disposed, 3-5 mm apart.
11. Inflorescence to 10 cm long, primary branches and spikes recurving.
- : 10. T. sinuosa var. guirozii.
11. Inflorescence ca. 32 cm long, primary branches and spikes ascending.
- : 9. T. sinuosa var. sinuosa.
8. Spike width at anthesis exclusive of petals and capsules 0.8-2.0 cm, inflores-

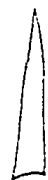
cence bi-tripinnate, branches NOT spreading or inflorescence bipinnate.



D

12. Branches maximally 6.0-7.0 cm long, spikes 5-7 mm apart.

13. Scape-bracts with apices caudate (D), scape visible, spikes 1.5-3.0 cm long
 : 11. T. subalata.



DD

13. Scape-bracts with apices acute (DD), scape totally obscured, spikes 3.0-4.5 cm long. : 12. T. monticola.

12. Branches maximally 12-25 cm long OR inflorescence bipinnate, spikes at least 0.8 cm apart.



E

14. Sepals symmetrical (E), mostly ovate, all three carinate, inflorescence tripinnate.

15. Leaf-sheaths NOT partly purple, inflorescence glabrous.
 . . . : 13. T. insularis var. insularis.

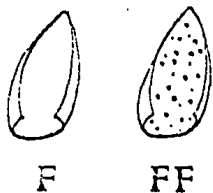


EE

15. Leaf-sheaths partly purple, inflorescence lepidote.
 . . : 14. T. insularis var. latilamina.

14. Sepals asymmetrical (EE), obovate, posteriorly carinate, inflorescence bi-quadripinnate.

16. Inflorescence tri-quadripinnate,

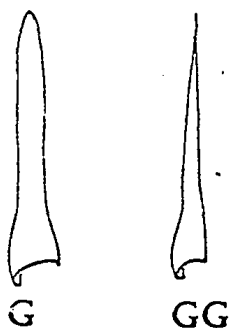


floral bracts glabrous within (F).

17. Spikes 3.0-12.0 cm long, floral bracts ca. 5 mm long, straw-colored when dry. : 15. T. micrantha.

17. Spikes ca. 2.0 cm long throughout, floral bracts 6-8 mm long, reddish when dry. : 16. T. quadripinnata.

16. Inflorescence bipinnate, floral bracts lepidote within (FF).

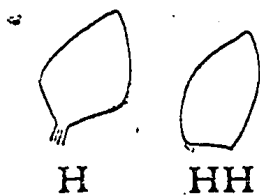


18. Leaf-blades lingulate (G), 40-60 cm long by 3.0-4.0 cm wide, floral bracts 1.2-1.5 cm long, spikes 4.0-5.5 cm long : 17. T. gilmartiniae.

18. Leaf-blades triangular to subtriangular (GG), to 45 cm long by 1.5-3.5 cm wide, floral bracts 0.3-1.2 cm long.

19. Floral bracts ca. 1.0-1.2 cm long, often secund.

20. Floral bracts glabrous without, trullate (H), leaves to 25 cm long. : 18. T. riocruexii.



20. Floral bracts much lepidote without, ovate (HH), leaves to 40 cm long.

21. Inflorescence elongate to 30 cm, primary bracts to 5.0 cm long. : 21. T. tetrantha var. scarlatina.

21. Inflorescence short, to 20 cm long, primary bracts 3.0-4.0 cm long. : 22. T. tetrantha var. aurantiaca.

19. Floral bracts NOT exceeding 9 mm in length.

22. Scape erect, leaves 18-23 cm long. : 19. T. homostachya.

22. Scape curving, leaves 25-45 cm long.

23. Floral bracts minute, much less than one-half sepal length (I), rhachis of inflorescence tortuously bent.

. . . : 20. T. tetrantha var. tetrantha.

23. Floral bracts 6-7 mm long, much more than one-half sepal length (II), rhachis of inflorescence nearly straight

. . . : 23. T. tetrantha var. densiflora.

1. Floral bracts conspicuously exceeded by sepals at anthesis (AA).

24. Inflorescence always erect, usually tri-quadripinnate.

25. Sepals all three carinate, NOT obviously asymmetrical (E), nor obovate.

26. Leaves very narrowly triangular, ca. 8 mm wide, branches NOT having an obvious stipe. . . . : 25. T. laminata.

26. Leaves lingulate to sublingulate, ca. 2.5-6.0 cm wide, branches with stipe 0.5-5.0 cm long.

27. Leaf-sheaths NOT partly purple,



inflorescence glabrous.

. : 13. T. insularis var. insularis.

27. Leaf-sheaths partly purple, inflorescence
lepidote.

. : 14. T. insularis var. latilamina.

25. Sepals posteriorly carinate only, obviously
asymmetrical (EE), or obovate or both.



EE

28. Floral bracts densely ferruginous lepi-
dote, 1.2-1.5 cm long.

. : 17. T. gilmartiniae.

28. Floral bracts NOT densely ferruginous
lepidote, to 6 mm long.



J

29. Lateral spikes NOT exceeding 3.0 cm in
length, usually ca. 2.0 cm long, distance
between flowers 1-2 mm.

30. Flowers spreading at not more than 45°
angle to spike-rhachis (J), spike-
rhachis lepidote. . . : 26. T. penlandii.



JJ

30. Flowers spreading at nearly right angles
to spike-rhachis (JJ), spike-rhachis
glabrous.

31. Leaf-blades ca. 1.2 cm wide, apex fil-
iform, primary bracts mostly exceeding
branches.

. . . : 27. T. multiflora var. multiflora.

31. Leaf-blades 2.0-3.0 cm wide, apex acute

or caudate, primary bracts mostly shorter than branches.

32. Leaf-apex long-caudate, blade ca. 2.5 cm wide, inflorescence ca. 10 cm or more in diameter.
 . . : 28. T. multiflora var. decipiens.
32. Leaf-blade apex acute-attenuate, blade to 3.0 cm wide, inflorescence usually 10 cm in diameter or less.
 . . : 29. T. multiflora var. tomensis.
29. Lateral spikes 2.0-4.5 cm long, distance between flowers 2-4 mm.
33. Floral bracts 3-4 mm long, scape-bracts NOT imbricate toward the inflorescence, primary bracts to 2.5 cm long. : 30. T. ropalocarpa.
33. Floral bracts 5-6 mm long, scape-bracts imbricate, primary bracts to 6.0 cm long. . . . : 31. T. tripinnata.
24. Inflorescence curved, usually bipinnate.
34. Leaf-blades lanceolate, ca. 2.0-3.0 cm wide, primary bracts bright red or yellow, exceeding and partially obscuring spikes.
 . . . : 24. T. tetrantha var. miniata.
34. Leaf-blades narrowly triangular, ca.

6-7 mm wide, NOT exceeding 2.0 cm in width, primary bracts mostly shorter than spikes and NOT at all obscuring or exceeding them.

35. Spikes erect, capsules 2.0-2.5 cm long

. . . . : 32. T. adpressa var. adpressa.

35. Spikes spreading, capsules 1.0-1.8 cm long

. . . . : 33. T. adpressa var. tonduziana.

1. TILLANDSIA CRISPA (Baker) Mez, 1896 (DC Monogr. vol. 9) p. 739; Mez, 1935, p. 499; Smith, 1930, p. 21.

Guzmania crispera Baker, 1887 (Jour. Bot. vol. 25) p. 173.

Tillandsia undulifolia Mez, 1896 (DC Monogr. vol. 9) p. 740.

T. plicatifolia sensu Smith, 1930, non Ule, 1907.

PLANT 10-25 cm tall, not stemmed; LEAVES 4.0-26.0 cm long, blades 0.4-1.0 cm wide, strongly undulate-crisped throughout, sheath 2.0-6.0 cm long by ca. 2.0 cm wide, very conspicuous, dark brown when dry; SCAPE ca. 2 mm in diameter, erect to slightly curved; SCAPE-BRACTS 0.8-1.4 cm long, erect with blades recurved, imbricate throughout; INFLORESCENCE 1.5-8.0 cm long by 1.4-6.5 cm in diameter, simple or bipinnate with few spikes; SPIKES ca. 1.5-2.0 cm wide with 6 to 20 flowers, erect, distance between ca. 2.0 cm; FLORAL BRACTS ca. 1.5 cm long by estimated 1.2 cm wide, broadly ovate, nerved, imbricate, apex rounded, papery, lepidote; SEPALS 5-8 mm long, coriaceous, broadly elliptic, not nerved, ecarinate; PETALS exceeding calyx, distance between flowers 3-4 mm.

MATERIAL EXAMINED: Purdie s. n. (K, TYPE; US, photo) Colombia; Drake 306 (K, NY; US, photo) Río de San Francisco, Prov. Guayas(?), 1882.

2. TILLANDSIA PENDULISPICA Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 745; Smith, 1952, p. 29.

T. dielsii Harms, 1935 (Notizblatt Bot. Gard. und Mus. vol. 12) pp. 534-535.

PLANT 25-35 cm tall, growing in clumps, epiphytic; LEAVES 2.5-35.0 cm long, blades 3-4 mm wide, subulate, involute, mottled red or purple, exceeding the scape and as long as or longer than inflorescence, sheath reddish-purple, densely, loosely lepidote, ca. 10 scales per mm², rosette erect, elongate-ovate; SCAPE 24-34 cm long with inflorescence, 1 mm in diameter, slightly curved; SCAPE-BRACTS 2.0-3.0 cm long by ca. 7 mm wide, erect throughout, not at all imbricate anywhere on scape, apex acute to short-caudate; INFLORESCENCE 7.0-13.0 cm long by 3.0-5.0 cm in diameter, bipinnate, lax, glabrous, nodding, with 4 to 6 spikes; PRIMARY BRACTS 1.0-1.7 cm long, erect, always covering stipe of spike; SPIKES 2.8-8.0 cm long by 0.9-1.1 cm wide, spike rhachis exposed and geniculate, distance between 1.0-2.5 cm, flowers per spike 8 to 20, stipe ca. 0.8-1.0 cm long, no sterile bracts; FLORAL BRACTS 0.8-1.0 cm long by 7 mm wide, trullate, strongly nerved, ecarinate or subcarinate, glabrous without, inconspicuously lepidote within, papery, erect, partly imbricate, reddish-orange; SEPALs 4-5 mm long, by 3-4 mm wide, strongly asymmetrical, obovate, obtuse, posteriorly carinate, subcoriaceous, free; PETALS not much exceeding calyx, yellow; CAPSULE ca.

1.8 cm long, distance between flowers 3-4 mm apart, time of flowering ca. September to November.

MATERIAL EXAMINED: Diels 951 (B, TYPE of T. dielsii; US, photo) epiphytic, Río Pastaza valley, near pueblo of Río Negro, between Baños and Puyo, Prov. Tungurahua, ca. 1250 m, 12 Sept. 1933; Camp E-1392 (US) epiphytic, ridge south and west of Río Itzintza, Cutucú range lying east of Mendez, Prov. Zamora, ca. 2000 m, 17 Nov. to 5 Dec. 1944.

PERU.

NOTES: Although I have not seen the type specimen of T. pendulispica Mez; from Mez's description (1935, p. 503) there does not seem to be any way to distinguish this from the later described T. dielsii Harms. Therefore I am reducing to taxonomic synonymy T. dielsii under T. pendulispica. The two collections of this plant which have been made in Ecuador are both from the Oriente of Ecuador, well east of the Andes.

3. TILLANDSIA SEEMANNII (Baker) Mez, 1896 (DC Monogr. vol. 9) p. 737; Smith, 1930, p. 20.

Guzmania seemanni Baker, 1889 (Handbook Bromel.) p. 153.

T. seemannii (Baker) Mez var. Mezii (André) L. B. Smith, 1930, p. 14.

PLANT ca. 20 cm tall by 10 cm in diameter; LEAVES 5.5-15.0 cm long, blades 5-7 mm wide, triangular, some involute, reddish when alive and when dry, sheath 3.0-4.5 cm long by 2.5-3.0 cm wide, elliptic to round, conspicuous, outermost leaves with short blades; SCAPE ca. 19 cm long with inflorescence, 2 mm in diameter, about as long as or slightly exceeding leaves; SCAPE-BRACTS 2.5-3.0 cm long, erect, imbricate, not at all foliaceous; INFLORESCENCE 4.0-5.0 cm long by ca. 1.7 cm wide, simple or occasionally with 2 or 3 spikes, lepidote, reddish; FLORAL BRACTS 1.4-1.6 cm long by ca. 1.4 cm wide, trullate, papery, ecarinate, strongly nerved, lepidote without, glabrous within, reddish, with 7 to 12 floral bracts per spike; SEPALs ca. 1.1 cm long by 0.7 cm wide, apex obtuse, posteriorly carinate, free, nerved, lepidote without, glabrous within, subcoriaceous; PETALS slightly exceeding calyx, white, turning yellow, distance between flowers ca. 4-5 mm, in flower around July-September.

MATERIAL EXAMINED: Seemann 898 (K, TYPE; US, photo) near Loja, Prov. Loja, estimated 2000 m, 1847; Lehmann

7761 (US) Ecuador; Espinosa E 696 (GH) epiphytic, Villanaco, Prov. Loja, 2900 m, 5 Oct. 1946; Espinosa E 1027 (GH) epiphytic, Horta-Naque, Prov. Loja, 3100-3500 m, 9 Nov. 1946; Harling 5976 (US) epiphytic, near border between Provs. of Zamora and Loja, Prov. Zamora, 2800 m, 14-19 July 1959; Dodson and Thien 680 (US) near pass, between Loja and Zamora, cloud forest, Prov. Loja ca. 3200 m, 18 Sept. 1961.

4. TILLANDSIA INCONSPICUA André, 1888 (Énumération Bromél.)
p. 8; André, 1889, pp. 74-75; Baker, 1889, p. 196;
Smith, 1930, p. 24.

PLANT ca. 2 m tall; LEAVES ca. 1 m long, blades 5.5-7.0 cm wide, lingulate, apex apiculate, subglabrous; SCAPE with inflorescence to nearly 2 m long, ca. 8 mm in diameter, erect; SCAPE-BRACTS at least 9.0 cm long, strictly erect, imbricate, green or reddish; INFLORESCENCE ca. 60 cm long by ca. 14 cm in diameter, bipinnate, lax, pyramidal to cylindrical; PRIMARY BRACTS 2.5-4.0 cm long, broadly ovate, spreading, much shorter than spikes; SPIKES 4.0-10.0 cm long by 1.5-2.0 cm wide, about 20 spikes, distance between 1.2-4.0 cm, 9 to 15 flowers per spike, spike-rhachis geniculate, stipe minimal; FLORAL BRACTS 1.4-1.6 cm long, spreading, mostly exposing spike-rhachis, imbricate only toward spike apex, apex obtuse, carinate, slightly nerved, slightly lepidote; SEPALs ca. 1.0 cm long, obovate, obtuse, lepidote, distance between flowers ca. 4-8 mm.

MATERIAL EXAMINED: André 3795 (K, TYPE; US, photo)
Niebli, Prov. Pichincha, ca. 2000 m, June 1876.

5. TILLANDSIA FRASERI Baker, 1889 (Handbook Bromel) p. 187; Smith, 1957, pp. 157-158, fig. 44.

T. rectiflora André, 1888 (Énumération Bromél.) p. 7.

T. erectiflora André, 1889 (Broméliaceae Andreanae) pp. 86-87, pl. 26 B.

FIG. 49

PLANT 1.5-3.0 m tall; LEAVES ca. 50 cm long, blades 6.5-8.0 cm wide, lingulate, apex acute, densely, much appressed-lepidote, sheath 12-14 cm long by ca. 9.0 cm wide, ovate, brown; SCAPE with inflorescence to nearly 3 m long, 0.9-1.0 cm in diameter, erect, red, much exceeding leaf-rosette; SCAPE-BRACTS 6.0-20.0 cm long, erect, imbricate and foliaceous below, imbricate above; INFLORESCENCE ca. 25-35 cm long by 12-16 cm in diameter, tripinnate, lax, pyramidal, with ca. 10 primary branches, glabrous; PRIMARY BRACTS 1.0-4.0 cm long, spreading, always exceeding the primary branch stipe, apex acute to attenuate; PRIMARY BRANCHES 8.0-10.0 cm long by 3.0-10.0 cm wide with 1 to 10 spikes; SPIKES 3.0-11.0 cm long by 0.8-1.0 cm wide, spreading, with flowers all or partly turning and facing upward, in bud, flowers may be distichous only, distance between spikes 1.0-2.5 cm, 12 to 30 flowers per spike; FLORAL BRACTS 0.8-1.0 cm long by ca. 0.7 cm wide, apex acute to attenuate, few scattered loose scales without, densely lepidote within, reddish, strongly nerved, ecarinate; SEPALs ca. 7 mm long by 3-4 mm wide, ovate-elliptic, not

asymmetrical, carinate, all free, strongly nerved, coriaceous, glabrous without and within, acute, reddish; PETALS ca. 9 mm long, white when fresh, turning yellow when dry; CAPSULE 2.0-3.0 cm long, distance between flowers 3-5 mm.

MATERIAL EXAMINED: Fraser s. n. (BM, TYPE; US, photo) Ecuador, collected before 1862; André 7249 (K, TYPE of T. erectiflora; US, photo) Niebli, Prov. Pichincha, ca. 2000 m, June 1876; Sodiro 171/34 (B; US, photo) Cotocallao, Prov. Pichincha, est. 3000 m, 1896; Hitchcock 20633 (US) Huigra, Prov. Chimborazo, 1200 m, 4, 16; 20-27 July 1923; Rose and Rose 22579 (US) near Huigra, on Hacienda de Licay, Prov. Chimborazo, 7 Sept. 1918; Foster 2596 (US) road to Cachicaran, epiphytic, Prov. Loja, ca. 900 m, 30 Nov. 1948; Levi-Castillo s. n. (US) Bucay, Prov. Guayas, 250 m, no date. Asplund 8623 (US) epiphytic, valley of Río Guayllabamba, near Perucho, Prov. Pichincha 1700-1800 m, 4 Sept. 1939; Naundorff s. n. cultivated by Marnier-Lapostolle, (US) in Crater Pululahua, Prov. Pichincha, ca. 1500 m, Aug. 1966.

6. TILLANDSIA ELEGANS L. B. Smith, 1954 (Contrib. U.S. Nat. Herb. vol. 29, no. 11) pp. 528-529, fig. 84.

PLANT ca. 1.5-2.0 cm tall; LEAVES ca. 45 cm long, blades 3.0-4.0 cm wide, blade lingulate to triangular, apex long-attenuate, moderately dense lepidote, ca. 5-8 scales per mm², sheath ca. 17 cm long by 9.0 cm wide, very dark castaneous; SCAPE unknown; INFLORESCENCE probably ca. 35 cm long by ca. 30 cm in diameter, tripinnate, lax, reddish, glabrous; PRIMARY BRACTS ca. 4.0 cm long, spreading, consistently shorter than main branch stipe, apex broadly acute; PRIMARY BRANCHES ca. 15-30 cm long, ascending, 10-12 cm wide, stipe to 6.5 cm long with one sterile bract, distance between primary branches ca. 5.0 cm, primary branches having ca. 4 spikes; SPIKES 6.0-12.0 cm long by 1.5 cm wide, ascending, distance between ca. 2.7-3.8 cm, flowers per spike 4 to 12, spike rhachis strongly undulate to nearly geniculate, stipe of spike ca. 1.0 cm long with no sterile bracts; FLORAL BRACTS ca. 1.3 cm long by ca. 1.1 cm wide, strongly nerved, papery, ecarinate, glabrous without, silvery lepidote within, reddish, apex acute, some bracts to 1.9 cm long, these apparently modified secondary bracts, with one flower in their axil; SEPALS 7-9 mm long by 4 mm wide, obtuse, obovate, posteriorly carinate, coriaceous, glabrous without, slightly lepidote within, free; PETALS ca. 1.1 cm long, white when fresh, turning red, slightly exerted beyond

calyx, stamens included as is stigma, distance between flowers 0.8-1.3 cm.

MATERIAL EXAMINED: Drew E-391 (US, TYPE) epiphytic, along trail between Laguna de La Virgen and Camp Arenillas, east of Volcan de Cayambe, wet rainforest, Prov. Imbabura, ca. 3000 m, 27 July 1944.

7. TILLANDSIA PECTINATA André, 1888 (Énumération Bromél.)
p. 7; André, 1889, pp. 87-88, pl. 30 A; Smith, 1957,
pp. 158-159.

PLANT 60-100 cm tall; LEAVES 20-40 cm long, blades 3.0-4.0 cm wide, lingulate, apex acute to apiculate, subglabrous, sheaths 8.0-15.0 cm long by 6.0-9.0 cm wide, brown, elliptic; SCAPE with inflorescence 58-98 cm long, 3-6 mm in diameter, erect, slightly exceeding leaf-rosette; SCAPE-BRACTS 5.0-14.0 cm long, imbricate and foliaceous throughout, erect, apex long-acute; INFLORESCENCE 25-40 cm long by 9.0-11.0 cm in diameter, tripinnate, lax, cylindrical; PRIMARY BRACTS 1.5-4.0 cm long by 0.8-1.3 cm wide, erect to spreading, apex long-attenuate, distance between 1.0-4.5 cm, subdistichous; PRIMARY BRANCHES 4.5-9.0 cm long by 2.5-3.0 cm wide, erect to ascending, some spreading with up to 5 spikes per branch; SPIKES 2.5-5.0 cm long by 6-8 mm wide, erect to ascending, distance between spikes 0.5-1.0 cm, flowers per spike 8 to 20, stipe of spike minimal; FLORAL BRACTS ca. 7 mm long by 8 mm wide, very broadly ovate, apex acute, erect to spreading, some turning and facing downwards, imbricate, papery, strongly nerved, ecarinate, lepidote without, loose but coalescing scales within, purplish with thin pale margins; SEPALS ca. 7 mm long by 3-4 mm wide, obovate, obtuse, carinate, mostly free, coriaceous, densely lepidote without, somewhat silvery within; PETALS ca. 8-9 mm long, white or

yellow; CAPSULE ca. 2.0 cm long, distance between flowers 2-3 mm.

MATERIAL EXAMINED: André 3032 (K, TYPE; US, photo) Tuza, Prov. Imbabura, June, 1876; Drew E-464 (US) in Parque Alameda Quito, epiphytic on "Cedrela," Prov. Pichincha, ca. 2800 m, 15 Aug. 1944; Acosta-Solis 13496 (F) Quito city park, Prov. Pichincha, ca. 2800 m, 20 Aug. 1949; Rauh, Hirsch E 298 (US) "Los Alpes." Prov.(?) ca. 3300 m, 18 Sept. 1954; Marnier-Lapostolle cultivated from Naundorff s. n. (US) Parachoa Prov. Pichincha, 17 April 1963.

COLOMBIA.

8. TILLANDSIA PUGIFORMIS L. B. Smith, 1930 (Contrib. Gray Herb., vol. 89) pp. 13-14, pl. 1, figs. 4-7.

PLANT 25-120 cm tall by ca. 30 cm in diameter, a campanulate rosette, epiphytic or close to ground; LEAVES 10-34 cm long, blades 1.5-2.5 cm wide, narrowly triangular with margins slightly to strongly undulate, densely much appressed-lepidote, sheath 8.0-13.0 cm long by 4.0-7.0 cm wide, reddish brown; SCAPE with inflorescence 75-110 cm long, ca. 3 mm in diameter, erect to slightly curving, very much exceeding leaf-rosette; SCAPE-BRACTS 3.5-15.0 cm long by 0.8-1.2 cm wide, erect, imbricate below only, above, shorter than internodes, apices caudate to acute; INFLORESCENCE 20-40 cm long by 10-15 cm in diameter, tripinnate, distichous in both disposition of flowers and primary spikes, lax, slightly lepidote but not conspicuously so; PRIMARY BRACTS 1.0-2.5 cm long by ca. 5 mm wide, apex acute, spreading, mostly shorter than sterile base of spikes; PRIMARY BRANCHES 7.0-13.0 cm long by ca. 5.0 cm wide, distance between 1.0-3.0 cm; SPIKES 4.0-5.0 cm long by 6-7 mm wide, reflexed, linear, with 6 to 23 flowers, stipe 1.5-3.0 cm long with 1-2 sterile bracts; FLORAL BRACTS ca. 5 mm long by ca. 5 mm wide, erect but not imbricate because of distance between them and because of strongly undulate spike-rhachis, ovate, apex acute, mostly not at all carinate, strongly nerved, papery, slightly lepidote without, glabrous within; SEPALs ca. 5 mm

long by 2-3 mm wide, elliptic, acute to apiculate, scarcely asymmetrical, papery, lepidote without, glabrous within; PETALS ca. 5-6 mm long, yellow, stigma and stamens included, stigma surrounded by anthers; OVARY ca. 2 mm long; CAPSULE ca. 1.6-2.0 cm long, distance between flowers 0.3-1.0 cm.

MATERIAL EXAMINED: Hitchcock 21586 (US; TYPE) epiphytic, between Oña and Cuenca, Prov. Azuay, 2700-3300 m, 9-10 Sept. 1923; Penland and Summers 1056 (GH) near Cuenca, Prov. Azuay, 2600 m, 16 July 1939; Steyermark 54388 (GH) desert country between Vilcabamba and Cachiyacu, Prov. Loja, 1600-2100 m, 6 Oct. 1943; Foster 2613 (US) terrestrial, growing in large masses, km 100, Cuenca-Loja, near Oña, Prov. Loja, ca. 2400 m, 4 Dec. 1948; AJG 843 (US) epiphytic, 2-3 m from ground, between Oña and Antonio de Cumbe, Prov. Loja, 2100 m, 20 Feb. 1963; AJG 1152 (US) very common locally, some water in rosette's tank, near ground to 1 m from ground, steep grassy slopes above Río Tanta, km 71 Loja-Cuenca, Prov. Loja, 2300 m, 12 Aug. 1965. Teuscher 2013-56 (US) apparently cultivated from specimen collected near Montaña Cajanuma, near Loja, Prov. Loja, estimated 2000 m.

NOTES: The extraordinary length of the spikes in Teuscher 2013-56, with spikes to 16 cm long, is probably not typical of the species in its natural environment. This is probably a Montreal cultivated plant derived from

collections in Ecuador. Frequently the spike length of cultivated specimens is much greater than that found on plants growing wild.

TILLANDSIA SINUOSA L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89) p. 14, pl. 2, figs. 8-12.

PLANT 30-35 cm tall by ca. 25 cm in diameter, base of rosette with well developed holdfasts; LEAVES 20-30 cm long, blade 1.2-2.0 cm wide, triangular, apex attenuate, very densely, much appressed lepidote, sheath ca. 6.0 cm long by 3.5 cm wide, pale to dark brown; SCAPE 20-62 cm long with inflorescence, by ca. 2 mm in diameter, erect, much exceeding the leaf-rosette; SCAPE-BRACTS 4.0-5.0 cm long, elliptic, strictly erect, imbricate throughout; INFLORESCENCE 7.0-32.0 cm long by 10-12 cm in diameter, tripinnate, ellipsoid, erect, lax; PRIMARY BRACTS 1.0-3.0 cm by ca. 6 mm, spreading, about as long as or slightly exceeding primary branches; PRIMARY BRANCHES 4.0-9.0 cm long by ca. 1.5-4.0 cm wide, distance between 1.5-2.0 cm, ascending to recurving; SPIKES 2.0-6.0 cm long by 4-5 mm wide, linear, ascending or recurved, with 4 to 12 flowers per spike, stipe 0.5-2.5 cm long with 1-4 sterile bracts, spike-rhachis slightly sinuose; FLORAL BRACTS 4-7 mm long by 3-4 mm wide, ovate, erect but not imbricate except toward spike apex, apex attenuate, ecarinate, strongly nerved, papery, lepidote without, glabrous within; SEPALS ca. 4 mm long by 2-4 mm wide, elliptic-obovate, symmetric or asymmetric, apex apiculate, erect, slightly carinate, not obviously nerved, strongly lepidote without, glabrous

within; PETALS very slightly longer than sepals, stamens deeply included; CAPSULES ca. 2.0 cm long, distance between flowers 3-5 mm.

9. Tillandsia sinuosa var. sinuosa

Leaves to 25 cm long; inflorescence to 32 cm long with spikes ascending, blades ca. 2.0 cm wide. Floral bracts 4-5 mm long; sepals asymmetric and narrowly obovate.

MATERIAL EXAMINED: Hitchcock 21358 (US, COTYPE) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, 3 Sept. 1923; Espinosa E 1838 (US) epiphytic on trees near bank of Río Calera, just west of Zaruma, Prov. El Oro, ca. 820 m, 21 Aug. 1948.

NOTES: T. sinuosa L. B. Smith is probably closely related to the Colombian T. tenuispica André.

10. TILLANDSIA SINUOSA L. B. Smith var. quirozii Gilmartin,
var. nov.

FIG. 51

A var. sinuosa inflorescentia breviori spicis decurvis differt.

Plant habit and most dimensions and shapes largely like T. sinuosa var. sinuosa. However, the plant is shorter, the inflorescence is to 7.0 cm long and the spikes rather than being ascending are recurved. The leaves are longer, to 30 cm long, and narrower. Floral bracts are 6-7 cm long; sepals are symmetric and broadly obovate.

MATERIAL EXAMINED: AJG 1176 (US, TYPE) in cloud forest, near Monte Negro, between El Tambo and Guayaquil, Prov. Cañar, 950 m, 14 Aug. 1965.

NOTES: This variety, quirozii of T. sinuosa L. B. Smith, is found in a section of the western slopes of the Andes about 50-70 km north of the collection sites of the typical variety which seems to be restricted to the region south of Cuenca to around Loja.

11. TILLANDSIA SUBALATA André, 1888 (Énumération Bromél.)
p. 7; André, 1889, pp. 70-71, pl. 25 B; Smith, 1957,
pp. 147-148.

PLANT 40-70 cm tall; LEAVES 15-40 cm long, blades 1.5-2.5 cm wide, triangular, apex short-caudate, densely lepidote, erect, sheath 10-14 cm long by 4.5-5.5 cm wide; SCAPE ca. 3 mm in diameter, erect; SCAPE-BRACTS 3.0-6.0 cm long, erect with caudate blades about equaling the internodes, but exposing scape; INFLORESCENCE ca. 25 cm long by ca. 7.0-8.0 cm in diameter, ellipsoid, tripinnate, lax, erect, moderately lepidote turning glabrous; PRIMARY BRACTS 1.5-4.0 cm long by ca. 2.0 cm wide, ovate-elliptic, spreading, shorter than spikes; BRANCHES 3.5-7.0 cm long, spreading with 2 to 4 spikes; SPIKES 1.5-3.0 cm long by ca. 1.0 cm wide, spreading, distance between spikes ca. 5 mm, having 7 to 10 flowers per spike, spike-rhachis sharply bent at floral nodes; FLORAL BRACTS 7-9 mm long by 6-7 mm wide, papery, mostly not keeled, obviously nerved, subglabrous without, glabrous within, broadly ovate to trullate; SEPALS 3-4 mm long, obovate, obtuse, all three carinate, free, not nerved, glabrous without and within, subcoriaceous; PETALS ca. 7 mm long, yellow or white, spreading; CAPSULES 1.7-1.9 cm long, some of the terminal capsules only 1.0 cm long; distance between flowers 2-3 mm.

MATERIAL EXAMINED: André 3763 (K, TYPE; US, photo)

near Niebli, Prov. Imbabura, ca. 2000 m, 1876; Pennell 7564 (US) epiphytic, Colombia; Foster 2645 (US) road between Santo Domingo and Quito, Prov. Tichincha, ca. 2000 m, 8 Dec. 1948; Acosta-Solís 14503 (F) Shanshipamba, Prov. Imbabura, 2750 m, 18 Nov. 1949.

COLOMBIA.

12. TILLANDSIA MONTICOLA Mez and Sodiro, 1904 (Bull.

Herb. Boiss, series 2, vol. 4) p. 1135; Smith, 1930, pp. 29-30.

PLANT ca. 70 cm tall; LEAVES 25-30 cm long, blades 3.5-4.0 cm wide, apex acute to apiculate, mottled purple, linguulate, sheath ca. 9.0 cm long by ca. 6.0 cm wide, elliptic, apparently brown when dry; SCAPE ca. 68 cm long with inflorescence, 6-8 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS ca. 4.0-8.0 cm long, strictly erect, acute, all imbricate but barely so above, scape obscured throughout; INFLORESCENCE ca. 30 cm long by 8.0-10.0 cm in diameter, lax, thyrsoid, tripinnate, glabrous or subglabrous; PRIMARY BRACTS 1.0-4.5 cm long, all exceeding greatly the short stipe of primary branches, acute, spreading; PRIMARY BRANCHES 5.0-6.0 cm long with up to 3 spikes, branches ca. 1.8-3.0 cm apart, mostly distichously disposed as are the spikes and flowers; SPIKES 3.0-4.5 cm long by 1.0-1.2 cm wide, oblong, spreading, distance between spikes 6-7 mm, with 6-14 flowers per spike, spike-rhachis geniculate, stipe ca. 5 mm, no sterile bracts, stipe of primary branch, ca. 1.2 cm long and also without sterile bracts; FLORAL BRACTS ca. 8 mm long by ca. 7 mm wide, broadly ovate, ecarinate, coriaceous, not nerved, spreading-erect, not imbricate but nearly so, lepidote without; SEPALS shorter than floral bracts, obovate, obtuse-lepidote, coriaceous; PETALS yellowish,

scarcely longer than sepals, distance between flowers 3-5 mm.

MATERIAL EXAMINED: Sodiro 171/33 (B, TYPE; US, photo)
on sides of crater Puluahua, north of Quito, Prov. Pichincha,
Jan. 1883.

TELLANDSIA INSULARIS Mez, 1896 (DC. Monogr. Phaner. vol.

9) p. 756; Smith, 1930, pp. 33-34.

PLANT 20-150 cm tall; LEAVES 13-45 cm long, blades 2.0-7.0 cm wide, lingulate, coriaceous, margins with or without some purple or red, moderately lepidote, apex usually apiculate, sheath 2.0-6.0 cm long, very inconspicuous, blending into blade, concolorous with blade or purple; SCAPE extremely variable in length within the species, from not exceeding leaf-rosette to nearly 75 cm long exclusive of inflorescence, erect; SCAPE-BRACTS imbricate or not, not foliaceous, approximately the same length throughout the scape from ca. 3.0-15.0 cm long, erect; INFLORESCENCE 12-48 cm long by ca. 8.0-15.0 cm in diameter, some depauperate specimens with inflorescences as small as 4.0 cm long by 2.0 cm wide, usually tripinnate, lax, main rhachis exposed, erect; PRIMARY BRACTS 1.0-6.0 cm long, always exceeding branch stipe, erect-spreading, apex acute, lepidote to glabrous; BRANCHES 3.0-15.0 cm long by 2.0-3.0 cm wide, distance between branches ca. 0.5-4.0 cm, branch stipe 0.5-5.0 cm long with several sterile bracts; SPIKES 2.0-9.0 cm long by 0.8-1.1 cm wide, often with several apical sterile bracts, erect to ascending or spreading to recurved, rhachis geniculate or undulate, having 4 to 14 flowers per spike, spike-stipe minimal; FLORAL BRACTS 4-7 mm long by ca. 5 mm wide, not imbricate, may be turning secund, subcarinate

to carinate, nerved, ovate, glabrous or lepidote without, lepidote within, papery, apex acute, shorter than or exceeding sepals; SEPALS 4-7 mm long by ca. 3 mm wide, all 3 carinate, free, glabrous without and glabrous or lepidote within, subcoriaceous, ovate to elliptic, sub-obtuse to acute; PETALS scarcely exerted beyond calyx, white; CAPSULE 1.6-3.0 cm long, seeds reddish or black, distance between flowers 4-8 mm.

13. Tillandsia insularis var. insularis

FIG. 52

Leaf-blades 2.5-4.0 cm wide, leaf-sheaths usually concolorous with blade and blade without any purple, floral bracts glabrous without and usually shorter than sepals, spikes spreading to recurving, capsules to 2.3 cm long.

MATERIAL EXAMINED: All the following specimens are from the Galapagos islands. The species is endemic to this archipelago. Bauer 237 (GH) Isla Pinzon (Duncan), Aug. 1891; AJG 906 (US) Isla Santiago (James) ca. 250 m, in mountains above the salt mines near James Bay, 27 Feb. 1964; Schimpff 153 (MO; US, photo and fragments) northwest side of Isla San Cristobol (Chatham) ca. 250 m, 30 Sept. 1932; AJG 907 (US) Isla Isabela (Albemarle) up the mountains from Bahia Iguana, probably ca. 200 m, March, 1964.

The following specimens are all from the Isla Santa Cruz (Indefatigable): AJG 875 (US) epiphytic on lianas, ca. 6 m from ground, northeast of Bella Vista on property of Sr. Gallardo, ca. 200 m, 25 Jan. 1964; AJG 876 (US) growing in clump of several plants on main trunk of Scalesia, Bella Vista, ca. 200 m, 27 Jan. 1964; AJG 883 (US) (number 11 of 3 Feb. 1964) on cultivated land at Bella Vista, epiphytic on Scalesia, ca. 200 m, 3 Feb. 1964; AJG 884 (US) (number 5 of 3 Feb. 1964) on lianas or on Psidium galapageium "guayaba" cultivated land at Bella

Vista, ca. 200 m, 3 Feb. 1964; AJG 928 (US) Bella Vista, ca. 200 m, 4 Feb. 1964; AJG 929 (US) Bella Vista, ca. 200 m, 4 Feb. 1964; AJG 930 (US) Bella Vista, forest area, ca. 240 m, 3 Feb. 1964; AJG 931 (US) Bella Vista, forest area, ca. 240 m, 3 Feb. 1964; AJG 932 (US) Bella Vista, ca. 240 m, 3 Feb. 1964; Svenson 70 (GH) up the mountains from Academy Bay, ca. 155 m, 2 April, 1930.

14. TILLANDSIA INSULARIS var. LATILAMINA Gilmartin, var. nov.

FIG. 53

A var. insularis foliorum vaginis violaceis, laminis latioribus, spicis ascendentibus, bracteis florigeris lepidotis differt.

Ample collections of Tillandsia insularis Mez have made it possible to distinguish two varieties of this species. Variety, latilaminis has wider leaves, usually 4.3-7.0 cm wide at the blade, some purple is usually evident either on the sheath or blade or both, the outer surface of the floral bracts is lepidote, the spikes are usually ascending and unlike the typical variety the floral bracts may be longer slightly than the sepals.

MATERIAL EXAMINED: AJG 882 (US, TYPE) epiphytic on Scalesia, "Table Mountain" a flat-top mountain visible from Academy bay, Isla Santa Cruz (Indefatigible), west of "Table Mountain" and east of a large crater, ca. 400 m, 3 Feb. 1967; AJG 877 (US) El Occidente, west side of Isla Santa Cruz, ca. 6 km north west of Bella Vista, ca. 220 m, 28 Jan. 1964; AJG 878 (US) same site as AJG 877 (US) 28 Jan. 1964; AJG 879 (US) same site as above two, 28 Jan. 1964; AJG 880 (US) same site as above three, 28 Jan. 1964; AJG 881 (US) same site as above four, 28 Jan. 1964; AJG 918 (US) collected by M. Gilmartin, epiphytic, near Progreso, Isla San Cristobol (Chatham), ca. 250 m, March 1964;

Lund 1 (US) near Progreso, southwest side of Cerro Jose Herrera, Isla San Cristobol, ca. 200 m, 26 Jan. 1965;
Lund 2 (US) same site as Lund 1, 26 Jan. 1965; Stewart 1117 (GH) above Wreck Bay, Isla San Cristobol, ca. 170 m, 27 Jan. 1906; Stewart 1116 (GH) "common on bushes, small trees, among rocks in vegetable mold," Isla Floreana (Charles) ca. 400 m, 9 Oct. 1906; AJG 885 (US) ca. 2 hours walk from Black Beach toward inland, Garcia-Wittmer farm, epiphytic on Inga "Guaba," Isla Floreana, ca. 240 m, 6 Feb. 1964; AJG 886 (US) epiphytic on Psidium "guayaba," common locally, Isla Floreana, ca. 300 m, 6 Feb. 1964; AJG 917 (US) epiphytic on Psidium "guayaba," common, near Garcia-Wittmer farm, Isla Floreana, ca. 240 m, 6 Feb. 1964.

15. TILLANDSIA QUADRIPINNATA Mez and Sodiro, 1905 (Bull. Herb. Boiss, series 2, vol. 5) p. 105; Smith, 1930, p. 31.

FIG. 54

PLANT 60-100 cm tall by ca. 45 cm in diameter, from a rosette that remains erect for 15 cm before leaves begin to spread, well-developed holdfasts at rosette base; LEAVES 20-50 cm long, blades 2.5-4.0 cm wide, lingulate, apex long acute, appears glabrous, actually 20-25 scales per mm², sheath 13-14 cm long by 6.0-11.0 cm wide, dark brown to purple within, elliptic, conspicuous; SCAPE 58-98 cm long with inflorescence, 5-7 mm in diameter, purple, turning red when dry, erect, much exceeding leaf-rosette; SCAPE-BRACTS 3.0-12.0 cm long, not imbricate, erect with apices curling back; INFLORESCENCE 30-65 cm long by 12-13 cm in diameter, erect, reddish, elliptic, densely flocculose, tripinnate, lax, branches subdistichously disposed, spikes distichous and flowers so, 10-15 main branches, 3.0-14.0 cm long with ca. 6 secondary branches, distance apart of principle branches 3.0-6.0 cm; PRIMARY BRACTS 2.5-7.0 cm, long-spreading; SPIKES ca. 2.0 cm long throughout by 1.0-1.2 cm wide, spreading, ovate, distance between spikes 1.0-2.0 cm, with 6 to 12 flowers per spike, spike-rhachis moderately to strongly geniculate; FLORAL BRACTS 6-8 mm long by 7-8 mm wide, broad-ovate, apex acute, papery, strongly nerved, scarcely carinate, lepidote without,

glabrous within, reddish; SEPALS 6 mm long by 5-6 mm wide, asymmetrical, obovate, obtuse, equally free, not nerved, coriaceous, few scattered scales without, glabrous within, posteriorly carinate; PETALS 5-7 mm long, yellow when dry, petals a scant 1 mm longer than sepals, distance between flowers 2-3 mm.

MATERIAL EXAMINED: Sodi 171/31 (B, TYPE; US, photo) near Montaña Corazon, Prov. Pichincha, estimate 3000 m, Nov. 1873; AJG 1164 (US) epiphytic 1-3 m from ground, common locally, on cliff above road, km 85 Cuenca-Guayaquil, Prov. Cañar, ca. 2800 m, 13 Aug. 1965; AJG 1180 (US) cloud forest, between Guayaquil and El Tambo, Prov. Cañar, ca. 1000 m, 14 Aug. 1965.

16. TILLANDSIA MICRANTHA Baker, 1887 (Jour. Bot. vol. 25)
p. 303; Smith, 1930, pp. 26-27; Smith, 1957, p. 148.

FIG. 55

PLANT ca. 40 to 50 cm tall, not stemmed; LEAVES 25-40 cm long, blades ca. 2.5-4.0 cm wide, lingulate, apex apiculate, obscurely punctulate, sheath ca. 8.0 cm long by 6.5 cm wide, conspicuous, some purple mottling; SCAPE 38-48 cm long with inflorescence, 2-3 mm in diameter, equaling or shorter than leaves; SCAPE-BRACTS 2.5-3.0 cm long, imbricate to subimbricate, erect; INFLORESCENCE ca. 30 cm long by ca. 20 cm wide, tripinnate, lax, both the primary branches, secondary branches as well as flowers distichous, mostly glabrous; PRIMARY BRACTS 0.5-3.0 cm long, spreading, mostly shorter than sterile bases of branches; PRIMARY BRANCHES up to 12 cm long; SPIKES 3.0-12.0 cm long by 0.8-1.0 cm wide, linear, ascending, 1.0-2.0 cm apart, with 6 to 25 flowers per spike, stipe 0.5-4.0 cm long with 1 to 2 sterile bracts; spike-rhachis sinuous; FLORAL BRACTS ca. 5 mm long by 4-5 mm wide, broad-ovate, apex acute, spreading at ca. 50° angle with spike-rhachis, not imbricate, nerved, ecarinate, slightly lepidote without, glabrous within, papery; SEPALs ca. 5 mm long by 3 mm wide, obovate, asymmetrical, apex obtuse, posteriorly carinate, coriaceous, subequally free, very slightly lepidote without, glabrous within; PETALS green probably mostly included in calyx; distance between flowers 3-6 mm.

MATERIAL EXAMINED: Asplund 19887 (US) epiphytic, Mera, near path, Prov. Napo-Pastaza, 1100 m, 23 March 1956; AJG 1141 (US) ca. 6 m from ground, epiphytic, rain forest, moderately abundant, water in tank, Prov. Zamora, km 3 Zamora-Loja, 900 m, 11 Aug. 1965.

17. TILLANDSIA GILMARTINIAE L. B. Smith, 1963 (Phytologia vol. 9, no. 4) pp. 247-248, pl. 2, fig. 5, 6.

FIG. 56

PLANT ca. 60 cm tall, growing in clumps, epiphytic; LEAVES 40-60 cm long, blades 3.0-4.0 cm wide, lingulate, apex acute, densely lepidote, sheath 14-16 cm long by ca. 8.0 cm wide, dark castaneous; SCAPE ca. 7 mm in diameter, not much exceeding leaves; SCAPE-BRACTS 5.0-8.0 cm long or more, imbricate, apices caudate and spreading, erect but for apices; INFLORESCENCE ca. 25 cm long by 14 cm in diameter, bipinnate, lax, with ca. 12 polystichously disposed spikes, densely ferruginous, curved; PRIMARY BRACTS 5.0-7.0 cm long, consistently longer than spikes, spreading; SPIKES 4.0-5.5 cm long by 1.6-2.0 cm wide, spreading, distance between spikes 0.8-2.5 cm, flowers per spike 12 to 14, stipe minimal to 6 mm long, rhachis nearly straight, obscured toward spike apex otherwise visible; FLORAL BRACTS 1.2-1.5 cm long by ca. 9 mm wide, papery, imbricate, incurved, ovate, ecarinate, lepidote without and within, slightly nerved, apex long acute; SEPALS 0.9-1.0 cm long by 7-8 mm wide, very asymmetrical, subcoriaceous, free, densely lepidote without, glabrous within; PETALS ca. 1.5 cm long, yellow, distance between flowers 4 mm.

MATERIAL EXAMINED: AJG 799 (US, TYPE) in wooded lot opposite Hotel Nuevo, Pilaló, ca. 2300 m, 19 Aug. 1963.

18. TILLANDSIA RIOCREUXII André, 1888 (Énumération Bromél.)
p. 7; André, 1889, p. 73-74, pl. 35; Smith, 1930, p. 46.

FIG. 57

PLANT 50-90 cm tall with inflorescence by ca. 20 cm in diameter; LEAVES 3.0-25.0 cm long, blades 2.0-2.5 cm wide, forming erect rosette, the outermost leaves short, 2.0-3.0 cm long, sheath 5.0-11.0 cm long by 4.0-5.0 cm wide, elliptic to round, blade triangular, densely appressed lepidote; SCAPE 48-88 cm tall with inflorescence, 4-6 mm in diameter, erect, much exceeding leaf-rosette; SCAPE-BRACTS 3.0-5.0 cm long, erect, partly imbricate; INFLORESCENCE 24-38 cm long by 10-18 cm in diameter, erect, pyramidal, lax, bipinnate or slightly tripinnate, with 12-16 spikes, glabrous; PRIMARY BRACTS 1.5-4.5 cm long, spreading, some reflexed, always exceeding stipe; SPIKES 4.5-8.0 cm long by ca. 1.3-2.0 cm wide, spreading to slightly recurved, rhachis geniculate, distance between 1.5-3.0 cm, with 10-16 flowers per spike, stipe 0.5-1.5 cm long with none or one sterile bract; FLORAL BRACTS 1.0-1.2 cm long by 0.8-1.1 cm wide, erect, imbricate, broadly ovate, slightly nerved, ecarinate, papery, glabrous without, lepidote within, may or may not be secund; SEPALS ca. 8 mm long, obtuse, obovate, asymmetrical, slightly lepidote within; PETALS ca. 2.3 cm long, petals ca. 8-9 mm longer than calyx, strongly lobed; CAPSULE ca. 2.2 cm long, distance between flowers 4-8 mm.

MATERIAL EXAMINED: André 4408 (K, TYPE; US, photo) western slopes of Mt. Chimborazo, Prov. Chimborazo, ca. 2500 m, July 1876; AJG 1138 (US) rainforest, km 18 Loja-Zamora, Prov. Zamora, ca. 2500 m, 11 Aug. 1965.

NOTES: T. riocreuxii André apparently has been collected only two times to date. This would reflect more upon the habitat of the plant than upon its abundance. It grows in very wet forest and is not particularly conspicuous.

19. TILLANDSIA HOMOSTACHYA André, 1888 (Énumération Bromél.) p. 7; André, 1889, p. 70, pl. 25A; Smith, 1930, p. 29.

PLANT ca. 50 cm tall, an erect rosette; LEAVES 18-23 cm long, blades 2.0-3.0 cm wide, sublingulate to triangular, apex attenuate to short-caudate, densely and finely lepidote, sheath ca. 9.0 cm long by 6.0 cm wide, elliptic, conspicuous, dark brown when dry; SCAPE ca. 48 cm long with inflorescence, 2-3 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS 2.6-4.5 cm long, erect, imbricate; INFLORESCENCE 15 cm long by ca. 4.5 cm in diameter, lepidote, with ca. 10 spikes, lax, ellipsoid to cylindrical, bipinnate; PRIMARY BRACTS 1.2-3.0 cm long, spreading, ovate, apex long acute, lowermost exceeding spike, others at least one-half spike length, spreading more than spikes and exposing spikes throughout; SPIKES 2.0-3.0 cm long by 1.2 cm wide, erect to spreading, distance between 0.5-2.0 cm, having 9-14 flowers, spike-rhachis geniculate, stipe minimal; FLORAL BRACTS 7-9 mm long, apex acute, erect to spreading, not imbricate, exposing spike-rhachis, slightly nerved, ovate; SEPALS shorter than floral bracts, broadly acute, obovate, lepidote, coriaceous; PETALS slightly longer than sepals, yellowish, distance between flowers ca. 4-5 mm.

MATERIAL EXAMINED: André 3763 (K, TYPE; US, photo) western slopes of Mt. Corazon, Prov. Pichincha, 2500-2800 m, June 1876.

TILLANDSIA TETRANTHA Ruiz and Pavon, 1802 (Flora Peruv.
vol. 3) p. 39.

PLANT ca. 50 cm tall; LEAVES 25-45 cm long, blades 2.5-3.5 cm wide, apex acute to short-caudate, sublingulate to triangular, very densely appressed-lepidote, sheath 10-14 cm long by 6.0-7.0 cm wide, elliptic, conspicuous; SCAPE 3-4 mm in diameter, curving; SCAPE-BRACTS 3.0-9.0 cm long, erect, scarcely imbricate; INFLORESCENCE 8.0-30.0 cm long by 4.0-8.0 cm in diameter, with main rhachis geniculate or nearly straight, bipinnate, lax or dense, curved, or not, having ca. 9 to 11 spikes these reflexed, lepidote; PRIMARY BRACTS 1.5-5.0 cm long by ca. 2.0 cm wide, reflexed, apex acute to apiculate, mostly about as long as spikes, distance between, 1.0-4.0 cm; SPIKES 2.0-3.5 cm long by ca. 1.3 cm wide with flowers sometimes secund and upward turning, spike-rhachis geniculate or nearly straight, having ca. 3 to 6 flowers per spike, stipe minimal to 1.0 cm long, no sterile bracts; FLORAL BRACTS 0.3-1.0 cm long by ca. 3 mm wide, inconspicuous, nerved, papery, lepidote within and without, exceeding or exceeded by sepals; SEPALS 0.8-1.0 cm long by ca. 4 mm wide, very much asymmetrical, strongly nerved, free; PETALS ca. 1.3 cm long, blades white or yellow, exerted by 2-3 mm beyond calyx, distance between flowers ca. 5-6 mm.

20. TILLANDSIA TETRANTHA var. TETRANTHA

Floral bracts not exceeding 3 mm in length, main rhachis of inflorescence strongly geniculate, flowers turning upwards at anthesis at least in part.

MATERIAL EXAMINED: Weberbauer 7913 (US, photo) Peru; Ferreyra 2402 (US, photo and fragment) Peru; Foster 2597 (US) road to Cachicarán, epiphytic, Prov. Loja, ca. 760 m, 30 Nov. 1948.

PERU.

21. TILLANDSIA TETRANTHA Ruiz and Pavon var. SCARLATINA

(André) L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89) pp. 15, 43; Smith, 1957, p. 156.

Tillandsia aurantiaca var. scarlatina André, 1888 (Énumération Bromél.) p. 7; André, 1889, p. 73.

FIG. 58

Floral bracts to 7 mm long, main rhachis of inflorescence nearly straight, primary bracts to 5.0 cm long.

MATERIAL EXAMINED: André 3138 (K, TYPE; US, photo) Orejuela, Prov. Carchi, ca. 2900 m, June 1876; Hitchcock 21383 (US) epiphytic, in flower, between La Toma and Loja, Prov. Loja, 1800-2600 m, 4 Sept. 1923; Hitchcock 21571 (US) "petals white," inflorescence red, epiphytic, between San Lucas and Oña, Prov. Loja, 2200-3100 m, 7 Sept. 1923; Asplund 18257 (US) "petals white, with pale yellow tips," epiphytic, Lago Papallacta, Prov. Pichincha, 3300 m, 31 Oct. 1955; Harling 6240 (US) epiphytic, "peduncles and

bracts violet-red, flowers yellow," Saraguro, 12 km south of Saraguro, Prov. Loja, 2900 m, 1-3 Aug. 1959; AJG 853 (US) epiphytic, wooded lot opposite Hotel Nuevo, Pilaló, through flowering, Prov. Cotopaxi, 2400 m, 23 July 1963; AJG 1150 (US) immature, water in tank, km 54 Loja-Cuenca, cloud forest, Prov. Loja, 2850 m, 12 Aug. 1965.

COLOMBIA.

22. TILLANDSIA TETRANTHA Ruiz and Pavon var. AURANTIACA (Grisebach) L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89) p. 15, 43; Smith, 1957, p. 155.

FIG. 59

Tillandsia aurantiaca Grisebach, 1865 (Goett. Nachr. Ges. Wis. vol. 1864) p. 16.

PLANT like T. tetrantha var. tetrantha but floral bracts larger to 1.0 cm long, primary bracts to 3.0-4.0 cm long.

MATERIAL EXAMINED: André 2214 (K, TYPE; US, photo) Colombia; Hitchcock 21424 (US) between La Toma and Loja, Prov. Loja, 1800-2600 m, 4 Sept. 1923; AJG 1132 (US) km 38 Catamayo, cloud forest, moderately common, tank filled with water, in capsule, capsules 1.8-2.3 cm long, copious seeds, Prov. Loja, 2500 m, 10 Aug. 1965.

COLOMBIA.

23. TILLANDSIA TETRANTHA Ruiz and Pavon var. DENSIFLORA
(André) L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89)
p. 15, 43; Smith, 1957, pp. 155-156.

Tillandsia aurantiaca Grisebach, 1864 (Gött. Nachr,
p. 16) var. densiflora André, 1888 (Énumération Bromél.)
p. 7.

PLANT like T. tetrantha var. tetrantha but floral
bracts larger, 6-7 mm long, main rhachis of inflorescence
stout and nearly straight, and spikes densely disposed,
obscuring the main rhachis.

MATERIAL EXAMINED: André 2342 (K, TYPE; US, photo)
near Sabanetas, foot of Chimborazo, July 1876; Penland
and Summers 1029 (GH) Tipococha, Prov. Cañar, 3200 m, 12
July 1939; Camp E 4079 (US) epiphytic, corolla yellow,
near El Tambo, Prov. Cañar, between 3050 and 3500 m, 6-9
July 1945.

COLOMBIA.

24. TILLANDSIA TETRANTHA Ruiz and Pavon var. MINIATA
(André) L. B. Smith, 1930 (Contrib. Gray Herb. vol.
89) p. 15, 44; Smith, 1957, p. 156, fig. 43.

Tillandsia aurantiaca var. miniata André, 1888
(Énumération Bromél.) p. 7.

PLANT like T. tetrantha var. tetrantha but inflores-
cence small, compact, floral bracts exceeded by sepals,
inflorescence mostly glabrous, main rhachis practically
straight.

MATERIAL EXAMINED: André 3138 (K, TYPE; US, photo)
Colombia; Drew E-150 (US) epiphytic, bracts brown, near
San Geronimo, east of Cayambe, Prov. Imbabura, ca. 3200
m, 15 May 1944; Camp E-4685 (US) epiphytic, "corolla
bright yellow," 4-6 km north of Sevilla de Oro, Prov.
Azuay, 2700-3050 m.

25. TILLANDSIA LAMINATA L. B. Smith, 1963 (Phytologia vol. 9, no. 4) pp. 253-254.

PLANT 80-130 cm tall; LEAVES 55 cm to over 1 m long, blades 0.8-2.8 cm wide, very narrowly triangular, caudate-attenuate, densely, appressed-lepidote, coriaceous, sheaths to 17 cm long by ca. 5.5 cm wide, dark castaneous; SCAPE to 1.5 cm in diameter at base, ca. 7 mm in diameter above, erect or curved, about as long as leaf-rosette; SCAPE-BRACTS 1.5-14.0 cm long, lower ones with very long blades, densely pale-lepidote, imbricate, erect to spreading; INFLORESCENCE 40-70 cm long by 8.0-10.0 cm in diameter, tripinnate, having ca. 36 branches, erect, exceeding leaf-rosette, lax, may be red tinged when alive; PRIMARY BRACTS with long blades exceeding branches; PRIMARY BRANCHES 4.0-9.0 cm long by ca. 2.0 cm wide exclusive of capsules, sub-erect, branch stipe minimal or none, having ca. 1 to 4 spikes, distance between branches 0.7-1.5 cm; SECONDARY BRANCHES 1.5-3.0 cm long by ca. 1.2 cm wide exclusive of capsules, rhachis geniculate, ca. 10-flowered, sessile; FLORAL BRACTS ca. 7 mm long by 6 mm wide, broadly ovate, obtuse to broadly acute, coriaceous, carinate, strongly nerved, glabrous without, lepidote within; PEDICELS 2-7 mm long; SEPALs 0.8-1.0 cm long by 5 mm wide, asymmetric, broadly ovate, obtuse to broadly-acute, free to subfree, all three carinate, nerved, coriaceous, glabrous without, lepidote within; CAPSULES 1.6-2.0 cm long, distance

between flowers 4-5 mm.

MATERIAL EXAMINED: Wurdack 1502 (US, TYPE) Peru, 2350-2400 m; AJG 837 (US) terrestrial, growing among low trees and shrubs, cloud forest, km 24 Loja-Zamora, Prov. Zamora, 2050 m, 21 Feb. 1963.

NOTES: This species appears to be intermediate between the subgenera *Allardtia* and *Pseudo Catopsis*. The leaves and general habit are more allied to the former while the inflorescence seems more like that of the subgenus, *Pseudo Catopsis*. The sepals are only slightly asymmetrical, however, and are more nearly oblong than obovate. Nevertheless, at the moment it seems to me to be more closely allied to other species of *Pseudo Catopsis*.

26. TILLANDSIA PENLANDII L. B. Smith, 1941 (Contrib. Gray Herb. vol. 137) pp. 384-385, pl. 1, figs. 14-15.

PLANT ca. 60 cm tall, rosette approaching a pseudo-bulb shape; LEAVES 15-30 cm long, blades ca. 1.8 cm wide, narrowly triangular, involute, coriaceous, densely lepidote, sheath 7.0-10.0 cm long, inflated, brown; SCAPE with inflorescence to 58 cm long, ca. 5 mm in diameter, erect, about as long as leaves; SCAPE-BRACTS 3.5-12.0 cm long with caudate apices, scarcely imbricate but scape exposed; INFLORESCENCE ca. 30 cm long by ca. 8.0 cm in diameter, quadripinnate, lax, subcylindric, erect; PRIMARY BRACTS 1.0-3.0 cm long, spreading, mostly about as long as stipe of branch; BRANCHES 2.0-6.5 cm long, erect to spreading, about 14 per inflorescence; SPIKES 1.0-2.5 cm long by ca. 1.2 cm wide, spreading, 2 to 10 per primary branch, distance between spikes 0.5-1.2 cm, mostly distichously disposed upon branch rhachis, spike-rhachis lepidote, having ca. 8 flowers per spike, stipe minimal, rhachis geniculate, no sterile bracts; FLORAL BRACTS ca. 4-5 mm long, apex broadly acute to obtuse, glabrous or subglabrous, nerved, exposing sepals, exposing spike-rhachis, spreading to erect; SEPALs 5-6 mm long, obovate, obtuse, lepidote without, carinate, not nerved; PETALS pale yellow or white, distance between flowers 1-2 mm.

MATERIAL EXAMINED: Penland and Summers 1138 (GH, TYPE; US, photo) near Loja, Prov. Loja, 2300 m, 28 July

1939; Espinosa 1897 (US) epiphytic, Cordillera de Güishag
(?) east of Zaruma, Prov. El Oro, 1700 m, 29 Aug. 1947.

TILLANDSIA MULTIFLORA Benth., 1844 (Bot. Voyage Sulpher)

p. 174.

PLANT 40-80 cm tall; LEAVES 30-40 cm long, blades 1.2-2.5 cm wide, coriaceous, densely lepidote, apex filiform or caudate, sheath inconspicuous; SCAPE 2-3 mm in diameter, erect; SCAPE-BRACTS 5.0-15.0 cm long, foliaceous, erect to spreading, scarcely or much imbricate; INFLORESCENCE 6.0-40.0 cm long by 3.0-10.0 cm in diameter or more, tripinnate or bipinnate, lax; PRIMARY BRACTS 1.0-14.0 cm long by ca. 1.0 cm wide, all exceeding primary branches to all shorter than primary branches, spreading to reflexed, apex attenuate; PRIMARY BRANCHES 2.0-6.0 cm long by 1.0-3.5 cm wide, spreading, distance between branches ca. 2.0 cm, each branch having up to 5 spikes; SPIKES 1.8-3.0 cm long by 1.0-1.8 cm wide, spreading, 0.5-1.3 cm apart, having 9 to 17 flowers per spike, spike-rhachis glabrous and not concealed; FLORAL BRACTS 2-3 mm long by ca. 2-3 mm wide, apex acute, nerved, papery, slightly lepidote to glabrous without, glabrous within, spreading, not imbricate; SEPALS 4-5 mm long, nerved, posteriorly carinate, coriaceous, glabrous without and within, spreading, obovate, obtuse, scarcely asymmetrical; CAPSULE 10-15 mm long, distance between flowers 1-2 mm.

27. TILLANDSIA MULTIFLORA var. MULTIFLORA

Primary bracts all longer than branches, inflorescence not much more than 6.0 cm in diameter, leaves to 30 cm

long, blades to ca. 1.2 cm wide with filiform apices, scape-bracts scarcely exceeding internodes.

MATERIAL EXAMINED: Cuming 1269 (K, TYPE; US, photo) near Guayaquil, Prov. Guayas, ca. 50 m, 1836-1842; Eggers 15040 El Recreo, north of Bahia de Caraquez, Prov. Manabí, near sea level, 1893; Hitchcock 21244 (US) epiphytic, dry hill, Portovelo, gold mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. - 3 Sept. 1923; Espinosa E 850 (GH) epiphytic, Arenel, Prov. Loja, ca. 1200 m, 19 Oct. 1946.

23. TILLANDSIA MULTIFLORA Benth. var. DECIPIENS (André)

L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89) p. 13.

FIG. 60

T. decipiens André, 1888 (Énumération Bromél.) p. 7,
pl. 24 A.

PLANT very similar to T. multiflora var. multiflora but primary bracts all shorter than branches, inflorescence up to 10 cm or more in diameter; leaves 40 cm long, blade 2.5 cm broad with long-caudate tip, scape-bracts all greatly exceeding internodes.

MATERIAL EXAMINED: André 4055 (NY, ISOTYPE; US, photo); Barclay 524 (BM; US, photo) near Machala, Prov. El Oro, near sea level, Oct. 1930; Hitchcock 21106 (US) between Machala and Puerto Bolívar, Prov. El Oro, 0-10 m, 26 Aug. 1923; Levi-Castillo s. n. (US) near Vinces, Prov. Los Rios, ca. 200 m, 1955; Rauh, Hirsch, E 3 (US) in Bomba woods, near Santa Rosa, Prov. El Oro, 200 m, 28 Aug. 1954; Foster 2590 (US) epiphytic, Portovelo, Prov. Loja, ca. 600 m, 29 Nov. 1948; Asplund 18110 (US) epiphytic, between Puente Boquerón and Gonzanamá, Prov. Loja, 1600 m, 9 Oct. 1955; Asplund 15878 (US) epiphytic, Puerto Jelí, Prov. El Oro, near sea level, 22 March 1955; Fagerlind and Wibom 560 (US) Jipijapa, Prov. Manabí, ca. 100 m, 10 Oct. 1952; AJG 809 (US) Cerro Monte Criste, Prov. Manabí, ca. 300 m, 10 Aug. 1962; AJG 854 (US) 20-40 km west of Colonche, epiphytic, flowers very fragrant, cactus-scrub complex, Prov. Guayas,

ca. 300 m, 18 Aug. 1963; AJG 1050 (US) Bombax-"evergreen"
shrub, epiphytic in semi-open area, very common, no water
in tank, km 80 Guayaquil-Quevedo, ca. 50 m, 2 Aug. 1965.

PERU.

29. TILLANDSIA MULTIFLORA var. TOMENSIS L. B. Smith,
1930 (Contrib. Gray Herb. vol. 89) p. 13, p. 35.

Plant like the typical variety but with leaf blades up to 3.0 cm broad, apex acute to attenuate, scape 7-8 mm in diameter, scape-bracts equaling or slightly exceeding internodes, primary bracts broadly lanceolate, much shorter than axillary branches.

MATERIAL EXAMINED: Hitchcock 21357 (GH, TYPE; US, COTYPE) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, 3 Sept. 1923.

30. TELLANDSIA ROPALOCARPA André, 1888 (Énumération Bromél.) p. 6; André, 1889, pp. 66-67, pl. 23, fig. A; Smith 1957, pp. 150-151, fig. 41.

FIG. 61

PLANT 40-90 cm tall, erect to spreading rosette; LEAVES 15-26 cm long, blades ca. 1.3-1.8 cm wide, outermost leaves shorter than those within, blade narrowly triangular to lingulate, coriaceous, moderately densely lepidote, ca. 5-6 scales per mm², grey-green, sheath brown without, purple within; SCAPE 39-89 cm long with inflorescence, ca. 3 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS 1.3-12.0 cm long, erect with apices slightly spreading, generally not at all imbricate, may be imbricate below; INFLORESCENCE 15-35 cm long by 10-12 cm in diameter, tripinnate-quadripinnate, lax, pyramidal, erect, with 8 to 15 branches; PRIMARY BRANCHES 2.0-8.0 cm long, spreading to ascending with 3 to 6 spikes; PRIMARY BRACTS ca. 0.7-2.5 cm long, spreading, apex acute to attenuate, as long as or shorter than stipe of branch; SPIKES 2.0-4.5 cm long by ca. 1.0 cm wide, distance between spikes 5 to 8 mm, having 5 to 10 flowers per spike, stipe 5-8 mm long, no sterile bracts; FLORAL BRACTS 3-4 mm long by 3 mm wide, spreading, not at all imbricate and exposing calyx completely, lepidote, nerved; SEPALs 4-5 mm long, obovate, much exserted beyond floral bracts, obtuse, asymmetrical; FLOWERS scarcely or not at all touching at

anthesis; PETALS scarcely exerted beyond calyx, yellow;
CAPSULE 1.4-1.6 cm long, distance between flowers 2-4 mm.

MATERIAL EXAMINED: André 2319 (Life-size illustration, André, 1889) Colombia, ca. 1280 m; Steyermark 53921 (US, fragments) 10 km northeast of Curtincapa, east of Zaruma, Prov. El Oro, 1500-2890 m, 16 Aug. 1943; Espinosa E 890 (US) epiphytic, Hacienda Horta-Naque, Prov. Loja, ca. 3000 m, 6 Nov. 1946; AJG 1080 (US) epiphytic, 2 to 6 m from ground, very common, in pasture on avocado tree, km 53, Santo Domingo-Quito, Prov. Pichincha, ca. 1450 m, 4 Aug. 1965; AJG 1173 (US) between Guayaquil and El Tambo, Monte Negro, cloud forest, epiphytic, Prov. Cañar, ca. 920 m, 14 Aug. 1965.

31. TILLANDSIA TRIPINNATA (Baker) Mez, 1896 (DC Monogr.

Phaner. vol. 9) p. 745; Smith, 1930, p. 38.

PLANT probably ca. 1 m tall; LEAVES 6.0-36.0 cm long, blades ca. 3.0 cm wide, outermost leaves much shorter than inner leaves; SCAPE, ca. 5-6 mm in diameter, probably erect; SCAPE-BRACTS elliptic, blade caudate, imbricate; INFLORESCENCE 25-35 cm long by ca. 14 cm in diameter, mostly tripinnate, or slightly quadripinnate, erect(?), reddish brown when dry; PRIMARY BRACTS 1.5-6.0 cm long, erect to spreading, apex acute; PRIMARY BRANCHES 3.0-8.0 cm long by 3.0-6.0 cm wide, spreading stiffly, having ca. 4 to 7 spikes; SPIKES 2.5-4.0 cm long by 1.0-1.5 cm wide, spreading stiffly, distance between spikes 0.5-1.2 cm, flowers per spike 7 to 12, rhachis of spike stout, densely ferrugineous, 1.5 mm in diameter, geniculate, stipe ca. 8 mm long, no sterile bracts; FLORAL BRACTS 5-6 mm long by ca. 5 mm wide, spreading at ca. 90° angle with spike-rhachis, subcoriaceous, apex acute, much exceeded by sepals, dull reddish, lepidote without, glabrous within, strongly nerved, not imbricate; SEPALS 7 mm long by 5 mm wide, strongly asymmetrical, coriaceous, subfree, carinate, scarcely nerved, glabrous without and within; PETALS 0.9-1.0 cm long, ca. 3 mm of petal exerted from calyx, yellow when dry, distance between flowers ca. 3 mm.

MATERIAL EXAMINED: Drake 152 (K; US, photo) Santiago, Prov. (?); Espinosa 2035 (US) Hacienda Ambocas northeast of

Zaruma, between Payama and Tioloma, Prov. El Oro, 2900-
3100 m, 30 Aug. 1947.

TELLANDSIA ADPRESSA André, 1888 (Énumération Bromél.) p. 6;
André, 1889, pp. 67-68, pl. 23 B; Smith, 1930, p. 40;
Smith, 1957, pp. 152-153.

PLANT 20-70 cm tall, leaf-bases forming an elongate rosette 15-30 cm long; LEAVES 12-25 cm long, blades ca. 6-7 mm wide, not exceeding 2.0 cm in width, narrowly triangular to subulate, involute, spotted purple when living, very densely appressed lepidote, sheath 6.0-8.0 cm long by 4.0-5.0 cm wide, elliptic, inflated, very conspicuous, dark brown with narrow hyaline margin; SCAPE 2-3 mm in diameter, erect to curving, about as long as leaves or slightly shorter, ferruginous or pale lepidote; SCAPE-BRACTS 5.0-10.0 cm long, blades exceeding nodes but nevertheless scape completely exposed, long caudate, erect; INFLORESCENCE ca. 19-21 cm long by 3.0-4.0 cm wide, bipinnate, cylindric, lepidote, curving; PRIMARY BRACTS spreading to ascending, some equaling spikes, most shorter, apex acute; SPIKES 3.0-4.0 cm long by ca. 1.5 cm wide, erect to spreading, 4 to 12 spikes, having 7 to 12 flowers, distance between 0.8-2.5 cm, stipe 2-8 mm long, no sterile bracts; FLORAL BRACTS 4-5 mm long by 3-4 mm wide, ovate, imbricate, much exceeded by sepals, erect to spreading, apex acute, inconspicuously nerved, ecarinate, papery, densely ferruginous to pale lepidote without, glabrous within; SEPALS 4-5 mm long by 2-3 mm wide, obovate, asymmetrical, carinate, free, densely lepidote; PETALS ca. 7 mm long by 3 mm wide,

spreading, yellow; OVARY 1-2 mm long by 1-2 mm in diameter, stigma surrounded by stamens; CAPSULE 1.0-2.5 cm long, distance between flowers 2-3 mm.

32. TILLANDSIA ADPRESSA var. ADPRESSA

FIG. 62

Spikes erect, scape about equaling leaves, capsules 2.0-2.5 cm long.

MATERIAL EXAMINED: André 3792 (K, TYPE; US, photo) near crater Pululauha, Prov. Pichincha, 3000 m, 1876; AJG 1135 (US) km 10 Loja-Zamora, dwarf forest, moderately common, Prov. Loja, 2450 m, 11 Aug. 1965; Rauh, Hirsch, P 2257 (US) Peru, 15 Oct. 1954.

COLOMBIA, PERU.

33. TILLANDSIA ADPRESSA var. TONDUZIANA (Mez) L. B. Smith, 1930 (Contrib. Gray Herb. vol. 89) pp. 8-9; Smith, 1957, p. 153, fig. 42.

FIG. 63

Variety tonduziana is like T. adpressa var. adpressa in most respects. The distinguishing features are somewhat nebulous. The spikes may be somewhat more spreading and the plant somewhat smaller with leaves exceeding the scape though not the inflorescence. Capsules may be as short as 1.0 cm.

MATERIAL EXAMINED: Asplund 18837 (US) epiphytic on trunk, Mera, Prov. Pastaza, ca. 1100 m, 14 Dec. 1955; AJG 1133 (US) epiphytic, dwarf forest in windswept area, km

38 Catamayo-Loja, Prov. Loja, 2500 m, 10 Aug. 1965.

BOLIVIA, COLOMBIA, COSTA RICA, PANAMA, PERU.

TILLANDSIA

Tillandsia L., 1753 (Sp. Pl.) p. 286.

Leaves lingulate, narrowly triangular or linear, entire; plant often epiphytic; inflorescence usually of distichous-flowered spikes or simple and polystichously flowered; flowers perfect; primary bracts ecarinate; sepals usually symmetrical, free or united posteriorly; petals free, naked; ovary superior, glabrous; ovules numerous, caudate; capsule septocidal; seeds narrowly cylindrical or fusiform, the plumose appendage white, straight, basal.

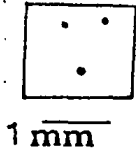
Subgenera ALLARDTIA and ANOPLOPHYTUM

Tillandsia subgenus Allardtia Baker, 1888 (Jour. Bot. vol. 26) p. 40. Tillandsia subgenus Anoplophytum Baker, 1887 (Jour. Bot. vol. 25) p. 212.

Leaf blades lingulate to narrowly triangular; stamens equaling petal claw but usually not exerted beyond petal blade; style slender and at least as long as ovary. In Ecuadorian species, stomata mostly restricted to lower surface, round in surface view, disposition scattered on leaf and not in distinct longitudinal rows; flowers not exceeding 5.0 cm in length, usually much smaller, petal blades inconspicuous; leaf scales with well developed ala, having 3 or more distinct and symmetrical layers around the four center cells; capsule 2.0-5.0 cm long.

KEY TO THE ECUADORIAN SPECIES OF TILLANDSIA

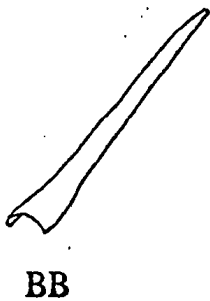
Subgenera Allardtia and Anoplophytum



- 1. Floral bracts ecarinate, or carinate and stamen filaments NOT plicate, plant may be pseudobulbous; floral bracts and sepals usually papery, glabrous within or less than 5 scales per mm² (A)*.

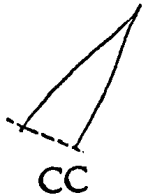


- 2. Inflorescence strongly lepidote, leaves with filiform apices (B), and loosely lepidote.
- 3. Plant including inflorescence less than 10 cm tall, growing in extensive mats, inflorescence appearing simple : 1. T. rupicola.



- 3. Plant including inflorescence 20-40 cm tall, inflorescence usually pinnate- or digitate-compound.
- 4. Base of leaf-rosette forming a distinct pseudobulb, petals usually yellow : 2. T. disticha.
- 4. Base of leaf-rosette NOT forming a distinct pseudobulb, petals usually violet : 3. T. tectorum.
- 2. Inflorescence NOT strongly lepidote, leaf-blades broadly triangular or lingulate (BB), appressed lepidote.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



5. Leaf-apices rounded-apiculate (C), leaf-sheaths glaucous, scape-bracts imbricate toward inflorescence, more distant below.

6. Petals yellow, sepals acute : 4. T. asplundii.

6. Petals white, sepals obtuse : 5. T. truncata.

5. Leaf-apices NOT rounded-apiculate but acute to attenuate (CC), leaf-sheaths NOT glaucous, scape-bracts imbricate throughout, NOT longer above and shorter below.

7. Floral bracts less than 2.0 cm long, inflorescence compound.

8. Inflorescence to 3.0 cm in diameter, leaf-blade width to 2.5 cm : 6. T. ionochroma.

8. Inflorescence 4.0-5.5 cm in diameter, leaf-blade width to 4.0 cm : 7. T. wangerinii.

7. Floral bracts 3.0 cm or longer, inflorescence mostly simple.

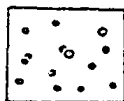


9. Sepals 3.0 cm long, ovate (D), leaf-sheath reddish-brown in strong contrast to blade : 8. T. petraea.

9. Sepals 5.0 cm long, elliptic (DD), leaf-sheath purple or concolorous with blade,

NOT reddish-brown : 9. T. walteri.

1. Floral bracts carinate, or ecarinate and stamen filaments plicate, plant NOT pseudobulbous; floral bracts and sepals usually coriaceous, lepidote within (AA).



1mm
AA



E

10. Leaf-blades lingulate (E), NOT densely gray lepidote on both surfaces, if conspicuously lepidote on one side then not so on the other and then the blade length about the same as sheath length.



F

11. Floral bracts conspicuously glossy, NOT nerved or very inconspicuously so (F), appearing smooth.

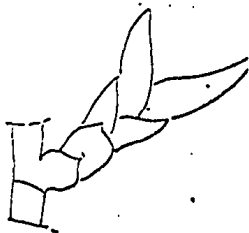
12. Primary bracts mostly much shorter than spike midpoint, stipe often exceeding 4.0 cm long, if primary bracts longer, then floral bract apex acuminate (G).



G

13. Floral bracts acuminate (G), and unicarinate toward apex, spikes 1.0-2.0 cm long, leaf-blade width 3.0-5.5 cm.

14. Spikes and primary bracts sharply reflexed at anthesis.
. : 10. T. superba.



H

14. Spikes and primary bracts erect to spreading at anthesis.

15. Inflorescence tripinnate, two basal sterile bracts on branch forming a collar-like structure (H).

. : 12. T. stenoura var. gonzalezii.

15. Inflorescence bipinnate, NOT having collar-like structure (HH).



HH

16. Inflorescence ca. 10 cm in diameter, spikes having 6 to 16 flowers per spike.

. : 13. T. stenoura var. mauroi.

16. Inflorescence ca. 20 cm in diameter, spikes having 8 to 30 flowers per spike.

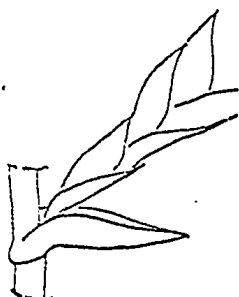


GG

. : 11. T. stenoura var. stenoura.

13. Floral bracts NOT acuminate, with rounded backs, acute (GG), to broadly acute or cuspidate, spikes mostly much exceeding 10 cm in length, often to 30 cm, leaf-blade width 4.5-11.0 cm or if less than 4.5 cm wide, then spikes much longer than 20 cm.

17. Leaf-blades 9.0-11.0 cm wide, much purple spotted, spikes and primary bracts spreading to reflexed (I). . . : 10. T. superba.



I

17. Leaf-blades NOT exceeding 6.0-8.0 cm in width, NOT much purple spotted, spikes and primary bracts erect to spreading (II).

18. Inflorescence mostly simple, scape much shorter than leaf-rosette.



II

. : 19. T. fendleri var. reducta.

18. Inflorescence compound, scape much exceeding leaf-rosette.



J

19. Sepals united for 5-6 mm (J), not at all nerved, leaves 35-40 cm long : 14. T. pyramidata.



JJ

19. Sepals NOT united, free (JJ), nerved at least slightly, leaves 35 cm long to much longer.



K

20. Floral bracts 1.5-2.4 cm long, capsules 2.2 or 4.0 cm long, sepals obtuse to subacute (K), leaf-blades 5.0-8.0 cm wide.

21. Inflorescence bipinnate, floral bract apex obtuse to cuspidate, capsules ca. 2.2 cm long, NOT exceeding calyx : 15. T. brevicapsula.



KK

21. Inflorescence tripinnate, floral bract apex acute, capsules to 4.0 cm long, exceeding calyx : 16. T. denudata.
20. Floral bracts 2.2-4.0 cm long, capsules 2.4-6.0 cm long, sepals broadly acute (KK), leaf-blades 3.5-6.0 cm wide.

22. Inflorescence with 12 to 20 spikes, sepals oblong-ovate, capsules 2.4-2.5 cm long : 17. T. clavigera.

22. Inflorescence with up to 10 spikes, sepals elliptic, capsules 3.0-6.0 cm long.

23. Floral bracts to 2.7 cm long, sepals strongly nerved, broad, ca. 1.2 cm wide,

- capsules 5.5-6.0 cm long.
- : 20. T. fendleri var. nervisepala.
23. Floral bracts 3.5-4.0 cm long, sepals NOT
strongly nerved, narrow, ca. 7-8 mm wide,
capsules ca. 3.0 cm long.
- : 18. T. fendleri var. fendleri.

12. Primary bracts mostly exceeding the mid-point of the spikes, stipe to 3.5 cm long and inconspicuous.

24. Spikes less than 3.5 cm wide at anthesis.

25. Inflorescence less than 11 cm long, spikes few to 7, all erect, and obscuring the rhachis. : 21. T. aequatorialis.

25. Inflorescence more than 15 cm long, spikes numerous, at least 10, if fewer, inflorescence at least 8.0 cm in diameter, spikes erect to spreading or reflexed.

26. Spikes strict (L), inflorescence pendent.

27. Sepals posteriorly connate, narrow, 6-8 mm wide.

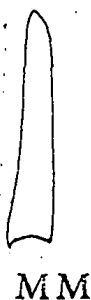
28. Leaves subtriangular (M), scape 5-7 mm in diameter, inflorescence less than 22 cm long, sepals obtuse.

. : 22. T. dichrophylla.

28. Leaves lingulate (MM), scape at least 1.0 cm in diameter, inflorescence 30-50 cm long.

29. Spikes 4.0-8.0 cm long with 7 to 10 flowers per spike.
. : 23. T. brunonis.

29. Spikes 9-15 cm long with ca. 20 flowers per spike : 24. T. polyantha.



27. Sepals free, broad, 0.8-1.4 cm wide.

30. Leaves 50-60 cm long by 5.0-6.5 cm wide, sepals more than 3 times as long as broad, inflorescence to 30 cm long. : 25. T. sodiroi.

30. Leaves to 120 cm long by 8.0-11.0 cm wide, sepals ca. 2.5 times as long as broad, inflorescence to ca. 120 cm long : 26. T. demissa.

26. Spikes NOT strict (LL), inflorescence NOT pendent.



31. Sepals connate for 4 mm or more, leaves 30-40 cm long.

32. Spikes spreading, sepals linear-ovate, 6 mm wide and posteriorly connate for 1/2 sepal length (N). : 27. T. emergens.



32. Spikes reflexed, sepals ovate, ca. 8 mm wide and posteriorly connate for only 4-6 mm (NN). : 29. T. buseri var. nubicola.



31. Sepals free or if united, then united for less than 3 mm, leaves 38-60 cm long.

33. Inflorescence dense, floral bracts 2.0-2.5 cm long, primary bract apex attenuate (O).



. : 28. T. buseri var. buseri.

33. Inflorescence lax, spikes 1-5 cm apart,
floral bracts 2.7-3.4 cm long, primary
bract apex attenuate to caudate (OO).

34. Leaf-blades glabrous or subglabrous be-
neath, width 6.0-7.5 cm.

. : 30. T. fosteri.

34. Leaf-blades densely lepidote beneath,
width 3.5-6.0 cm. . . . : 31. T. wurdackii.

24. Spikes more than 3.5 cm wide at anthesis.

35. Inflorescence pinnately compound (P),
spikes spreading.

36. Spikes short-elliptic, 5.0-6.0 cm wide
at anthesis. : 32. T. lajensis.

36. Spikes elongate-ovate, ca. 3.6 cm wide
at anthesis. : 33. T. ampla.

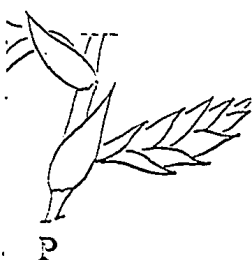
35. Inflorescence digitate (PP), or sub-
digitate, spikes erect to recurving.

32. Leaf-blades to 3.0 cm wide, spikes ca. 2.5
cm wide.

. : 35. T. arcuans var. naundorfii.

32. Leaf-blades 4.5 cm wide or wider, spikes
at least 4.0 cm wide.

. : 34. T. arcuans var. arcuans.



11. Floral bracts definitely nerved (F), NOT conspicuously glossy.



38. Inflorescence compound, dense, the main rhachis mostly obscured, distance between spikes or branches less than 1.0 cm or, if greater and main rhachis partly exposed, then the spike width 3.0 cm or more and floral bract length more than 2.0 cm.



39. Inflorescence digitate or subdigitate (Q), primary bracts foliaceous, erect, with triangular blades, spikes few, 3 to 5.
 : 36. T. schimperiana.



39. Inflorescence pinnately compound (QQ), primary bracts NOT foliaceous, spikes at least 15.

40. Primary bract sheath orbicular (R), petals ca. 3.0 cm long.



41. Primary bracts and spikes obscuring the main rhachis, primary bracts at inflorescence apex shorter than the spikes, spikes 1.5-2.5 cm wide at anthesis. . .
 : 37. T. orbicularis.

41. Primary bracts and spikes partly exposing the main rhachis, primary bracts consistently exceeding the spikes, spikes 3.0-3.5 cm wide at anthesis

. : 38. T. pachyaxon.

40. Primary bract sheath triangular (RR),
petals 2.0-2.5 cm long.



42. Flowers and spikes erect at anthesis
and at capsule maturity, capsules 3.0-
4.0 cm long. . . . : 39. T. pastensis.

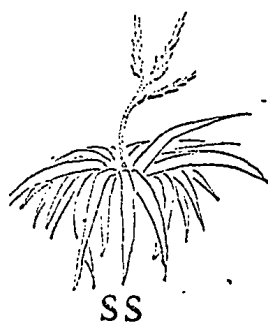
42. Flowers and spikes spreading at capsule
maturity, capsules less than 3.0 cm long

. : 40. T. sceptriformis.

38. Inflorescence apparently simple, or com-
pound, if compound then NOT dense, main
rhachis obviously exposed, distance be-
tween spikes or branches at least 1.0 cm
or if somewhat dense toward the apex of
inflorescence then the floral bracts less
than 2.0 cm long, spike width less than
2.1 cm at anthesis.



43. Inflorescence, simple, multiscaped (S),
spike width always less than 1.5 cm,
spikes axillary, several to many spikes
arising from different leaf-axils of
same plant. : 41. T. complanata.



43. Inflorescence obviously compound, one
scape per plant (SS).

44. Sepals slender (T), 1.8-2.1 cm long,
posteriorly connate for 2-7 mm, floral





U



UU

bracts acuminate.

45. Leaves equaling the inflorescence, scape-bracts imbricate (U), leaves NOT mottled : 42. T. zamorensis.

45. Leaves NOT equaling the inflorescence, scape-bracts remote (UU) at least in part, leaves purple-mottled. : 43. T. maculata.



TT

44. Sepals broad (TT), 1.0-1.6 cm long by 0.4-1.0 cm wide, free or if connate then less than 1.5 cm long.



V

46. Primary bracts mostly nearly as long as the branches, sepals acute (V), spike length mostly less than 3.5 cm. : 44. T. rubella.



VV

46. Primary bracts mostly less than 1/2 branch length, sepals obtuse (VV), to broadly acute, spike length mostly more than 3.5 cm.



W

47. Sepals united posteriorly, leaf-blade apex attenuate (W). : 45. T. barbeyana.



WW

47. Sepals free, leaf-blade apex acute (WW), or apiculate.

48. Inflorescence bipinnate or tripinnate at base, scape-bracts NOT imbricate or



X

scarcely so above, sepals obviously obovate (X).

49. Plant 50-90 cm tall, leaf-blades acute, 2-4 cm wide. : 17.* T. riocreuxii.

49. Plant 2-3 m tall, leaf-blades cuspidate, 5-7 cm wide. : 4.* T. inconspicua.

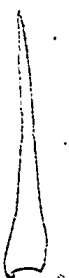


XX

48. Inflorescence tripinnate throughout, scape-bracts imbricate throughout, sepals elliptic or elliptic-obovate (XX).

50. Scape shorter than leaf-rosette, inflorescence ca. 15 cm long having ca. 6 branches, sepals broadly acute, weakly nerved. : 46. T. pinnata.

50. Scape much longer than leaf-rosette, inflorescence ca. 50 cm long, having 12 to 22 branches, sepals obtuse, strongly nerved. : 47. T. towarensis.



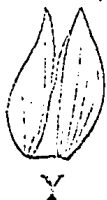
EE

10. Leaf-blades definitely triangular (EE), densely gray lepidote usually on both surfaces.

51. Floral bracts 3.0-4.5 cm long, sepals free, ca. 3.0 cm long, spikes broad, usually 3.0 cm or more in width at anthesis or more than 2.4 cm broad in bud.

* The descriptions of 17. T. riocreuxii André and 4. T. inconspicua André are with the subgenus, Pseudo Catopsis where they are also keyed.

52. Inflorescence pinnately compound, spikes spreading.
54. Spikes short-elliptic, ca. 7.0-10.0 cm long by 5.0-6.0 cm wide at anthesis. : 32. T. lajensis.
54. Spikes elongate-ovate, ca. 9.0-12.0 cm long by 2.5-3.5 cm wide at anthesis. : 33. T. ampla.
52. Inflorescence with spikes digitate-subdigitate, spikes erect to nodding.
53. Leaf-blades 5.0 cm wide, spikes 4.0-5.0 cm wide. . . : 34. T. arcuans var. arcuans.
53. Leaf-blades to 3.0 cm wide, spikes 2.5 cm wide. . . : 35. T. arcuans var. naundorfii.
51. Floral bracts always less than 3.0 cm long, sepals posteriorly connate and less than 2.5 cm long or free, spikes narrow, usually less than 2.6 cm wide at anthesis or less than 2.0 cm wide in bud, if simple, dimensions apply to inflorescence.
55. Sepals either NOT connate posteriorly, or connate for 2-6 mm (Y), (1/4-1/2 or less of sepal length).
56. Sepals NOT connate, 1.6-1.7 cm long, plant to ca. 40 cm tall. : 48. T. latifolia var. latifolia.



56. Sepals connate for 1-6 mm (1/4 to 1/2 of sepal length or less) 1.0-1.2 cm long or 1.7-2.2 cm long, plant ca. 1 m tall.

57. Sepals 1.7-2.2 cm long, moderately lepidote within, petals 3.0-3.5 cm long, main rhachis of inflorescence obscured.
 : 50 T. queroensis.

57. Sepals 1.0-1.2 cm long, glabrous within, petals 1.5-2.0 cm long, main rhachis of inflorescence exposed.

58. Filaments strongly plicate (Z), inflorescence having ca. 8 spikes, each spike with ca. 6 to 8 flowers, and 1 to 2 basal sterile bracts. . . : 51. T. gayii.

58. Filaments NOT strongly plicate (ZZ), inflorescence having ca. 17 spikes, each spike with 8 to 12 flowers, and usually no basal sterile bracts.
 : 52. T. oroyensis.

55. Sepals connate posteriorly for 6-15 mm (YY), (1/2 to 3/4 or more of sepal length).

59. Inflorescence simple, floral bracts strongly nerved and lepidote without.
 : 53. T. incarnata.

59. Inflorescence compound, floral bracts NOT strongly nerved, glabrous without or



Z



ZZ



YY

if lepidote then floral bracts less than 1.8 cm long and stamen filaments strongly plicate (Z).

60. Floral bracts lepidote without, less than 1.8 cm long, filaments plicate (Z)

. . . : 49. T. latifolia var. divaricata.

60. Floral bracts glabrous without, lustrous on outer surface.

61. Inflorescence pink, NOT red or red-yellow, sepals ca. 1.2 cm long.

. . . : 49. T. latifolia var. divaricata.

61. Inflorescence red or red-yellow, sepals 2.0-2.2 cm long.

62. Inflorescence lax, with 5 to 8 spikes, leaf-sheath narrow, 4.5-5.5 cm wide.

. . . : 54. T. confinis.

62. Inflorescence dense, with 6 to 12 spikes, leaf-sheath broad, ca. 7.0 cm wide.

. . . : 55. T. confertiflora.



1. TILLANDSIA RUPICOLA Baker, 1888 (Journ. Bot. vol. 26)
p. 13; Mez, 1935, p. 560.

PLANT 7.0-10.0 cm tall by ca. 8.0 cm wide, growing in aggregations and forming dense mats on ground; LEAVES 4.0-6.0 cm long, blades 4-5 mm wide, involute, recurved, densely, spreading lepidote, with a filiform apex; sheath 0.9-1.1 cm long by ca. 8 mm wide, conspicuous, ovate; SCAPE including inflorescence ca. 6.0 cm long by 3 mm in diameter below inflorescence, erect; SCAPE-BRACTS to 2.0 cm long by 4-5 mm wide, strict, imbricate; INFLORESCENCE superficially simple, 1.6-2.4 cm long by 9 mm in diameter, erect, ellipsoid; PRIMARY BRACTS ca. 2.0 cm long by 8-9 mm wide, erect, glabrous, apex caudate; FLORAL BRACTS to 1.2 cm long, exceeding sepals, papery, obviously nerved, ecarinate, apex acute, glabrous within, lepidote without; PETALS violet.

MATERIAL EXAMINED: Hall s. n. (ISOTYPE, GH) growing in dense mats opposite the village of Oña, Prov. Azuay, ca. 2600 m, 1833.

NOTE: While superficially simple and thus described by Baker (1888) and Mez (1935), the inflorescence is actually bipinnate with very short spikes. The ISOTYPE specimen (GH) is in bud and appears to have a simple inflorescence but for the presence of several floral bracts subtended by a common primary bract.

2. TILLANDSIA DISTICHA H. B. K., 1816 (Genera et Species Plantarum, vol. 1) p. 22; Smith, 1957, p. 117.

FIG. 15

PLANT ca. 30 cm tall but up to 65 cm tall occasionally, ca. 15 cm in diameter, growing in aggregations of 5 to 20 interconnected individuals, plant base in form of pseudobulb ca. 2.5-6.0 cm long by ca. 3.5 cm wide; LEAVES 20-30 cm long, blades 2-3 mm wide, involute, spreading lepidote, apex filiform, bright green to olive green; sheaths ca. 2.5 cm long by 3.0 cm wide, conspicuous, round; SCAPE ca. 3 mm in diameter, erect to ascending; SCAPE-BRACTS 1.5-2.5 cm long, blades 2 mm wide, spreading, imbricate; INFLORESCENCE 7.0-12 cm long by ca. 4.0 cm wide, bipinnate, lax, tending to be digitate with 6 to 10 spikes, lepidote; PRIMARY BRACTS ca. 2.0 cm long by 8 mm wide, densely lepidote, apex attenuate to filiform; SPIKES 5.0-10 cm long by 6 mm wide having a stipe ca. 8 mm long, distance between spikes ca. 1.0 cm, having 10 to 20 flowers per spike; FLORAL BRACTS 0.7-1.0 cm long by 4 mm wide, imbricate, nerved, papery, lepidote without, mostly glabrous within, ovate, carinate; SEPALS ca. 8 mm long by 2 mm wide, glabrous, carinate, acute; PETALS ca. 1.3 cm long, usually yellow but occasionally white with age; CAPSULE length variable, 2.0-6.0 cm long, always slender.

MATERIAL EXAMINED: Humboldt and Bonpland 3455 (P, TYPE; GH, photo) locality given as Peru, probably Ecuador, Prov.

Loja; Foster 2614 (US) epiphytic, dry, windy area, km 85-90 Cuenca-Oña, Prov. Azuay, 1000 m, 4 Dec. 1948; Fagerlind and Wibom 354 (US) between Palmar and Las Americas, Prov. Guayas, near sea level, 28 Sept. 1952; Harling 4018 (US) epiphytic in Jacquinia (coastal "barbasco") Colonche, Prov. Guayas, 6-7 May 1959; AJG 645 (US) 2 km south of Ayangüe, cactus-scrub, Prov. Guayas, 24 March 1962; AJG 1183 (US) near Palmar, open scrub, Prov. Guayas, near sea level, Aug. 1965; Sodiño 171/17 (B; US, AJG, photo) between Balao and Guayaquil, Prov. Guayas, near sea level, Oct. 1890; AJG 865 (US) epiphytic on Guazuma ulmifolia Lam. ("guasmo") ca. 2 m from ground, in pasture, km 5 Esmeraldas-Santo Domingo, Prov. Esmeraldas, 20 m, 12 Oct. 1963; AJG 1125 (US) epiphytic on Prosopis, in semi-closed scrub, km 27 Loja-Catamayo, Prov. Loja, 10 Aug. 1965; Fagerlind and Wibom 558 (US) Prov. Manabí, 10 Oct. 1952; Mille, Luis 1991 (F) Prov. Manabí, no date; Eggers 14200 (US) shrubby area near swamp, between Machala and Puerto Bolívar, Prov. El Oro, near sea level, Sept. 1923; Steyermark 54037 (US) epiphytic, along Río Amarillo, upstream from Portovelo, Prov. El Oro, 640-760 m, 22 Aug. 1943; Foster 2588 (US) epiphytic, Portovelo, Prov. El Oro, 1948; Rauh, Hirsch E 375 Arenillas, Bombax-scrub, Prov. El Oro, 200 m, 28 Sept. 1957; Rauh, Hirsch E 7 (US) Paisaje, Prov. El Oro, 300 m, 28 Aug. 1957; Rauh, Hirsch E 4 (US) Santa Rosa, Prov. El Oro, ca. 200 m, 28 Aug. 1957; Rauh, 70128 (US) near Quito, no capsules although well past

anthesis, Prov. Pichinche, ca. 2000 m; Asplund 15572 (US)
epiphytic in Crescentia, Quevedo, Prov. Los Rios, ca. 100 m,
28 Feb. 1955.

NOTES: The capsule length may vary from 2.0-6.5 cm long
in plants of the same clone of T. disticha H. B. K. Flower-
ing time seems to be approximately from August through October
in the Sierra and from about February to May on the coast
during typical years. However, during "El Niño" years when
rains on the coast greatly exceed the usual 12-25 cm annual
precipitation, plants of T. disticha on the coast may flower
as early as August.

A cultivated specimen of Foster not cited above has un-
usually long spikes, one spike measuring 22 cm in length.

The holdfasts of this species are well developed and in
coastal specimens often have round or elliptic nodules.
These are apparently insect produced and measure 2-4 mm long
by 2 mm in diameter with small holes at each end. They are
similar to the nodules found on the holdfasts of some in-
dividuals of T. latifolia var. divaricata (Benth.) Mez. *

COLOMBIA, PERU.

3. TILLANDSIA TECTORUM E. Morren, 1877 (Belgic. Hortic. vol. 27) p. 328, pl. 18; Smith, 1936, pp. 553-554.

FIG. 16

PLANT ca. 20 cm tall by 15 cm in diameter, usually saxicolous; LEAVES 10-20 cm long, blades 4-5 mm wide, involute, filiform, silvery-gray, densely spreading lepidote, recurved, sheath ca. 2.0 cm long by 1.3 cm wide, nearly concolorous with blade, ovate, distinct; SCAPE including inflorescence 15-20 cm long by 3 mm in diameter below inflorescence; SCAPE-BRACTS ca. 5 cm long by 1.0 cm wide, imbricate, apex caudate; INFLORESCENCE 5.0-12 cm long by ca. 2.0 cm in diameter, simple to bipinnate, with 1-7 erect spikes, lepidote, curving, dense; SPIKES ca. 3.0 cm long by 0.7-1.2 cm wide, erect, with 8-12 flowers, linear; PRIMARY BRACTS ca. 1.5 cm long by 7-8 mm wide, erect, ovate, lepidote, apex caudate; FLORAL BRACTS ca. 1.4 cm long by 7-8 mm wide, reddish-yellow, ovate, lepidote without, glabrous within, slightly bicarinate at base to ecarinate at apex, obviously nerved, apex acute; SEPALS 1.0 cm long by ca. 3 mm wide, posteriorly united for 2-3 mm, ovate, lepidote without, glabrous within, apex acute, papery, nerved, ovate; PETALS ca. 1.8 cm long, erect, violet, naked; OVARY 2-3 mm long, distance between flowers 4 mm, in flower around August.

MATERIAL EXAMINED: Steiermark 53731 (US) between the dry rocky slopes of south side of Río León and Tablón de Oña on north side of Río León south of Río Oña, Prov. Azuay,

1,970-2287 m, 3 Aug. 1943; Foster 2616 (US) on rocks in Oña valley, km 90-110 Cuenca-Luja, Prov. Azuay, 1400-2000 m, 3 Dec. 1948; Gilmartin 1118 (US) terrestrial, dry pebbly slopes, no water in rosette, km 101 Cuenca-Loja, Prov. Azuay, 2000 m, 9 Aug. 1965; Gilmartin 1156 (US) on rocks, km 110 Loja-Cuenca, rare, Prov. Azuay, 2100 m, 12 Aug. 1965.

PERU.

4. TILLANDSIA ASPLUNDII L. B. Smith, 1959 (Phytologia vol. 6, no. 8) p. 441, pl. 2, figs. 18, 19.

PLANT 65-90 cm tall, epiphytic; LEAVES 30-50 cm long, blades 5.0-7.0 cm wide, reddish in dry state, lingulate, apex rounded and apiculate, densely appressed-lepidote below, subglabrous above, sheath 12-16 cm long by 8.0-9.0 cm wide, blue-white glaucous, elliptic, conspicuous; SCAPE including inflorescence to 85 cm long by 4-7 mm in diameter, erect, red; SCAPE-BRACTS 2.5-7.0 cm long by 1.8-2.0 cm wide, imbricate toward inflorescence, more distant below, strict; INFLORESCENCE 25-40 cm long by 10-20 cm in diameter, bipinnate, cylindric to subpyramidal, glabrous, erect; PRIMARY BRACTS 2.5-5.0 cm long by 1.5 cm wide, spreading, red, glabrous; SPIKES 7.0-11 cm long by 1.5-3.0 cm wide, erect, having ca. 15 to 20 per inflorescence, ca. 1.5 cm apart, 5 to 12 flowers per spike; FLORAL BRACTS 1.6-2.2 cm long by 0.9-1.1 cm wide, spreading to erect, ovate to ovate-elliptic, glabrous without and within, ecarinate, papery, apex acute; SEPALs 1.6-1.7 cm long by 5-9 mm wide, dull green, obovate, glabrous without, subglabrous within, ecarinate, papery, acute; PETALS ca. 2.5 cm long, yellow; OVARY 5-6 mm long by 3-4 mm in diameter, very slightly inferior; stamens included with corolla by ca. 3 mm, free from petals, distance between flowers 7-10 mm, in flower February to April.

MATERIAL EXAMINED: Asplund 19279 (S, TYPE; US, photo) near Apayacu, Mera, Prov. Napo-Pastaza, 1050 m, 8 Feb. 1956;

Asplund 20123 (US) Shell Mera, Prov. Napo-Pastaza, 900 m,
3 April 1956.

5. TILLANDSIA TRUNCATA L. B. Smith, 1954 (Contrib. U.S. Nat. Herb. vol. 29, no. 11) pp. 530-531, fig. 85.

PLANT 80-100 cm tall, epiphytic and terrestrial; LEAVES 35-55 cm long, blades 4.0-6.5 cm wide, lingulate, apex rounded and apiculate, reddish when dry, apparently glabrous above, punctulate below, sheath 10-18 cm long by 8.0-12 cm wide, glaucous, ovate, conspicuous; SCAPE 80-90 cm long including inflorescence, 3-6 mm in diameter, reddish when dry; SCAPE-BRACTS 3.0-5.0 cm long by 1.0-2.5 cm wide, strict, not imbricate toward base, barely imbricate just below inflorescence, nearly of uniform length throughout scape; INFLORESCENCE 20-35 cm long by 3.0-4.0 cm in diameter, erect, narrowly cylindrical to ellipsoid, glabrous, bipinnate, with 10-20 spikes these 1.2-2.5 cm apart; PRIMARY BRACTS 2.0-4.0 cm long by ca. 1.0 cm wide, erect in bud, spreading to reflexed at anthesis, apex acute to acuminate, ovate, reddish, glabrous; SPIKES 3.0-4.5 cm long by ca. 1.5-2.0 cm wide, stipe 5-9 mm long naked or with 1 sterile bract, linear to ovate; FLORAL BRACTS 1.3-1.5 cm long by 0.8-1.2 cm wide, imbricate but at anthesis not touching, spreading, ovate, glabrous within and without, papery, apex acute, strongly nerved, ecarinate; SEPALS 1.1-1.2 cm long by 4 mm wide, erect, obovate, apex broadly obtuse, strongly nerved, slightly carinate, glabrous within and without, subequally connate for 4 mm; PETALS ca. 1.4 cm long by 4 mm wide, erect, white; OVARY 5 mm long by 1 mm in diameter, style more than 2 times ovary length,

stigma as long as anther apices, stamens included in corolla by 2-3 mm, distance between flowers 4-5 mm, in flower December, January.

MATERIAL EXAMINED: Foster 2642 (US, TYPE) on road between Santo Domingo and Quito, Prov. Pichincha, ca. 1800 m, 8 Dec. 1948; Foster 2644 (US) on road between Santo Domingo and Quito, Prov. Pichincha, ca. 1400 m, 8 Dec. 1948.

6. TILLANDSIA IONOCHROMA Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 801.

Caraguata violacea André, 1888 (Énumération Bromél.) p. 6; André, 1889, pp. 50-51, pl. 18 a.

PLANT 30-40 cm tall, epiphytic; LEAVES 25-30 cm long, blades ca. 1.8-2.5 cm wide, lingulate, apex acute to attenuate, very slightly lepidote on both surfaces; sheath, 9.0-11 cm long by 4.0-5.0 cm wide, dark, with overtones of purple when fresh, ovate, conspicuous; SCAPE 25-35 cm long including inflorescence, 3-5 mm in diameter; SCAPE-BRACTS 6.0-12 cm long by ca. 2.5 cm wide, erect but not strict, imbricate and foliaceous throughout; INFLORESCENCE 10-15 cm long by 2.5-3.0 cm in diameter, bipinnate, ellipsoid to cylindrical, glabrous, dense; PRIMARY BRACTS 2.5-5.5 cm long by 1.5-2.5 cm wide, erect with apices short-caudate, reflexed, ovate with sheath elliptic-orbicular; SPIKES 2.0-4.0 cm long by 1.1-1.3 cm wide, erect, having ca. 14 per inflorescence, stipe minimal to 5 mm long, 4-7 flowers per spike, no sterile bracts; FLORAL BRACTS 9-10 mm long by 5-6 mm wide, erect, imbricate, ovate, glabrous within and without, apex broad-acute, papery, rugose when dry, slightly nerved but very inconspicuously so, ecarinate; SEPALS 0.8-1.0 cm long by 5 mm wide, erect, obovate, obtuse, posteriorly carinate, strongly nerved, glabrous within and without, subequally connate for 2 mm; PETALS ca. 1.8 cm long; OVARY 5-6 mm long by 2 mm in diameter, style ca. 2 times ovary length; CAPSULE 2.5 cm long

by 5-6 mm in diameter, seeds with beige colored pappus, seeds themselves green-brown, distance between flowers 3-4 mm, in flower around July-August.

MATERIAL EXAMINED: André 2746 (K, TYPE; US, photo)
Chiquiri bamba; Drake 55 (NY; GH fragment; US, fragment)
Prov. Loja; Hitchcock 21387 (US) between La Toma and Loja,
Prov. Loja, 1800-2600 m, 4 Sept. 1923.

7. TILLANDSIA WANGERINII Mez, 1906 (Repert. Nov. Spec, Regnum Veg., vol. 3) p. 40; Mez, 1935, pp. 543-544.

PLANT ca. 40 cm tall, epiphytic; LEAVES 30-35 cm long, blades 2.5-4.0 cm wide, lingulate, apex acute to attenuate, punctulate to subglabrous; sheath 10-12 cm long by 5.0-6.0 cm wide, dark, elliptic-ovate, conspicuous; SCAPE 30-40 cm long including inflorescence, 6-9 mm in diameter; SCAPE-BRACTS 6.0-16 cm long by 2.0-3.0 cm wide, erect to spreading, imbricate and foliaceous throughout; INFLORESCENCE 12-14 cm long by 4.0-5.5 cm in diameter, ellipsoid, glabrous, dense, bipinnate with 15-20 spikes, distance between spikes ca. 1.0 cm; PRIMARY BRACTS 2.0-6.0 cm long consistently exceeding the spikes, erect with nearly orbicular sheath, minutely lepidote, apex acute to attenuate, papery; SPIKES 2.0-4.0 cm long by ca. 2.0 cm wide, erect, stipe ca. 6 mm long, no sterile bracts, ca. 4-6 flowers per spike; FLORAL BRACTS 1.4-1.6 cm long by 0.8-1.2 cm wide, erect, ovate, punctulate lepidote outside, glabrous within, unicarinate, slightly to moderately nerved, papery, apex acute; SEPALs 1.2-1.4 cm long by 7-8 mm wide, erect, obovate, obtuse-rounded, subequally connate 3-4 mm; PETALS ca. 2.4 cm long; STAMENS with filaments narrowing toward anthers and slightly plicate in part, anthers with conspicuous tails 1-2 mm long, included within corolla by 2-3 mm; OVARY 8-9 mm long by 3-4 mm in diameter; distance between flowers 3-4 mm, in flower around September.

MATERIAL EXAMINED: Weberbauer 2920 (B, TYPE; US, photo)
Peru; Hitchcock 21687 (US) between Cuenca and Huigra, Prov.
Cañar, 2700-3000 m, 12-13 Sept. 1923.

8. TILLANDSIA PETRAEA L. B. Smith, 1951 (Contrib. U. S. Nat. Herb. vol. 29, no. 10) p. 497-498, fig. 65.

PLANT ca. 65 cm tall, saxicolous; LEAVES 20-30 cm long, blades 2.0-2.5 cm wide, narrowly triangular, gray-green, involute, apex caudate, surface dense, moderately appressed-lepidote, sheath 10-15 cm long by ca. 6.0 cm wide, reddish brown, dense-lepidote, elliptic, very conspicuous; SCAPE to 63 cm tall including inflorescence, 8-9 mm in diameter, erect; SCAPE-BRACTS 5.0-15 cm long by 2.5 cm wide, erect, imbricate throughout; INFLORESCENCE ca. 18 cm long by ca. 3.0 cm across, red, narrowly cylindrical, glabrous, simple with ca. 20 flowers; FLORAL BRACTS 5.0-5.5 cm long by 2.7-3.1 cm wide, erect, imbricate, red, elliptic, glabrous within and without, strongly nerved, ecarinate, apex acute; SEPALs 3.0 cm long by 1.0 cm wide, erect, ovate, apex acute, glabrous within and without, ecarinate, equally free; PETALS 6.0-6.5 cm long by ca. 1.0 cm wide, erect; green, naked; OVARY 1.0 cm long by 5 mm in diameter, style several times longer than ovary, stigma exerted beyond corolla by ca. 5 mm, stamens included by 2 mm, distance between flowers 2.0-2.5 cm.

MATERIAL EXAMINED: Espinosa E 2002 (US, TYPE) Llanos Payama, northeast of Zaruma, Prov. El Oro, 2950 m, 30 Aug. 1947.

NOTES: The distinctions between T. petraea L. B. Smith and T. walterii Mez are few: sepal size and leaf sheath coloration. T. petraea has been collected only from the

western slopes of the Andes growing on rocks. The petal color may offer an additional distinction, green in T. petraea and rose in T. walterii, however this may not be reliable even in fresh material and in dry specimens the color approaches yellow in both species.

9. TILLANDSIA WALTERII Mez, 1906 (Repert. Nov. Spec. Regnum Veg. vol. 3) p. 43; Mez, 1935, pp. 553-554; Smith, 1936, pp. 550-551.

PLANT 50-80 cm tall, epiphytic; LEAVES 30-35 cm long, blades 1.5-4.0 cm wide, triangular, apex attenuate, appears glabrous, deep green with some purple splotches, sheath 10-18 cm long by ca. 7.0 cm wide, concolorous with blade on outer surface, densely, finely lepidote; SCAPE to 85 cm long including inflorescence, 5-7 mm in diameter, erect; SCAPE-BRACTS 4.5-15 cm long by 2.5 cm wide, imbricate throughout, foliaceous below, strict; INFLORESCENCE 15-20 cm long by 3.0 cm in diameter at anthesis, red, narrowly elliptic, glabrous, simple, with ca. 9-12 flowers, dense; FLORAL BRACTS 4.0-6.0 cm long by 3.5 cm wide, scarcely nerved, ecarinate, subcoriaceous, glabrous without and within, apex broad-acute, red, elliptic-orbicular, imbricate, erect; SEPALS ca. 5.0 cm long by 1.2 cm wide, erect, light green to yellow, elliptic, glabrous without, glabrous to scantily lepidote within, apex very broad-acute, strongly nerved, papery, ecarinate, equally free; PETALS 6.0-8.0 cm long, deep rose when fresh, turning yellow, exceeding calyx by 2.3 cm, distance between flowers 1.5-2.5 cm, in flower around September to December.

MATERIAL EXAMINED: Weberbauer 4319 (B, TYPE; US, photo) Peru; Foster 2617 (US) Cuenca-Oña highway, Prov. Azuay, ca. 4000 m, 3 Dec. 1948; Asplund 17711 (S; US, photo, fragment) Hacienda Pizhin, Prov. Azuay, ca. 2800 m, 23 Oct. 1955.

NOTES: T. walterii Mez has been collected from near the Andean crest between Cuenca and Oña and on the eastern slopes of the Andes. Unlike T. petraea L. B. Smith, it has been found growing epiphytically only.

BOLIVIA, PERU.

10. TILLANDSIA SUPERBA Mez & Sodiro, 1904 (Bull. Herb. Boiss, series 2, vol. 4) p. 1132.

PLANT to 2 m tall; LEAVES 50-70 cm long, blades 9.0-11.0 cm wide, lingulate, apex acute, much purple spotted, subglabrous, sheath ca. 26 cm long by 15 cm wide, purple, elliptic, conspicuous; SCAPE with inflorescence to 2 m tall, by ca. 1.1 cm in diameter; SCAPE-BRACTS not known; INFLORESCENCE 90-110 cm long by ca. 22 cm in diameter, red, bipinnate; PRIMARY BRACTS 4.5-7.0 cm long by 2.5 cm wide, spreading to reflexed, with 11-18 flowers per spike, distance between spikes 1.4-3.5 cm, stipe to 1.0 cm long with single sterile bract; FLORAL BRACTS ca. 4.0 cm long by 2.0 cm wide, erect, imbricate, not nerved, bicarinate, coriaceous, glabrous without, finely punctulate within, apex acute to obtuse; SEPALS 3.6 cm long by 7-8 mm wide, linear-ovate, acute, free, glabrous without, lepidote within, posteriorly carinate; PETALS ca. 4.0 cm long by 3 mm wide, erect; OVARY 9 mm long by 2-3 mm wide, style more than 2 times as long as the ovary, stamens included by 6-7 mm, free from petals, distance between flowers 5-6 mm; in flower May-July.

MATERIAL EXAMINED: Sodiro 37d (B, TYPE; US, photo) western slopes of Mt. Pichincha, Prov. Pichincha, May 1896; Asplund 16795 (US) below San Juan towards Chiriboga, Prov. Pichincha, ca. 2900 m, 2 July 1955; Sodiro 171/27c (Quito; AJG, photo), Ecuador ca. 2000 m, Oct. 1891.

TILLANDSIA STENOURA Harms, 1935 (Notizblatt, Gart. und Mus. Berlin, vol. 12, no. 115) p. 537.

T. arguta L. B. Smith, 1959 (Phytologia vol. 6, no. 8) pp. 440-441, pl. 2, figs. 16, 17.

PLANT ca. 1 m tall; LEAVES 30-60 cm long, blades 3.0-5.5 cm wide, lingulate, densely lepidote beneath, apex acute, sheath 10-18 cm long by 5.5-10.0 cm wide, purple, turning very dark when dry, ovate-elliptic, conspicuous; SCAPE with inflorescence ca. 1 m long by 1.0-1.6 cm in diameter; SCAPE-BRACTS 12-30 cm long by ca. 2.0 cm wide, erect, imbricate; INFLORESCENCE 25-50 cm long by 10-20 cm in diameter, red, bipinnate or tripinnate toward base, pyramidal, glabrous; PRIMARY BRACTS 4.0-7.0 cm long by ca. 2.5 cm wide, erect to spreading, ovate, glabrous; SPIKES 5.0-20.0 cm long by 2.0-2.5 cm wide at anthesis, erect to spreading, ca. 12 to 15 per inflorescence, sessile or with stipe 1.0-3.0 cm long with 1 to 3 sterile bracts, each spike with 8 to 30 flowers; FLORAL BRACTS 2.5-3.5 cm long by 1.5-2.0 cm wide, erect, imbricate, red or purple, ovate, glabrous without, lepidote within, bicarinate, unicarinate toward apex, not nerved, apex acuminate; SEPALS 2.1-2.5 cm long by 4-6 mm wide, erect, free, long-elliptic or long-ovate, acute, posteriorly carinate, strongly to slightly nerved, glabrous without, lepidote within, papery; PETALS ca. 3.0 cm long, violet; OVARY ca. 7 mm long by 2-3 mm in diameter, style at least 2 times ovary length; CAPSULE 2.5-2.8 cm long by 8-9 mm in diameter,

distance between flowers 6-7 mm, flowering around May-July.

11. T. STENOURA var. STENOURA

FIG. 17

Scape at least 1.4 cm in diameter; inflorescence 30-40 cm long, bipinnate, red, spikes not sessile but with stipe 1.0-3.0 cm long having 1 to 3 sterile bracts, floral bracts not exceeding 3.0 cm in length.

MATERIAL EXAMINED: Diels 558 (B, TYPE; US, photo)

Tipochocha, Prov. Chimborazo, 3000 m, 16 Aug. 1933; 740 AJG (US) terrestrial, cloud forest, km 60 Quevedo-Latacunga, Prov. Cotapoxi, 3350 m, 16 June 1961; 841 AJG (US) terrestrial, growing in a clump on hummock at roadside, ca. 60 km south of Cuenca, Prov. Azuay, 3000 m, 20 Feb. 1963; Hitchcock 21676 (US) between Huigra and Cuenca, Prov. Azuay or Cañar, ca. 2700-3000 m, 12-13 Sept. 1923; Espinosa E342 (GH) near Cajairuma, Prov. Loja, 2400 m, 7 May 1946; Foster 2619 (US, TYPE of T. arguta) km 50 Cuenca-Oña, Prov. Azuay, 4000 m (?), 4 Dec. 1948.

NOTES: I am reducing T. arguta L. B. Smith to taxonomic synonymy with T. stenoura Harms. T. arguta L. B. Smith shows no significant differences from the previously described T. stenoura Harms. Had there been access earlier to the type specimen of T. stenoura Harms, undoubtedly T. arguta would not have been described. Some specimens deposited in the Berlin herbarium which had been thought lost, have since turned up.

12. T. STENOURA var. GONZALEZII Gilmartin, var. nov.

FIG. 18

A var. T. stenoura inflorescentia tripinnatis; spicis subsessilibus differt.

Scape ca. 1.0 cm in diameter; inflorescence tripinnate at least toward base, purple, branches with 1 to 2 collar-like sterile bracts at base; spikes subsessile, floral bracts 2.7-3.0 cm long.

MATERIAL EXAMINED: Espinosa E 1412 (GH, TYPE) "Grandes rosetas de hojas tiesas, inflorescencia muy grande (1 metro o más) compuesta de espigas múltiples, decusadas, de color rojo oscuro; Brácteas con bordes negros. Páramos del occidente de Saraguro, ca. 5 km north of Saraguro, Prov. Loja, 2500 m, 10 March 1947.

NOTES: This variety is closely allied to T. stenoura var. stenoura but differs in the tripinnate inflorescence, the collar-like sterile bracts at branch base and the subsessile spikes. It differs from T. stenoura var. mauroi in the tripinnate inflorescence, and also in the shorter floral bracts.

13. T. STENOURA var. MAUROI Gilmartin, var. nov.

FIG. 19

A var. T. stenoura bracteis florigeris longioribus; foliorum laminis angustioribus; inflorescentia gracilis differt.

Leaves somewhat triangular to lingulate, blade width

3.0-3.5 cm; inflorescence ca. 25 cm long and ca. 10 cm in diameter, bipinnate, having ca. 7 spikes, the lower ones remote, to 7.0 cm distant; spikes 5.0-10.0 cm long, erect; floral bracts 3.0-3.5 cm long.

MATERIAL EXAMINED: 1112 AJG (US, TYPE) dwarf forest, epiphytic, moderately common, km 40 Cuenca-Loja, Prov. Azuay, 3000 m, 9 Aug. 1965.

NOTES: T. stenoura var. mauroi Gilmartin differs from the typical variety in its narrower leaf-blades, the slender inflorescence, the smaller number of spikes and the longer floral bracts.

14. FILLANDSIA PYRAMIDATA André, 1889, Bromél. Andreanae, p. 86.

FIG. 20

PLANT to 150 cm tall; LEAVES 35-40 cm long, blades 4.5-5.0 cm wide, pale green, red toward apex, lingulate, very minutely punctulate below, subglabrous above, sheath ca. 15 cm long by 7.5 cm wide, slightly purple, elliptic, conspicuous; INFLORESCENCE ca. 33 cm long by 20 cm in diameter, bipinnate, with ca. 8 branches, ellipsoid, glabrous; SCAPE ca. 145 cm long with inflorescence by 8-9 mm in diameter, erect; SCAPE-BRACTS 8.0-10.0 cm long by 3.5 cm wide, imbricate, green to purple, erect; PRIMARY BRACTS 4.0-6.0 cm long by 2.5-3.0 cm wide, erect, ovate, glabrous, apex acute to attenuate; BRANCHES 8.0-11.0 cm long by 2.5-3.0 cm wide, erect at branch base then decurving, elliptic, stipe 1.4-4.0 cm long; FLORAL BRACTS 2.0-2.1 cm long by 1.9-2.0 cm wide, erect, imbricate, ovate, glabrous without, lepidote within, apex broadly acute, bicarinate with rounded backs, coriaceous, not nerved; SEPALS 1.8-1.9 cm long by 1.0 cm wide, erect, posteriorly connate for 5-6 mm, elliptic, not nerved, glabrous without, lepidote within, carinate posteriorly, broadly acute, OVARY ca. 6 mm long, distance between flowers 5 mm.

MATERIAL EXAMINED: Gilmartin 1151 (US) km 71 Loja-Cuenca, slopes above Río Tanta, Prov. Loja, ca. 2300 m, 12 August 1966.

COLOMBIA, PERU.

NOTES: The great elongation of the scape may not be typical, as Gilmartin 1151 has several vegetatively produced plantlets growing from the axil of some floral bracts. Frequently when a bromeliad plant has these vegetatively produced plantlets there is a concomittant greater than normal elongation of the scape. Very common locally at km 71 Loja-Cuenca, growing on steep rocky hillsides.

15. TILLANDSIA BREVICAPSULA Gilmartin, spec. nov.

Habitu T. denudata André similis sed capsulis brevis, ramis ad 30 cm longis.

PLANT probably at least 1 m tall; LEAVES ca. 46 cm long, blades 5.0-5.5 cm wide at blade, apex long acute, punctulate, lingulate, sheath 18-20 cm long by 9.0 cm wide, purple above; INFLORESCENCE probably ca. 50 cm long by ca. 30 cm in diameter, bipinnate, spikes laxly disposed, 3.0-4.0 cm between spikes, glabrous; PRIMARY BRACTS ca. 7.0-8.0 cm long, 2.0 cm wide, apex attenuate, erect to spreading; SCAPE 1.0-1.5 cm in diameter; SCAPE-BRACTS unknown; SPIKES to ca. 30 cm long by 2.0 cm wide at anthesis, spikes ca. 3.5 cm wide at capsule maturity, spreading to recurved, with stipe ca. 10 cm long having 4 to 5 sterile bracts; FLORAL BRACTS 2.1-2.4 cm long by 1.5-1.6 cm wide, gently rounded back, apex obtuse to cuspidate, glabrous without, densely lepidote within, scarcely nerved, coriaceous, imbricate and erect at anthesis, spreading and not touching at capsule maturity; SEPALS 2.0 cm long by 8 mm wide, ovate-elliptic, obtuse, posteriorly carinate, free, slightly nerved, glabrous without, lepidote within; PETALS at least 3.5 cm long; CAPSULE 2.2 cm long, not exceeding calyx, seeds dark brown with white coma, distance between flowers 7-8 mm.

MATERIAL EXAMINED: Firmin 652 (US, TYPE) Gütig-Visalia, Prov. Pichincha, 2700 m (?), 3 Jan. 1929.

NOTES: This species may be the same entity as André mentioned under T. denudata, 1358 André, that portion collected near Huaca Ecuador, at 2950 m. André says that the Ecuadorian specimen has much longer spikes. However in his description André says of T. denudata that the capsule is twice as long as the bract.

16. TILLANDSIA DENUDATA André, 1888 (Énumération Broméél.)

p. 8; André, 1889, p. 96; Smith, 1957, pp. 111-112.

PLANT 1-3 m tall; LEAVES 50-80 cm long, blades 5.0-8.0 cm wide, lingulate, apex acute, glabrous above; sheath elliptic, conspicuous, dark castaneous at least toward base; SCAPE erect, stout; SCAPE-BRACTS imbricate throughout, foliaceous below; INFLORESCENCE narrowly pyramidal, ca. 20 cm in diameter, tripinnate; PRIMARY BRACTS ovate, mostly shorter than the branch stipe; PRIMARY BRANCHES 1.5-3.0 cm apart; SPIKES ca. 4.0-27.0 cm long by ca. 2.0 cm wide, arching long-bracteate-stipate, linear, stipe 3.0-5.0 cm long with 2 to 3 sterile bracts; FLORAL BRACTS 1.5-2.0 cm long by 1.5 cm wide, coriaceous, not nerved, bicarinate throughout, broadly ovate, apex acute, glabrous without, densely lepidote within; SEPALS ca. 1.9 cm long by 7 mm wide, elliptic, free, obtuse to subacute, slightly nerved, strongly carinate, coriaceous, glabrous without, lepidote within; PETALS blue; CAPSULE to 4.0 cm long.

MATERIAL EXAMINED: André 1358 (K, TYPE; US, photo) Colombia; Acosta Solis 14085 (F) Cerro Ilalo, epiphytic, Prov. Imbabura (?), 2500-3100 m, 6 Oct. 1949.

COLOMBIA.

17. TILLANDSIA CLAVIGERA Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 783.

T. deppeana Steudel var. clavigera (Mez) L. B. Smith, 1956 (Phytologia vol. 5) p. 395.

PLANT ca. 2 m tall; LEAVES ca. 85 cm long, blades 4.0 cm wide, lingulate, apex acute, subglabrous, sheath ca. 20 cm long by 10-11 cm wide, brown, ovate, conspicuous; SCAPE with inflorescence to 160 cm long, 10-11 mm in diameter, erect; SCAPE-BRACTS 16-20 cm or more long, spreading to reflexed; INFLORESCENCE 50-80 cm long by ca. 65 cm in diameter, glabrous, erect, bipinnate, with 12 to 20 spikes; PRIMARY BRACTS 2.0-9.0 cm long by ca. 2.0 cm wide, erect, glabrous; SPIKES 8.0-80.0 cm long by ca. 2.5 cm wide, spreading to reflexed, linear, with 6-50 flowers per spike, stipe 5.0-15 cm long with 3-7 sterile bracts; FLORAL BRACTS 3.0-3.5 cm long by ca. 2.5 cm wide, ovate, erect, imbricate, bicarinate, not nerved, apex acute, glabrous without, densely lepidote within, coriaceous; SEPALs 2.8-3.0 cm long by 8-9 mm wide, erect, oblong-obovate, sides nearly straight, free, broadly acute, strongly nerved, posteriorly carinate; CAPSULE 2.4-2.5 cm long, distance between flowers 7-8 mm, flowering time probably around July-Oct.

MATERIAL EXAMINED: Steubel 208 a (B, TYPE; GH, photo) near Quito, Prov. Pichinche, ca. 3000 m, Sept., 1871; Foster 2602 (US) road between Cachicaran and Portovelo, Prov. Loja, ca. 800 m, 30 Nov. 1948.

NOTES: The differences evident between T. clavigera Mez and T. fendleri seem to be ample to set this apart at the species level, the floral bracts do not exceed 3.5 cm in length, the sepals are not more than 3.0 cm long, the stipe is consistently longer than 1.0 cm and up to 15 cm long.

TILLANDSIA FENDLERI Griseb. 1865 (Gott. Nachr. Ges. Wis. Goet. vol. 1864) p. 17.

PLANT 60-110 cm tall; LEAVES 35-70 cm long, blades 3.5-6.0 cm wide, lingulate, apex acute, sheath 10-16 cm long by 7.0-10.0 cm wide, mostly concolorous with blade or purple; SCAPE 1.0-1.5 cm in diameter, erect; SCAPE-BRACTS 15 to 25 cm long, erect, imbricate; INFLORESCENCE 40-50 cm long by 40 cm in diameter or ca. 11 cm long by 7.0-8.0 cm in diameter, bipinnate, erect, glabrous with 4 to 10 spikes; PRIMARY BRACTS 3.0-15.0 cm long, spreading, apex attenuate; distance between primary bracts 0.6-4.0 cm; SPIKES 3.0-30.0 cm long at anthesis by 2.5-3.0 cm wide, spreading, with a stipe 4.0-9.0 cm long, having up to ca. 4 or 5 sterile bracts; FLORAL BRACTS 2.2-4.0 cm long by 2.4-2.8 cm wide, smooth, not nerved or very inconspicuously so, backs gently rounded, coriaceous, apex acute and may be cuspidate but not acuminate, imbricate at anthesis, lepidote within, glabrous without; SEPALS 2.0-3.7 cm long by 0.7-1.2 cm wide, elliptic, broadly acute, posteriorly carinate, free, glabrous without, lepidote within, slightly or strongly nerved; PETALS to 4.5 cm long; CAPSULE 3.0-6.0 cm long.

18. T. FENDLERI var. FENDLERI

Plant ca. 1 m tall, leaf-blades 5.0-6.0 cm wide, mostly concolorous with sheath; inflorescence 40-50 cm long by 40 cm in diameter, having ca. 10 spikes; floral bracts 3.5-4.0

cm long by 2.6-2.8 cm wide; sepals 3.2-3.7 cm long by 7-8 mm wide, inconspicuously nerved; capsule ca. 3.0 cm long.

MATERIAL EXAMINED: Schimpff 293 (GH) west of Balsapambo, by Río Cristal, Prov. Bolívar, 500 m, 24 Oct. 1933; Steyermark 92519 (US) Venezuela, 1400-1450 m.

BOLIVIA, COLOMBIA, VENEZUELA.

19. T. FENDLERI var. REDUCTA Gilmartin, var. nov.

FIG. 21

A var. T. fendleri omnibus partibus florigeris minoribus; foliis inflorescentia superantibus differt.

Plant to ca. 110 cm tall; leaves 35-45 cm long, blade 3.5-4.5 cm wide, sheath purple; scape including inflorescence ca. 50 cm long, much exceeded by leaf-rosette; inflorescence ca. 11 cm long by 7.0-8.0 cm in diameter; having 4 to 5 spikes; floral bracts 2.2-2.4 cm long by ca. 2.0 cm wide; sepals ca. 2.2 cm long by 9 mm wide.

MATERIAL EXAMINED: AJG 1109 (US, TYPE) km 11 Cuenca-Loja, 2600 m, Prov. Azuay, 9 Aug. 1965.

20. T. FENDLERI var. NERVISEPALA Gilmartin, var. nov.

A var. fendleri sepalis nervatis, bracteis florigeris sepalisque brevioribus differt.

Plant ca. 60 cm tall; leaves ca. 70 cm long, blades ca. 5.0 cm wide; inflorescence ca. 40 cm long by 30 cm in diameter; floral bracts 2.6-2.7 cm long by 2.4 cm wide; sepals ca. 2.0 cm long by ca. 1.2 cm wide, obtuse, strongly nerved; capsules 5.5-6.0 cm long much exceeding calyx.

21. TILLANDSIA AEQUATORIALIS L. B. Smich, 1958 (Phytologia vol. 6, no. 5) p. 258.

PLANT ca. 50 cm tall; LEAVES 50 cm long, blades 4.0-5.0 cm wide, lingulate, apex short caudate, some purple, sheath ca. 20 cm long by 7.0-8.0 cm wide, leaf surface moderately densely appressed lepidote above, densely lepidote beneath; SCAPE ca. 4-5 mm in diameter, erect; SCAPE-BRACTS 3.5-12.0 cm long by 1.0 cm wide, strictly erect, imbricate throughout; INFLORESCENCE ca. 10 cm long by 5.0 cm in diameter, broadly ellipsoid, bipinnate; PRIMARY BRACTS 2.0-6.0 cm long by ca. 2.0 cm wide, erect, apex attenuate, the lower bracts equaling or slightly exceeding spikes, pale lepidote; SPIKES 3.5-5.0 cm long by ca. 2.0 cm wide, erect, having 6 to 9 flowers per spike, distance apart 0.7-1.0 cm, ca. 4 spikes per inflorescence, stipe minimal, no sterile bracts; FLORAL BRACTS 2.0-2.1 cm long by 1.4 cm wide, imbricate, elliptic, apex acute, carinate, not nerved, slightly lustrous, coriaceous, glabrous without, densely lepidote within; SEPALS ca. 2.0 cm long by 7-8 mm wide, elliptic, acute, subcoriaceous, glabrous without, densely lepidote within, posteriorly united for ca. 1.0 cm; PETALS not known; CAPSULES ca. 3.7 cm long, seeds nearly black; distance between flowers 3-4 mm.

MATERIAL EXAMINED: Hitchcock 21328 (US, TYPE) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, 3 Sept. 1923.

22. TILLANDSIA DICHROPHYLLA L. B. Smith, 1955 (Phytologia, vol. 5, no. 7) pp. 283-284; Smith, 1957, pp. 132-133, fig. 37.

PLANT ca. 55 cm tall; LEAVES 29-38 cm long, blades 3.0-5.0 cm wide, appearing glabrous above, densely lepidote below, blade subtriangular, sheath 10-20 cm long by ca. 5.0-7.0 cm wide, with some purple; SCAPE slightly curved, 5-7 mm in diameter; SCAPE-BRACTS 4.0-13.0 cm long, red tipped, erect, imbricate throughout; INFLORESCENCE 15-18 cm long by 5.0-6.0 cm in diameter, bipinnate, dense, cylindrical, pendent, glabrous except for apices of primary bracts, red; PRIMARY BRACTS 3.0-5.0 cm long by ca. 2.2 cm wide, erect to suberect, red, apex acute to acuminate, lowermost almost exactly equaling spikes; SPIKES 4.0-5.5 cm long by ca. 2.5 cm wide, erect, elliptic, ca. 0.5-1.5 cm apart, having 5 to 7 flowers per spike, imbricate, ca. 10 to 13 spikes per inflorescence; FLORAL BRACTS ca. 2.5 cm long by 2.2 cm wide, erect, red, elliptic, not nerved, unicarinate, apex acute, coriaceous, glabrous without, dark brown lepidote within, imbricate; SEPALS ca. 2.3 cm long by 7-8 mm wide, high connate posteriorly, obtuse, posteriorly carinate, papery, nerved, glabrous without, densely lepidote within; PETALS ca. 3.0 cm long; OVARY ca. 9 mm long by 2-3 mm in diameter, style and stigma included by ca. 2-3 mm, distance between flowers ca. 5 mm.

MATERIAL EXAMINED: Espinosa E 1094 (GH) Namanda,

2900-3000 m, Prov. Loja(?), 24 Nov. 1946.

COLOMBIA.

23. TILLANDSIA BRUNONIS André, 1888 (Énumération Bromél.)
p. 8; André, 1889, pp. 92-93, pl. 34; Smith, 1957, pp.
128-129, fig. 35.

T. brunonis var. mutabilis André, 1888 (Énumération
Bromél.) p. 8.

PLANT ca. 80 cm tall; LEAVES 30-50 cm long, blades ca.
5.0 cm wide, lingulate, purple mottled, subglabrous, sheaths
ca. 15 cm long, elliptic; SCAPE ca. 1.3 cm in diameter,
shorter than leaves; SCAPE-BRACTS 8.0-20.0 cm long, imbricate
throughout, foliaceous below; INFLORESCENCE 30-40 cm
long, ca. 8.0 cm in diameter, bipinnate, pendent, dense,
rhachis totally obscured, cylindrical; PRIMARY BRACTS erect,
covering lower spikes, shorter than upper spikes; SPIKES
4.0-8.0 cm long by ca. 3.0 cm wide, erect, with 7 to 10
flowers, stipe to 1.5 cm long with about 1 sterile bract;
FLORAL BRACTS 2.5 cm long by ca. 1.3 cm wide, ovate, apex
acute, imbricate, not nerved, unicarinate, coriaceous,
glabrous without, densely lepidote within; SEPALS ca. 2.2
cm long, ca. 6 mm wide, obscured by floral bracts, acute,
carinate, posteriorly connate half way; PETALS violet
toward apex, white below; distance between flowers ca. 5
mm, flowers around January-February.

MATERIAL EXAMINED: André 1757 (K, TYPE; US, photo)
Colombia, 2900 m, Feb. 1876; Asplund 17382 (US) immature
specimen, below San Juan towards Chiriboga, Prov. Pichincha,
ca. 3000 m, 19 Aug. 1955; Naundorff s. n. cultivated by

Marnier-Lapostolle, Chiriboga, Prov. Pichincha, 6 Jan.
1963 (US).

COLOMBIA.

NOTES: The only distinguishing features between T. brunonis André and T. sodiroi Mez seem to be the size and union of the sepals. T. brunonis has sepals ca. 1/2 connate posteriorly and ca. 2.2 cm long. T. sodiroi, according to Mez (1935, p. 545) has its sepals subequally free and I have found that they measure 2.8-3.0 cm long. Beyond these criteria the two seem to be nearly identical. Lacking further material, T. sodiroi and T. brunonis must be retained as separate species. However, it seems quite possible that further material will show gradations in union of sepals as this is frequently quite variable. T. oroyensis, for example, has shown specimens with all the sepals united, to the condition of posterior sepals low connate on the same plant.

24. TILLANDSIA POLYANTHA Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 1127; Mez, 1935, pp. 481-482.

FIG. 22

PLANT estimated 80 cm tall; LEAVES 40-70 cm long, blades 4.0-7.0 cm wide, lingulate, subglabrous; SCAPE exceeded by leaf rosette; SCAPE-BRACTS imbricate throughout; INFLORESCENCE 35-50 cm long, by 10-15 cm in diameter, bipinnate, dense, cylindric, having ca. 20 spikes; PRIMARY BRACTS 6.0-17.0 cm long, erect, lowermost exceeding spikes, apex acute; SPIKES 9.0-15.0 cm long by ca. 2.5 cm wide, erect, having up to 20 flowers, distance between spikes 1.5-3.0 cm; FLORAL BRACTS 2.6-3.4 cm long by ca. 2.2 cm wide, oblong-elliptic, apex acute, imbricate, erect, not nerved, carinate; SEPALS ca. 2.2 cm long, lustrous, coriaceous, posteriorly high-connate, glabrous, not nerved; CAPSULE 2.4 cm long, distance between flowers 4-5 mm.

MATERIAL EXAMINED: Sodiro 38b (B, TYPE, US, photo; Quito, ISOTYPE) near Niebli, Prov. Pichincha, Oct. 1879.

25. TILLANDSIA SODIROI Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 1133; Mez, 1935, pp. 545-546.

PLANT ca. 1 m tall; LEAVES ca. 55 cm long, blades 5.0-6.5 cm wide, lingulate, apex acute to apiculate, lepidote above, glabrous beneath, sheath ca. 15 cm long, ovate, not conspicuous; SCAPE ca. 1.2 cm in diameter; SCAPE-BRACTS 12-25 cm long, imbricate and foliaceous throughout; INFLORESCENCE to 30 cm long by 10 cm in diameter, bipinnate, dense, pendent, cylindric, glabrous having ca. 22 spikes; PRIMARY BRACTS 4.0-10.0 cm long, apex acute to apiculate, erect; SPIKES 4.5-8.0 cm long by 3.0-3.3 cm wide, erect, distance apart ca. 1.0 cm, having 4 to 6 flowers, stipe minimal; FLORAL BRACTS 2.6-2.9 cm long by ca. 1.4 cm wide, apex acute, not nerved, carinate, glabrous without, imbricate, densely lepidote within, papery; SEPALs ca. 2.8-3.0 cm long by 0.8 cm wide, elliptic, nearly free, glabrous without, densely lepidote within, subacute to obtuse; PETALS ca. 4.0 cm long, exceeding calyx by ca. 1.2 cm; OVARY ca. 7 mm long, distance between flowers ca. 7 mm.

MATERIAL EXAMINED: Sodiro 37c (B, TYPE; US, photo) Nanegal, west of Otavalo, Prov. Pichincha, May 1902; Rivet 903 (P) Chillacocha, Prov. Pichincha, ca. 3500 m, Jan. 1905; Hitchcock 21597 (US) between Oña and Cuenca, Prov. Azuay, 2700-3300 m, 9-10 Sept. 1923.

26. TILLANDSIA DEMISSA L. B. Smith, 1954 (Contrib. U.S. Nat. Herb. vol. 29, no. 11) pp. 527-528, fig. 83.

FIG. 23

PLANT 1-2 m tall when inflorescence is extended, by ca. 1 m in diameter; LEAVES 50-120 cm long, blades 8.0-11.0 cm wide, blue-green with some purple mottling, blade lingu- late, apex acute-attenuate, obscurely punctulate, erect to spreading; SCAPE with inflorescence to nearly 2 m long, ca. 1.5 cm in diameter, pendent, exceeded by leaves; SCAPE- BRACTS at least 20 cm long, densely imbricate and sub- foliaceous, erect; INFLORESCENCE ca. 120 cm long by 12-15 cm in diameter, bipinnate, dense, narrowly cylindrical, pendent with ca. 35 erect spikes, purple; PRIMARY BRACTS 12-20 cm long by ca. 5.0 cm wide, erect, green, glabrous, apex acute-attenuate; SPIKES 12-16 cm long by ca. 3.3 cm wide at anthesis, erect, having 8 to 18 flowers per spike, stipe 1.0-3.0 cm long with up to 4 sterile bracts; imbricate; FLORAL BRACTS ca. 3.2 cm long by 2.9 cm wide, erect, imbri- cate, suborbicular to elliptic, carinate, coriaceous, not nerved, slightly lepidote without, densely lepidote within, apex acute and incurved; SEPALS ca. 3.0 cm long by 1.2-1.4 cm wide, erect, green transparent, elliptic, coriaceous, acute, slightly carinate posteriorly, nearly free, glabrous without, densely lepidote within; PETALS ca. 4.5 cm long, erect, violet; OVARY ca. 6 mm long; CAPSULE ca. 3.4 cm long, distance between flowers ca. 0.7-1.2 cm, flowering

time around Sept. to December.

MATERIAL EXAMINED: Foster 2624 (US, TYPE) km 120
Oña-Saraguro, Prov. Loja, ca. 2100-2500 m, 4 Dec. 1948;
AJG 1154 (US) km 71 Loja-Cuenca, common, in capsule, ter-
restrial, Prov. Azuay, ca. 2300 m, 12 Aug. 1965.

27. TILLANDSIA EMERGENS Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 1132.

PLANT ca. 30 cm tall; LEAVES ca. 40 cm long, blades 4.0-5.0 cm wide, lingulate, or subtriangular, apex acute to apiculate, red toward apex, subglabrous above, minutely, densely lepidote beneath; SCAPE ca. 78 cm tall, 5-7 mm in diameter, erect; SCAPE-BRACTS foliaceous and imbricate throughout, erect, red when alive; INFLORESCENCE ca. 25-36 cm long by 10-14 cm in diameter, erect, red, cylindrical to ellipsoid, glabrous, bipinnate, dense; PRIMARY BRACTS 4.0-11.0 cm long by ca. 3.0 cm wide, erect to spreading, red, apex acute-attenuate; SPIKES 7.0-9.0 cm long by ca. 1.5-2.0 cm wide, spreading at anthesis, distance between spikes 1.0-4.0 cm, flowers per spike 8 to 12, stipe to 1.5 cm long with 2 to 3 sterile bracts; FLORAL BRACTS 2.4-3.0 cm long by ca. 1.2-1.8 cm wide, imbricate, ovate, apex long acuminate, not nerved, unicarinate, coriaceous, subglabrous without, densely lepidote within; SEPALs 2.1-2.4 cm long by 5-6 mm wide, linear-ovate, acute, posteriorly carinate, posteriorly united for 1.3-1.8 cm, not nerved, papery, glabrous to subglabrous without, densely lepidote within; PETALS ca. 3.0 cm long; CAPSULES 2.0-2.2 cm long, distance between flowers 4-5 mm, in flower around April.

MATERIAL EXAMINED: Sodiro 171/38 (B, TYPE; US, photo) Prov. Pichincha, 3000 m, June 1886; Drew E-142 (US) trail from Aparejos to San Pablo, Selva Alegre, west of Otavalo,

Prov. Imbabura, ca. 3600 m; 23, April 1944; Drew E-296 (US)
Páramo de Pinan, Prov. Imbabura, 25 June 1944; Naundorff s.
n. cultivated by Marnier-Lapostolle (US), Shell Mera, Prov.
Pastaza, ca. 1500 m (Naundorff says 600 m, this is not
likely if collected near Shell Mera), 22 March 1966.

TILLANDSIA BUSERI Mez, 1903 (Bull. Herb. Boiss. vol. 3)
p. 145; Smith, 1957, pp. 125-126.

PLANT at least 70 cm tall; LEAVES 30-60 cm long, blades 3.5-5.5 cm wide, lingulate, apex attenuate, glabrous above, densely appressed lepidote beneath, sheath 12-20 cm long by ca. 5.0-8.0 cm wide, elliptic, conspicuous, nearly concolorous with blade; SCAPE erect, SCAPE-BRACTS densely imbricate, subfoliaceous; INFLORESCENCE ca. 30 cm long by 9.0-14.0 cm in diameter, cylindric, red, glabrous, bipinnate, dense or lax; PRIMARY BRACTS 4.5-10.0 cm long by ca. 3.0 cm wide, spreading to reflexed, red, apex attenuate; SPIKES 5.0-7.5 cm long by ca. 2.5 cm wide, erect to reflexed, having 7 to 14 flowers per spike, ca. 25 spikes per inflorescence, stipe 0.5-1.5 cm long, sterile bracts absent or 1; FLORAL BRACTS 2.0-2.8 cm long by 1.6-2.0 cm wide, broadly elliptic, unicarinate, not nerved, apex acute, glabrous without, lepidote within, imbricate; SEPALs ca. 2.2-2.6 cm long by 6-8 mm wide, elliptic, posteriorly carinate, nerved, free or connate, acute, papery, glabrous without, lepidote within; PETALS 2.6-3.5 cm long, erect, usually purple, distance between flowers 5-8 mm.

28. T. BUSERI var. BUSERI

Inflorescence dense, sepals entirely free, sepals to 6 mm wide.

MATERIAL EXAMINED: Lugo 217 (US) Mera, Prov. Pastaza, ca. 1200 m, 21 April 1940.

COLOMBIA.

29. T. BUSERI var. NUBICOLA Gilmartin, var. nov.

FIG. 24

A var. buseri sepalis connatis, latioribus differt.

Inflorescence lax; spikes reflexed with ca. 7 to 10 flowers per spike; sepals 8 mm wide, posteriorly connate for 4-6 mm; petals ca. 3.5 cm long.

MATERIAL EXAMINED: Foster 2620 (US, TYPE) epiphytic, cloud forest, between Cuenca and Oña, Prov. Azuay, ca. 3000 m, 3 Dec. 1948.

NOTES: T. buseri var. nubicola AJG differs from the typical variety of T. buseri most conspicuously in the reflexed spikes. However, it is not known if this condition of reflexed spikes is consistent. The sepals do seem to be consistently posteriorly joined which helps to distinguish this variety from the typical one. T. buseri var. nubicola apparently occurs at a somewhat greater altitude and in an area that almost continuously remains within the clouds most days. This variety is also very close to T. wurdackii L. B. Smith.

30. TILLANDSIA FOSTERI Gilmartin, spec. nov.

Habitu T. wurdackii L. B. Smith sed laminis foliorum laticribus, glabris, stipis ad 3.5 cm longis, 2 to 3 bracteis vacuis praeditis.

FIG. 25

PLANT ca. 1.5 m tall by ca. 130 cm in diameter, rosette of spreading leaves; LEAVES 45-55 cm long, blade 6.0-7.5 cm wide, lingulate, purple blotched, glabrous both surfaces, apex acute, sheaths 17-20 cm long by 8.0-10.0 cm wide, purple in part, ovate, densely appressed-lepidote; SCAPE 1.3 cm in diameter, curved, much exceeded by leaves; SCAPE-BRACTS totally imbricate, foliaceous; INFLORESCENCE ca. 65 cm long by 8.0-10.0 cm wide, curved, lax, bipinnate, glabrous having ca. 19 spikes; PRIMARY BRACTS 4.5-18.0 cm long by 3.0-4.0 cm wide, apex attenuate to caudate, spreading; SPIKES 9.0-10.0 cm long by 2.0-2.5 cm wide, some of the lower spikes with 6 to 8 apical small floral bracts having aborted flowers, spreading, distance between spikes 1.5-4.0 cm, stipe to 3.5 cm long having 2 to 4 sterile bracts; FLORAL BRACTS 2.7-3.0 cm long by 2.1 cm wide, erect, imbricate, elliptic, glabrous, densely lepidote within, very obscurely nerved but still appearing smooth and lustrous, coriaceous, apex acute; SEPALS 2.1-2.5 cm long by 0.8 cm wide, elliptic, glabrous, densely lepidote within, acute, posteriorly carinate, posteriorly connate for 2-3 mm, obviously nerved; PETALS ca. 3.5 cm long, distance between

flowers 6-7 mm; CAPSULES 3.0 cm long, not extending beyond the floral bracts.

MATERIAL EXAMINED: Foster 2625 (US, TYPE) between Oña and Saraguro, on ledges, Prov. Loja, ca. 2400 m, 4 Dec. 1948.

31. WILLANDSIA WURDACKII L. B. Smith, 1963 (Phytologia, vol. 9, no. 4) pp. 254-255, pl. 4, figs. 4, 5.

FIG. 26

PLANT 50-150 cm tall by ca. 50 cm in diameter, campanulate rosette; LEAVES 38-55 cm long, blades 3.5-6.0 cm wide, lingulate to subtriangular, apex attenuate, grey-green, slightly involute toward apex, nearly glabrous above, densely lepidote beneath, ca. 36 scales per mm², sheath 14-25 cm long by up to 11 cm wide, gradually merging with blade, dark castaneous beneath, dark purple above; SCAPE ca. 7 mm in diameter, red, erect; SCAPE-BRACTS ca. 16-20 cm long by ca. 3.0 cm wide, erect, foliaceous and imbricate throughout; INFLORESCENCE ca. 38 cm long by 9.0-10.0 cm in diameter, erect, red, cylindrical-pyramidal, subglabrous, bipinnate, lax with ca. 14 spikes; PRIMARY BRACTS 3.5-12.0 cm long by ca. 2.4 cm wide, erect, red, apex attenuate to caudate, lowermost longer or shorter than spikes, upper primary bracts less than half as long as spikes; SPIKES 5.5-9.0 cm long by 2.0-3.0 cm wide, erect-spreading, red, ca. 2.0-4.0 cm apart, having 6 to 9 flowers per spike, stipe 1.5-3.0 cm long with 1 to 4 sterile bracts; FLORAL BRACTS 2.7-3.4 cm long by ca. 2.5 cm wide, erect, imbricate, red, broadly elliptic, apex acute, bicarinate, not nerved, coriaceous, subglabrous without, densely lepidote within; SEPALs 2.4-2.8 cm long by ca. 6-8 mm wide, erect, free or posteriorly short-connate,

strongly nerved, broadly acute to obtuse, posteriorly carinate, glabrous without, oblong to linear-ovate; PETALS with pink or purple-pink blades; OVARY 10-11 mm long by 3-4 mm in diameter, distance between flowers 4-5 mm, in flower around July and August.

MATERIAL EXAMINED: 1148 AJG (US) common, growing terrestrially, cloud forest, km 53, Loja-Cuenca, Prov. Loja, ca. 2800 m, 12 Aug. 1965.

PERU.

NOTES: Tillandsia wurdackii seems to be a fine example of a "variable species." Smith says (1963, p. 255) "It becomes increasingly difficult and dangerous to describe novelties from the complicated maze of Tillandsia subgenus Allardtia that centers on the northern and central Andes. Ample collections, such as those of T. wurdackii . . . show great variation in characters . . ." The present collection 1148 AJG shows some differences in size and union of sepals from the type collection Wurdack 801 according to Smith's description and illustrations. Nevertheless, it is probably properly allocated to that species. The collection area of AJG 1148 in the province of Loja, Ecuador is not far from the Peruvian collection site of Wurdack 801. Both are from the Amazon drainage area of the eastern Andean slopes.

32. BILLANDSIA LAJENSIS André, 1888 (Énumération Bromél.)
p. 7; André, 1889, pp. 88-89, pl. 31b; Smith, 1957, p.
111.

PLANT estimated 60 cm tall; LEAVES to 70 cm long, blades 4.5 cm wide, blades narrowly lingulate, glabrous (?); SCAPE slightly curved, ca. 1.5 cm in diameter; SCAPE-BRACTS ca. 15-20 cm long by 3.0 cm wide, imbricate, apex reflexed; INFLORESCENCE ca. 15 cm in diameter, bipinnate, lax; PRIMARY BRACTS 3.0-5.0 cm long, suberect, apex acuminate, distance between ca. 3.0-4.0 cm; SPIKES 7.0-10.0 cm long by 5.0-6.0 cm wide, elliptic, spreading at nearly right angles to rhachis; FLORAL BRACTS 4.5 cm long by ca. 2.2 cm wide, erect, imbricate, apex acute, carinate, not or scarcely nerved, glabrous without, much exceeding sepals; SEPALS 3.0 cm long, free, oblong; PETALS linear, violet, slightly exceeding stamens, distance between flowers ca. 5 mm.

MATERIAL EXAMINED: André 3477 (K, TYPE; US, photo)
Colombia near Ipiales, ca. 2900 m, 1876.

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NOTES: This species although not yet reported for Ecuador is certain to be found there. The type collection site is just north of the Colombia-Ecuador border. The plant is most striking for its very broad spikes, which appear to be nearly as broad as long and which spread out sharply from the rhachis.

33. TELMANDSIA ANPLA Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 1134; Mez, 1935, p. 534.

PLANT 60-100 cm tall; LEAVES 40-60 cm long, blades 4.0-7.0 cm wide, lingulate-triangular, apex attenuate, densely lepidote beneath, scales moderately appressed, sheath 18-20 cm long, purple when alive; SCAPE ca. 2.0 cm in diameter, erect; SCAPE-BRACTS imbricate, erect; INFLORESCENCE ca. 35 cm long by 15-20 cm in diameter, bipinnate, glabrous, ellipsoid-cylindric having 6-8 spikes; PRIMARY BRACTS 5.0-19.0 cm long, spreading, apex acute to caudate, glabrous; SPIKES 5.5-10.0 cm long by ca. 3.5 cm wide at anthesis, ca. 5.5 cm apart, spreading to reflexed, having ca. 10 flowers per spike, stipe 1.0-3.0 cm long with 1 sterile bract; FLORAL BRACTS 4.0-4.5 cm long by ca. 2.5 cm wide, elliptic-ovate, erect, imbricate, apex acute, slightly to strongly nerved, glabrous without, densely lepidote within; SEPALs ca. 3.0 cm long by 6-8 mm wide, elliptic, broadly acute-obtuse, posteriorly carinate, free, nerved, subglabrous without, lepidote within; PETALS ca. 4.7 cm long; OVARY ca. 7 mm long by 3 mm in diameter.

MATERIAL EXAMINED: Sodiro 17/37 (GH, ISOTYPE) Cerro Cinguiltina, Prov. (?); Couthouy s. n. (GH) "Quitensian Andes"; AJG 1081 (US) terrestrial, km 15 Quito-Otavallo, Prov. Pichincha, Aug. 1965.

TILLANDSIA ARCUANS L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 10) p. 436, fig. 41.

FIG. 27

PLANT to 1 m tall or more; LEAVES 25-70 cm long, blade 2.0-5.5 cm wide, lingulate, apex acute to attenuate, appressed lepidote below, shiny scales above, sheaths ca. 25 cm long by 9.0-10.0 cm wide, dark brown above when dry, elliptic; SCAPE arching-decurved, 0.9-1.5 cm in diameter; SCAPE-BRACTS 12-35 cm long, erect with apices reflexed, imbricate throughout, foliaceous below; INFLORESCENCE 10-20 cm long by ca. 7.0-20.0 cm in diameter, few branched subdigitate, glabrous; PRIMARY BRACTS 4.5-6.5 cm long, apex attenuate, much shorter than spikes, spreading, distance between 2.5-5.5 cm; SPIKES 7.0-25.0 cm long by 2.5-5.0 cm wide, secund, erect to nodding, having 12 to 17 flowers, stipe 1.0-2.5 cm long having up to 3 sterile bracts; FLORAL BRACTS 3.8-5.0 cm long by 2.3-3.3 cm wide, erect, imbricate, elliptic, apex sharply acute, exceeding sepals, carinate, coriaceous, not at all nerved, glabrous without, densely lepidote within; SEPALS 2.8-3.3 cm long by 0.8-1.2 cm wide, elliptic, free, subcoriaceous, posteriorly carinate, acute, nerved, glabrous without to subglabrous, densely lepidote within; PETALS 4.5-6.0 cm long, blade 0.6-1.0 cm wide, lilac to violet, stamens barely included in corolla; CAPSULE ca. 1.0-4.0 cm long, distance between flowers 4-9 mm.

34. TILLANDSIA ARCUANS var. ARCUANS L. B. Smith, 1951.

Leaves at least 50 cm long, blade width at least 4.5 cm; scape diameter ca. 1.5 cm; inflorescence ca. 20 cm in diameter; spikes at least 11 cm long and at least 4.0 cm wide; floral bracts to 5.0 cm long and to 3.3 cm wide; sepals papery; petals to 6.0 cm long; distance between flowers to 5 mm.

MATERIAL EXAMINED: Benoist 3917 (P) Pifo, east of Quito, Prov. Pichincha, ca. 2500 m, 19 Feb. 1931; Drew E-299 (US) 2 km east of Hacienda Pecillo, road to Guayabambilla, along roadside, Prov. Imbabura, ca. 3100 m, 29 June 1944; Asplund 18255 (US) Pifo, on wall above the village, Prov. Pichincha, ca. 2800 m, 31 Oct. 1966.

35. TILLANDSIA ARCUANS var. NAUNDORFFII Gilmartin, var. nov.

A var. arcuans parvioribus, sepalis chartaceis, spicis angustioribus differt.

Leaves 25-35 cm long, blades 2.0-3.0 cm wide; scape diameter to 1.0 cm; inflorescence ca. 7.0 cm in diameter; spikes to 9.0 cm long by 2.5 cm wide at anthesis; floral bracts 3.8-4.0 cm long by ca. 2.3 cm wide; sepals subcoriaceous; petals ca. 4.5 cm long, distance between flowers to 9 mm.

MATERIAL EXAMINED: Naundorff s. n. 26 March 1963 (US, TYPE) cultivated by Marnier-Lapostolle in Paris, quebrada near Quito, Prov. Pichincha, 2800 m, 26 March 1963.

36. TELLANDSIA SCHIMPERIANA Wittmack, 1889 (Engler's Bot. Jahrb. vol. 11) p. 67; Smith, 1957, p. 125.

PLANT probably 70 cm tall; LEAVES 50-70 cm long, blades 3.0-5.5 cm wide, appressed lingulate, lepidote, apex acuminate, sheath 15-16 cm long by 8.0-9.0 cm wide, elliptic; SCAPE 0.8-1.1 cm in diameter, erect; SCAPE-BRACTS 12-32 cm long by 2.5-3.5 cm wide, densely imbricate and foliaceous, erect; INFLORESCENCE 7.0-10.0 cm long by ca. 7.0 cm in diameter, red, with 3 to 5 subdigitate spikes, glabrous, dense; PRIMARY BRACTS 5.0-10.0 cm long by ca. 2.0 cm wide, erect to suberect, foliaceous, apex acute to attenuate, red, exceeding spikes; SPIKES 4.5-8.0 cm long by 1.7-2.0 cm wide, erect, having 6 to 10 flowers per spike, stipe ca. 0.5 cm long, usually with 1 sterile bract, ca. 7 mm between spikes; FLORAL BRACTS 2.2-2.5 cm long by 1.5-1.7 cm wide, erect, imbricate, uncarinate, apex acute, ovate, subglabrous without, densely lepidote within, obscurely nerved, dull; SEPALs ca. 2.1 cm long by 8-9 mm wide, erect, elliptic, apex broadly acute to obtuse, equally free, moderately lepidote without, densely lepidote within, nerved, posteriorly carinate, papery; PETALS with blades ca. 7 mm long; OVARY 9 mm long by 3 mm in diameter, distance between flowers 4 mm.

MATERIAL EXAMINED: Lehmann 26 (GH, TYPE; US, photo) Colombia, ca. 1800 m; Asplund 18261 (US) below Papallacta, Prov. Napo-Pastaza, epiphytic, 3000 m, 31 Oct. 1955.

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37. TILLANDSIA ORBICULARIS L. B. Smith, 1954 (Phytologia vol. 5) p. 38, pl. 3, figs. 4-7; Smith, 1957, pp. 126-127.

FIG. 28

PLANT ca. 65 cm tall; LEAVES 35-50 cm long, blades 3.5-6.0 cm wide, linear-lingulate, apex attenuate, light green, subglabrous above, densely lepidote beneath, sheath ca. 16 cm long by 9.0-10.0 cm wide, dark purple both surfaces, elliptic; SCAPE 0.9-1.2 cm in diameter, erect; SCAPE-BRACTS 0.8-12.0 cm long, erect, imbricate and foliaceous throughout, red-tipped; INFLORESCENCE ca. 14 cm long by 7.0-8.0 cm in diameter, erect, red, glabrous, bipinnate, dense, having ca. 18 spikes; PRIMARY BRACTS 4.0-8.0 cm long by 3.0-5.0 cm wide, erect, sheath orbicular, apex attenuate and red, the lower bracts with triangular blades exceeding spikes, the upper ones slightly shorter than spikes and with apices apiculate; SPIKES 4.0-5.0 cm long by 1.5-2.5 cm wide, having 4 to 6 flowers per spike, erect, stipe minimal to 1.0 cm long, usually having no sterile bracts; FLORAL BRACTS ca. 2.4 cm long by 1.8-2.0 cm wide, erect, imbricate, red or yellow, apex acute, carinate, coriaceous, glabrous without, densely lepidote within, slightly nerved, dull; SEPALS 1.8-2.1 cm long by 6-8 mm wide, broadly acute, posteriorly carinate, subequally free, elliptic-obovate, nerved; PETALS ca. 3.0 cm long, violet; CAPSULE ca. 2.5 cm long, distance between flowers 6-7 mm.

MATERIAL EXAMINED: Cuatrecasas 18931 (GH, TYPE; US, photo) Colombia, 3300-3350 m; Schimpff 832 (B; US, photo) west of Riobamba, Prov. Chimborazo, 19 March 1934; Espinosa E 1038 (GH) Hacienda Horta-Naque, Prov. Loja, 3000-3500 m, 10 Nov. 1948; Foster 2627 (US) km 55 Cuenca-Loja, Prov. Azuay, ca. 3500 m, 3 Aug. 1948; Foster 2628 (US) km 25 Cuenca-Loja, Prov. Azuay, ca. 2100 m, 4 Dec. 1948; Foster 2630 (US) Cuenca-Loja road, Prov. Azuay, ca. 3000 m, 4 Dec. 1948; AJG 623 (US) km 15 Ambato-Guaranda, Prov. Tungurahua, ca. 2700 m, 7 March 1962; AJG 1100 (US) km 18 Ambato-Cuenca, Prov. Tungurahua, 2800 m, 8 Aug. 1966; Foster 261E (US) between Cuenca and Oña, Prov. Azuay, ca. 4000 m, 4 Dec. 1948; AJG 625 (US) terrestrial, steep cliff, km 20 Ambato-Guaranda, Prov. Tungurahua, ca. 2800 m, 7 March 1962; AJG 1110 (US) terrestrial, roadcut, common, km 18 Cuenca-Loja, Prov. Azuay, ca. 2600 m, 9 Aug. 1966; AJG 1113 (US) "páramo," km 43 Cuenca-Loja, tank full of water, Prov. Azuay, 3300 m, 9 Aug. 1965.

COLOMBIA.

33. TILLANDSIA PACHYAXON L. B. Smith, 1958 (Phytologia vol. 6, no. 5) pp. 259-260, pl. 1, figs. 11, 12.

PLANT ca. 1 m tall or more; LEAVES ca. 70 cm long, blades 6.0-7.0 cm wide, lingulate, apex short-caudate, densely appressed-lepidote below, subglabrous above, sheath 20-24 cm long by 8.0-9.0 cm wide, slightly darker than blades; SCAPE ca. 1.6 cm in diameter, not exceeded by leaf-rosette, erect; SCAPE-BRACTS densely imbricate and foliaceous; INFLORESCENCE estimated 70 cm long by 8.0-12.0 cm in diameter, bipinnate, dense, cylindric; PRIMARY BRACTS 6.5-10.0 cm long by 4.0-4.5 cm wide, erect, lustrous, dark when dry, sheath orbicular, apex acuminate to caudate, consistently with blades exceeding spike, slightly lepidote toward apices; SPIKES 5.0-5.5 cm long by 3.0-3.5 cm wide, ca. 25 per inflorescence, ca. 1.5-2.0 cm apart, erect, having 6 to 9 flowers per spike; FLORAL BRACTS ca. 2.8 cm long by 2.2 cm wide, erect, imbricate, ovate, glabrous without, lepidote within, unicarinate, coriaceous, apex acute, slightly nerved; SEPALs ca. 2.5 cm long by 0.9-1.0 cm wide, erect, elliptic, equally free, subglabrous without, densely lepidote within, posteriorly carinate, acute; PETALS ca. 3.0 cm long with blades 1.0 cm long, purple; distance between flowers 7-8 mm.

MATERIAL EXAMINED: Hitchcock 21372 (US, TYPE) epiphytic, between Cuenca and Huigra, Prov. Azuay or Cañar, 2700-3000 m, 12-13 Sept. 1923.

39. BILLIANDSIA PASTENSIS André, 1888 (Énumération Bromél.)
p. 8; André, 1889, pp. 91-92, pl. 39a; Smith, 1957, pp.
127-128, fig. 34.

PLANT 1.0-1.5 m tall; LEAVES 50-60 cm long, blades
4.5-7.0 cm wide, lingulate, apex acute, densely lepidote
beneath, much appressed, sheath concolorous with blade;
SCAPE ca. 1.0 cm in diameter, much exceeding leaf-rosette,
erect; SCAPE-BRACTS at least 18 cm long, imbricate through-
out, erect, apex acute to attenuate; INFLORESCENCE 30-50 cm
long by 4.0-5.5 cm in diameter, bipinnate, dense, cylindric,
erect, glabrous, having ca. 25 spikes, these ca. 1.5 cm
apart; PRIMARY BRACTS 4.0-10.0 cm long, erect, apex caudate,
sheath triangular, glabrous without; SPIKES 4.5-7.5 cm long
by ca. 2.0 cm wide, erect, stipe minimal to 7 mm long with
up to 1 sterile bract, having 6 to 8 flowers per spike;
FLORAL BRACTS 1.9-2.4 cm long by 1.9 to 2.4 cm wide, im-
bricate, broadly ovate-elliptic, erect, apex acute, uni-
carinate, coriaceous, strongly nerved to slightly so,
glabrous without, densely lepidote within; SEPALS ca. 1.8
cm long by 0.9 cm wide, ovate, equally connate for 2-3 mm,
obtuse, carinate, nerved, glabrous without, densely lepi-
dote within; PETALS ca. 2.5 cm long; CAPSULES ca. 3.0-4.0
cm long, distance between flowers 4-6 mm.

MATERIAL EXAMINED: André 1747 (K, TYPE; US, photo)
Colombia; Firmin 645 (US) La Magdalena, "sobre un tapial,"
Prov. Pichincha, ca. 2800 m, 18 Feb. 1929; Penland and

Summers 753 (Gf) island in Lago Cuicocha, Prov. Imbabura,
ca. 3100 m, 29 May 1939.

COLOMBIA.

40. TILLANDSIA SCEPERIFORMIS Mez and Sodiro, 1905 (Bull. Herb. Boiss. series 5) p. 191; Mez, 1935, p. 546.

FIG. 29

PLANT 1.0-1.5 m tall, acaulescent; LEAVES ca. 50 cm long, blades 6.0-7.0 cm wide, lingulate, reddish-green, sheath ca. 12 cm long by 12 cm wide, some purple; SCAPE ca. 1.0 cm in diameter, erect, much exceeding leaf-rosette; SCAPE-BRACTS ca. 30 cm long by 1.5-2.0 cm wide, imbricate, red; INFLORESCENCE 40-65 cm long by ca. 10 cm in diameter, bipinnate, dense, cylindrical, slightly lepidote, having ca. 20 spikes; PRIMARY BRACTS 5-10 cm long by 3.5-4.0 cm wide, red; SPIKES 4.5-7.5 cm long by 3.5-4.0 cm wide, erect to spreading, having 4 to 8 flowers per spike, stipe to 2.0 cm long with 1 to 2 sterile bracts; FLORAL BRACTS ca. 2.5 cm long by ca. 1.0 cm wide, coriaceous, green, slightly nerved, dull, carinate, imbricate, glabrous without; SEPALS 1.8-2.0 cm long, acute, elliptic, subequally free, carinate, slightly nerved; PETALS ca. 2.0 cm long, blue, stamens included by 3-4 mm; CAPSULES 2.5-2.7 cm long, distance between flowers 5-8 mm, in flower around May-July.

MATERIAL EXAMINED: Sodiro 37E (B, TYPE; US, photo) near Cotacallao, Prov. Pichincha, ca. 2500 m, June 1886; REG 851 (US) Pilaló, wooded opposite Hotel Nuevo, Prov. Cotopaxí, 2500 m, 28 July 1963.

NOTES: This species, to date, seems to have been collected only in Ecuador. It is a very striking plant because

of its size and the red color of the primary bracts. The plant collected near Pilaló in July, 1963 was in flower. Later in Guayaquil, it produced capsules which dehisced in late October.

41. TILLANDSIA COMPLANATA Benth., 1845 (Bot. Voyage Sulph.)
p. 173; Smith, 1957, pp. 135-136.

FIG. 30

PLANT 30-40 cm tall by ca. 40 cm in diameter, erect rosette with many leaves; LEAVES 17-40 cm long, blades 2.0-5.0 cm wide, lingulate, apex acute, spotted, streaked or suffused with dark purple, moderately densely, much appressed lepidote, sheath 6.0-13.0 cm long by 3.5-6.0 cm wide, ovate to elliptic; SCAPE exceeded by leaves, ca. 1 mm in diameter, curved; SCAPE-BRACTS ca. 2.5-4.0 cm long, remote to partially imbricate, erect; INFLORESCENCE 2.5-8.0 cm long by 1.0-1.5 cm wide, appearing simple; many axillary "inflorescences" on same plant (see second paragraph under NOTES), having 4 to 24 flowers, glabrous; FLORAL BRACTS 1.2-2.0 cm long by 0.9-1.3 cm wide, apex acute to nearly obtuse, imbricate, coriaceous or subcoriaceous, carinate, nerved, glabrous without, densely lepidote within, ovate to elliptic; SEPALS 1.1-1.6 cm long by 4-5 mm wide, subfree to ca. 1/3 connate posteriorly, carinate posteriorly, ovate to elliptic, apex broadly acute to obtuse, glabrous without, lepidote within; PETALS 2.0-2.4 cm long, purple or blue, erect to suberect, stamens included by ca. 1 mm; OVARY 3-5 mm long by 2-3 mm in diameter; CAPSULE 2.5-3.0 cm long; in flower around September to February.

MATERIAL EXAMINED: Sinclair s. n. (K. TYPE; US, photo) probably Peru, Atacames, 1845; Rimbach 232 (US) "forest

region," Eastern Cordillera, Prov. (?), 3200 m, probably 1894; Rivet 687 (P) Ecuador; 28 Dec. 1904; Ruiz & Pavon s. n. (F) near Guayaquil, Prov. Guayas, 1777-1788; Edgers 14055 (US) Balao, Prov. Guayas, near sea level, Dec. 1891; Hitchcock 21671 (US) between Cuenca and Huigra, Provs. Azuay or Cañar, 2700-3000 m, 12, 13, Aug. 1923; Hitchcock 20945 (US) La Rinconada, ranch between Ibarra and Tulcán, Prov. Carchi, ca. 3000 m, 10-11 Aug. 1923; Hitchcock 21562 (US) between San Lucas and Oña, epiphytic, Prov. Loja, 2200-3100 m, 7 Sept. 1923; Hitchcock 21386 (US) between La Toma and Loja, Prov. Loja, 1800-2600 m, 4 Sept. 1923; Schimoff 887 (US) paramó, southwest of Rimbamba, 22 March 1934; Camp E 1753 (US) uplands of Huairacaja, 10-20 km northeast of Azogues, Prov. Cañar, ca. 3800 m, 2 Feb. 1945; Camp E 3957 A & B (US) ca. 15 km southwest of Cuenca, Cruz Pamba region above Baños, Prov. Azuay, ca. 3200-3400 m, 29-30 June 1945; Acosta Solis 11131 (F) Olla Cachi, Prov. Pichincha, 3200 m, 26 Oct. 1945; Foster 2629 (US) km 45 Cuenca-Loja, Prov. Cañar, "1000 ft," in this area, however, the altitude is probably closer to 2000 m; Foster 2649 (US) road from Quito to Santo Domingo, Prov. Pichincha, ca. 1800 m, 9 Dec. 1948; Rauh, Hirsch E 238 (US) Santa Rosa, Prov. El Oro, ca. 200 m, 29 Aug. 1954; Asplund 16680 (US) above El Pun towards Tulcan, Prov. Carchi, 3050 m, 14 July 1955; Barclay and Juaibicov 8373 (US) 37 km south of Cuenca, Prov. Azuay, 3200 m, 30 July-8 Aug. 1959; Harling 6235 (US) 10 km

south of Saraguro, Prov. Loja, 1-3 Aug. 1959; Asplund 15663 (US) epiphytic in Coccoloba tree in pasture, near Santa Rosa, Prov. El Oro, near sea level, 11 March 1955; Acosta-Solis 11033 (F) Isolote de Quicocha, 8 Sept. 1945; AJG 644 (US) 1 km east of the little town north of Manglaralto, Prov. Guayas, ca. 100 m; AJG 682 (US) Cerro Azul, tropical semi-deciduous forest, up the trail from Hacienda Barcelona, Prov. Guayas, ca. 300 m, 21 April 1962; AJG 760 (US) Cerro Azul, tropical semi-deciduous forest, up the trail from Hacienda Barcelona, Prov. Guayas, ca. 400 m, 24 July 1962; AJG 769 (US) Cerro Monte Cristi, south of Manta, part way down on western slope near boundary between "garua" moistened forest and the semidesert scrub, Prov. Manabí, ca. 400 m, 10 Aug. 1962; AJG 787 (US) Pilaló 2 km east of village, on scrubby hillside, Prov. Cotopaxi, ca. 2500 m, 18 Aug. 1962; AJG 798 (US) Pilaló, opposite Hotel Nuevo, in wooded lot, very abundant, Prov. Cotopaxi, ca. 200 m, 19 Aug. 1962; AJG 1111 (US) edge of cultivated field that had been burned, tank full of water, common, km 40 Cuenca-Loja, Prov. Azuay, 3000 m, 9 Aug. 1965.

COLOMBIA, COSTA RICA, WEST INDIES, BRITISH GUIANA, PERU.

NOTES: There seem to be three forms of E. complanata that blend into one another; 1) a coastal form represented by smaller plants with floral bracts and sepals having their apices narrowly acute, and sepals posteriorly united; 2) a middle altitude form represented by larger plants, with

leaves long and broad, sepals ovate-elliptic; 3) a very high altitude form, a smaller plant with narrow leaves, sepals free and tending to be oblong and obtuse. Examples of form 1) are: Engers 14055 (US), Rauh, Hirsch E 238 (US) ASG 644 (US) and ASG 682 (US). Examples of form 2) are: ASG 798 (US), Hitchcock 21671 (US) Campo E 1753 (US), ASG 787 (US), Foster 2649 (US). Examples of form 3 are: Campo E 3957A and E (US), Hitchcock 21562 (US), Schimoff 887 (US), Barclay and Juajibioy 8373 (US), and Rimbach 282 (US). Although these three different forms can be recognized, no attempt here is made to describe them as separate taxa.

From the observations of the specimens seen it appears likely that the so-called simple axial inflorescences of T. complanata are actually spikes of a compound inflorescence with the scape foreshortened so that it never grows to the point of being macroscopically recognizable. In some specimens several "inflorescences" appeared in the same leaf axil as for example with Rivet 687, Schimoff 387 and Campo E 3947. These fascicles of "inflorescences" are probably really spikes with elongate, bracteate stipes. Other specimens, especially the coastal ones, seem to have no more than one "inflorescence," that is, spike, per leaf axil. Support for this idea of a pseudo-simple inflorescence is obtained from the relative lengths of the bracts. In T. complanata what have always been called scape-bracts are often imbricate above but remote below and are

approximately all the same length. This is not the usual situation in species of the genus, Tillandsia. Usually scape-bracts are much longer below and imbricate; becoming shorter toward the inflorescence where they may not be imbricate. If we recognize the so-called inflorescences of T. complanata as spikes then the scape-bracts are in reality sterile floral bracts which typically do become closer to one another acropetally. The character of a foreshortened scape is held consistently throughout all forms of Tillandsia complanata that have been observed to date.

42. REILANDSIA ZAMORENSIS L. B. Smith, 1953 (Phytologia vol. 4, no. 4) pp. 213-214, pl. 1, figs. 3-5.

FIG. 31

PLANT ca. 50 cm tall; LEAVES 35-45 cm long, blades 3.0-4.0 cm wide, blade lingulate, apex apiculate to acuminate, glabrous above, densely and minutely lepidote beneath, sheath 10-11 cm long by 6.0-7.0 cm wide, some purple, ovate-elliptic; SCAPE ca. 2-3 mm in diameter, erect to slightly curved; SCAPE-BRACTS 2.5-3.5 cm long, strictly erect, nearly uniform in length, just barely imbricate; INFLORESCENCE ca. 20 cm long by 6.0-7.0 cm in diameter, bipinnate to partly tripinnate, sub-dense, glabrous; PRIMARY BRACTS ca. 3.0 cm long, erect, distance apart 1.5-2.0 cm, apex acute; SPIKES 7.0-8.5 cm long by 1.4-1.5 cm wide, linear, about 11 per inflorescence, erect, having 12-14 flowers per spike, stipe 0.5-1.5 cm long with 1 to 2 sterile bracts; FLORAL BRACTS ca. 2.0 cm long by 0.9 cm wide, erect, mostly imbricate but spike rhachis exposed, glabrous without, slightly punctulate within, apex acuminate, subcoriaceous to papery, unicarinate, strongly nerved; SEPALS ca. 1.9-2.1 cm long by 4-6 mm wide, elliptic, free to posteriorly connate for 2-3 mm, posteriorly carinate, glabrous without, inconspicuously lepidote within, strongly nerved, apex acute, papery; PETALS ca. 4 mm longer than sepals; OVARY 8-9 mm long by 2-3 mm in diameter, distance between flowers 5-6 mm, in flower around

January.

MATERIAL EXAMINED: AJG 842 (US) between Cumberatza and Zumbi, near banks of Río Zamora, Prov. Zamora, 770 m, 23 Feb. 1963.

NOTES: T. zamorensis L. B. Smith appears to be very similar to T. maculata Ruiz and Pavon. The former is a smaller plant and the scape is shorter than the leaves, with sepals posteriorly connate somewhat lower than in T. maculata. The differences seem to be largely differences of degree and suggest a close relationship between these two, T. zamorensis and T. maculata. Both are from the Amazon basin drainage area.

43. TILLANDSIA MACULATA Ruiz and Pavon, 1802 (Flora Peruv. vol. 3) p. 40, pl. 266; Smith, 1936, p. 557.

PLANT to 1 m tall; LEAVES to 80 cm long, blades 4.0 cm wide, linear-lingulate, apex acute, obscurely lepidote, spotted; SCAPE ca. 7-8 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS partly imbricate, partly remote; INFLORESCENCE ca. 70 cm long by 20 cm in diameter, glabrous, red, tri- to quadripinnate, lax, subpyramidal; PRIMARY BRACTS much shorter than branches, spreading, red, apex attenuate; PRIMARY BRANCHES 12-13 cm long by 2.0-6.0 cm wide, spreading, distance between 2.5-3.5 cm, at least 14 per inflorescence; SPIKES 7.0-9.0 cm long by 1.1-1.8 cm wide, spreading, linear, having 8 to 20 flowers per spike, stipe 0.4-1.2 cm long, no sterile bracts; FLORAL BRACTS 2.0-2.5 cm long by 1.0-1.1 cm wide, erect, scarcely or not at all imbricate, acuminate, nerved, papery, unicarinate, glabrous without; SEPALS 1.8-2.0 cm long by 0.9-1.1 cm wide, elliptic, apex acute, strongly nerved, glabrous without, slightly lepidote within, carinate, posteriorly united for 6-7 mm, coriaceous; PETALS much exceeding sepals, sub-spreading, distance between flowers 6-7 mm.

MATERIAL EXAMINED: Drake s. n. (P) Ecuador(?); Grubb et al. 1096 (US) montane forest in deep, steep sided valley, 5 miles northeast of Borja, Prov. Napo-Pastaza, 1960.

PERU.

44. TILLANDSIA RUBELLA Baker, 1888 (Jour. Bot. vol. 26)
p. 44; Mez, 1935, p. 536.

FIG. 32

PLANT ca. 1 m tall; LEAVES 30-60 cm long, blades 3.0-4.0 cm wide, linear-lingulate, apex attenuate, subglabrous both surfaces, much red, sheath 9.0-16.0 cm long by ca. 1.0 cm wide, red-purple above; SCAPE ca. 1.0 cm in diameter, erect-curving; SCAPE-BRACTS 5.0-16.0 cm long, imbricate throughout, apices red, erect; INFLORESCENCE 20-50 cm long by ca. 5.0-8.0 cm in diameter, cylindrical, lax to sub-dense, bi- to tripinnate; PRIMARY BRACTS 3.0-8.0 cm long, in part exceeding spikes, spreading to ascending, ovate, apex acute-caudate; PRIMARY BRANCHES 4.0-6.0 cm long by 2.0-4.0 cm wide, 0.8-3.0 cm apart; SPIKES 2.5-3.5 cm long by 1.0-1.4 cm wide exclusive of petals or capsules, 2 to 3 spikes per branch; erect, distance between spikes 4-5 mm; FLORAL BRACTS 1.0-1.6 cm long by 1.0-1.4 cm wide, bicarinate, imbricate, nerved, glabrous without, lepidote within, apex acute; SEPALS 1.2-1.5 cm long by 0.8-1.0 cm wide, wide-ovate, subequally nearly free, acute, posteriorly carinate, strongly nerved, glabrous without, lepidote within; PETALS ca. 2.0 cm long, violet, stamens included within corolla by 2-3 mm; OVARY 5-7 mm long by 2-3 mm in diameter, distance between flowers 4-6 mm.

MATERIAL EXAMINED: Mendon 1187 (B, TYPE) Bolivia;
Escher 2533 (US) on steep cliff, Cochabamba, Bolivia, ca.

2200 m; AUG 1158 (US) km 40 Loja-Cuenca, edge of "páramo" and dwarf forest, moderately common, Prov. Azuay, 2600 m, 11 Aug. 1965; AUG 1167 (US) windy cliff, km 94 Cuenca-Guayaquil, moderately common, no water in tank, Prov. Azuay, ca. 2800 m, 13 Aug. 1965; Asplund 7138 (US) Islote Chica, Lago Cuicocha, Prov. Imbabura, 3100 m, 23 June 1939.

BOLIVIA.

45. TILLANDSIA BARBEYANA Wittmack, 1890 (Engler's Bot. Jahrb. vol. 11) p. 66; Mez, 1935, p. 505.

FIG. 33

PLANT ca. 40-50 cm tall, erect rosette of leaves; LEAVES 20-35 cm long, blades 2.0-3.0 cm wide, blade, narrowly lingulate, apex attenuate, subglabrous, sheath ca. 10 cm long by 6.0 cm wide, dark castaneous; SCAPE ca. 5 mm in diameter, erect; SCAPE-BRACTS imbricate throughout, erect, green mottled with red; INFLORESCENCE 15-30 cm long by ca. 10 cm in diameter, having ca. 14 spikes, lax, bipinnate; PRIMARY BRACTS ca. 2.5 cm long, spreading, shorter than spikes; SPIKES 4.0-6.0 cm long by 1.0-1.5 cm wide, with 5 to 12 flowers per spike, stipe 1.0-1.5 cm long with 1 to 2 sterile bracts; FLORAL BRACTS ca. 1.2 cm long by 6 mm wide, coriaceous, ovate, purple-red when alive, slightly nerved, glabrous without, densely lepidote within, carinate; SEPALS ca. 1.0 cm long by 4-5 mm wide, elliptic, obtuse, nearly free to posteriorly united for 2-3 mm, glabrous without, densely lepidote within; PETALS ca. 1.5 cm long, purple; CAPSULE ca. 1.7 cm long.

MATERIAL EXAMINED: Lehmann 444 (B, TYPE; US, photo) near Baños, Prov. Tunguruahua, 1500-2000 m, 14 Sept. 1838; Asplund 19953 (S; US, photo) near Mera, epiphytic in "cedrera" tree in pasture, Prov. Napo-Pastaza, ca. 1100 m, 26 March 1956; Naundorff s. n., cultivated by Marnier-Lapostolle in France (US) collected near Baños, Prov.

Tungurahua, 7 April 1965; ATG 1098 just outside of Baños,
at roadside, epiphytic, moderately common, much water in
tank, Prov. Tungurahua, ca. 1900 m, 7 Aug. 1965.

46. TILLANDSIA PINNATA Mez and Sodiro, 1904 (Bull. Herb. Boiss., series 2, vol. 4) p. 1130; Mez, 1935, p. 519.

PLANT ca. 60 cm tall; LEAVES ca. 40 cm long, blades 3.5 cm wide, lingulate, apex apiculate, appearing glabrous, sheath ca. 11 cm long; SCAPE 5-6 mm in diameter, shorter than leaves; SCAPE-BRACTS imbricate; INFLORESCENCE estimated 15 cm long by ca. 17 cm in diameter, tripinnate, lax with about 6 branches, glabrous, apparently erect; PRIMARY BRACTS 2.0-4.0 cm long, spreading, apex acute; PRIMARY BRANCHES 7.0-9.0 cm long by ca. 4.0 cm wide, with 1-2 spikes, spreading; SPIKES 6.0-8.0 cm long by 1.4-2.0 cm wide, spreading, flowers per spikes ca. 12-16, stipe 0.5-1.5 cm long, spike rachis nearly straight, no sterile bracts; FLORAL BRACTS ca. 1.0 cm long, ovate-triangular, apex broadly acute, coriaceous, strongly nerved, erect to spreading, not at all imbricate, distinctly shorter than sepals; SEPALS ca. 1.5 cm long, less than 9 mm wide, free, subcoriaceous, elliptic, broadly acute, weakly nerved; PETALS ca. 1.8 cm long, distance between flowers 4-7 mm.

MATERIAL EXAMINED: Sodiro 171/35 (B, TYPE; US, photo) near Río Pilaton, western cordillera east of Santo Domingo, Prov. Pichincha, estimate ca. 1500 m, May 1885.

47. TILLANDSIA TOVARENSIS Mez, 1896 (DC. Monogr. Phaner. vol. 9) p. 769; Mez, 1935, pp. 520-521.

Tillandsia arnoldiana Harms, 1929 (Notizblatt Bot. Gart. und Mus. vol. 10) p. 579.

PLANT to 1 m tall; LEAVES ca. 60 cm long, blades 4.0-9.0 cm wide, lingulate, apex acute to apiculate, upper surface subglabrous, lower surface densely appressed lepidote, sheath 8.0-16.0 cm long; SCAPE ca. 1.2 cm in diameter, erect, much exceeding leaf rosette; SCAPE-BRACTS ca. 5.0 cm long of nearly uniform length throughout scape, imbricate; INFLORESCENCE ca. 50 cm long by 7.0-16.0 cm in diameter, tripinnate, lax, glabrous, having 12 to 22 branches; PRIMARY BRANCHES 8.0-20.0 cm long by 4.0-7.0 cm in diameter, erect to spreading; PRIMARY BRACTS 2.0-6.0 cm long, apex attenuate, glabrous, erect; SPIKES 2.0-10.0 cm long by ca. 1.1 cm wide, spreading to recurved, having 3 to 9 flowers per spike, stipe 1.5-3.5 cm long, usually with 1 sterile bract, spike rhachis nearly straight, much flattened; FLORAL BRACTS 1.1-1.3 cm long by ca. 8 mm wide, ovate, apex acute, strongly nerved, slightly carinate, imbricate, glabrous without, lepidote within; SEPALS 1.0-1.1 cm long by 5-6 mm wide, obtuse, strongly nerved, posteriorly carinate, free, elliptic-obovate; PETALS ca. 1.8 cm long, purple, stamens included by 2-3 mm; OVARY ca. 5-6 mm long by 2-3 mm in diameter; CAPSULE ca. 2.3 cm long, distance between flowers 4-5 mm, in flower around July-February.

MATERIAL EXAMINED: Fendler 2446 (TYPE, US, photo) Venezuela, ca. 2000 m; Schultze 1133 (B, TYPE of T. arnoldiana; F, photo) Santo Morto, Colombia; Hitchcock 21441 (US) between Loja and San Lucas, Prov. Loja, 2100-2600 m, 7 Sept. 1923; Killip and Smith 24298 (US) Dept. Junín, Huacapistana, Colombia, ca. 1800 m; Espinosa E345 (GH) Cajanuma, south of Loja, Prov. Loja, 2400 m, 7 May 1946; Espinosa E 920 (GH) Hacienda Horta-Naque, Prov. Loja, 3100 m, 7 Nov. 1946; Espinosa E 1574 (US) ca. 7 km southeast of Loja, Prov. Loja, 2300-2400 m, 3 July 1947.

COLOMBIA, VENEZUELA.

NOTES: Examination of the respective type specimens of T. tovarensis Mez and of T. arnoldiana Harms did not bring to light any significant differences. Harms (1929, p. 530) and Mez (1935, p. 446) distinguished the two on the basis of the size of the spikes. They say that the spikes of T. tovarensis are up to 35 mm long and 18 mm wide, being shorter and broader than the spikes of T. arnoldiana. However, examination of the photographs of the respective type specimens showed that both have their spikes from 2.0 to 10.0 cm long and both have their spikes ca. 1.1 cm wide. The only possible real difference between these two could be the size of the leaves. The type specimen of T. arnoldiana has a leaf ca. 60 cm long and 9.0 cm wide at the blade. The type specimen of T. tovarensis has leaves 24-25 cm long and ca. 4.0 cm wide. However, since

leaf size is often variable even within the same plant, much more so than are the dimensions of inflorescence parts, this difference alone does not seem to be sufficient to warrant circumscription of two taxa. Therefore, I am reducing E. arnoldiana Harms to taxonomic synonymy with E. townensis Mez.

TELEKODSIA LATIFOLIA Mayen, 1835 (Reise vol. 2) p. 45;
Smith, 1966, p. 141.

T. kunthiana Gaudichaud, 1842 (Atlas Voyage Bonite)
pl. 53.

PLANT 26-80 cm tall, often growing in clumps of several individuals, epiphytic and terrestrial; LEAVES 6.0-35.0 cm long, blades 1.5-3.5 cm wide, narrowly triangular, apex long-attenuate to filiform, densely lepidote throughout, coriaceous, sheaths 3.0-7.5 cm long, slightly purple, indistinct; SCAPE 3-5 mm in diameter, erect, shorter than leaf-rosette to much exceeding it; SCAPE-BRACTS 3.0-12.0 cm long, imbricate, erect with spreading, attenuate to filiform apices, green or with pink to red apices; INFLORESCENCE 6.0-20.0 cm long by 8.0-15.0 cm in diameter at anthesis, pink, nearly glabrous to densely lepidote, bipinnate, having 3 to 15 spikes; PRIMARY BRACTS 2.0-6.5 cm long, erect, apex attenuate to filiform, lepidote at least toward apices, orange-red; SPIKES 3.0-8.0 cm long by ca. 1.5 cm wide at anthesis, spreading at nearly right angles to axis of inflorescence at anthesis or erect, distance between spikes 0.7-1.1 cm, stipe minimal to 7 mm long with 2 or 3 sterile bracts; FLORAL BRACTS 1.4-2.2 cm long by 0.3-1.8 cm wide, apex acute, uncarinate, papery, imbricate, erect, obscuring spike-rhachis at anthesis, pink, glabrous to lepidote without, glabrous within; SEPALs 1.2-1.7 cm long by ca. 3-4 mm wide, ovate, acute, papery, slightly nerved, free

or posteriorly connate for 1/2 of sepal length or more, subglabrous to glabrous without, glabrous within, red-pink at apices; PETALS ca. 1.9 cm long with pink to violet blades, stamens and stigma included, stamen filaments plicate, often style also somewhat plicate; OVARY 2-3 mm long by 1-2 mm in diameter; CAPSULE ca. 3.0 cm long; distance between flowers 2-4 mm.

48. T. LATIFOLIA var. LATIFOLIA

Plant usually not more than 40 cm tall; floral bracts 2.0-2.2 cm long; sepals 1.6-1.7 cm long, free.

MATERIAL EXAMINED: Gaudichaud s. n. (P, TYPE) Peru.

NOTES: The typical variety of T. latifolia has not yet been collected in Ecuador.

49. T. LATIFOLIA var. DIVARICATA (Benth.) Mez, 1896 (DC.

Monogr. Phaner. vol. 9) p. 789; Smith, 1966, p. 141.

T. divaricata Bentham, 1846 (Bot. Voyage Sulph.) p. 174.

T. kunthiana var. divaricata (Benth.) L. B. Smith, 1960 (Phytologia vol. 7, no. 9) p. 108.

FIG. 34

Plant to 80 cm tall; floral bracts 1.4-1.6 cm long; sepals ca. 1.2 cm long and united posteriorly for 1/2 or more of sepal length.

MATERIAL EXAMINED: Sinclair s. n. (K, TYPE; US, photo) Ecuador; Rivet 559 (P) Prov. Azuay, near Alausí, June 1904; Camp E-2303 (US) valley of Río Paute, between Paute and Cuenca, terrestrial on dry cliffs, Prov. Azuay, ca. 2200 m,

1946; AJG 1155 (US) above Río Tenta, near Saraguro, km 71 Loja-Cuenca, Prov. Azuay, 2300 m, 12 Aug. 1965; AJG 1160 (US) km 13 Cuenca-Guayaquil, "barranco," common, no water in tank, Prov. Azuay, 2250 m, 13 Aug. 1965; Rose and Rose 22554 (GH) near Huigra, on Hacienda de Licay, Prov. Chimborazo, 6 Sept. 1918; Hitchcock 20347 (US) near Huigra, Prov. Chimborazo, 1200 m, 4, 16, 20-27 July, 1923; Fosberg and Giler 22585 (US) cliffs and talus at cliff bases, abundant, stems branching, cañon of Río Sibambe, tributary of Río Chanchan, Sibambe, Prov. Chimborazo, 2460-2550 m, 28 Jan. 1945; AJG 1104 (US) roadcut, rare, km 8 Alausí-Cuenca, Prov. Chimborazo, 2600 m, 8 Aug. 1965; AJG 1105 (US) roadcut, km 8.5 Alausí-Cuenca, Prov. Chimborazo, 2600 m, 8 Aug. 1965; AJG 1106 (US) km 22 Alausí-Cuenca, common, terrestrial and epiphytic, Prov. Chimborazo, 2500 m, 8 Aug. 1965; AJG 646 (US) ca. 2 km south of Ayangüe, Prov. Guayas, ca. 50 m, 24 March 1962; AJG 649 (US) epiphytic, abundant, north slope of gentle hill, 12 km south of Manglaralto, Prov. Guayas, ca. 15 m, 24 March 1962; AJG 651 (not pressed, photo only) 12-15 km south of Manglaralto, Prov. Guayas, 24 March, 1962; AJG 855 (US) Colonche and just east of pueblo, ca. 15 km southeast of Ayangüe, Prov. Guayas, ca. 250 m, 18 Aug. 1963; AJG 856 (US) same locality as AJG 855, 18 Aug. 1963; AJG 1051 (US) km 80, Guayaquil-Quevedo, epiphytic, very common in Bombacaceae-evergreen scrub, small trees and shrubs, semi-open association, Prov. Guayas, ca.

70 m, 2 Aug. 1965; AJG 1184 (US) collected by Edward Anderson for AJG, Palmar, near beach, Prov. Guayas, near sea level, Aug. 1965; Hitchcock 21412 (US) epiphytic, between La Toma and Loja, Prov. Loja, 1923; Foster 2623 (US) km 110-140 Oña-Saraguro; Prov. Loja, ca. 2000 m, 4 Dec. 1948; Harling 6099 (US) San Pedro, near top of Río Guayabal river valley, Prov. Loja, 2200 m, 27 July 1959; Harling 5988 (US) km 25 Loja-La Toma, epiphytic, Prov. Loja, 1900 m, 20 July 1959; AJG 845 (US) rocky face of stream cut, not common, between Oña and Antonio de Cumbe, Prov. Loja, 2160 m, 12 March 1963; AJG 1127 (US) 2 km west of Catamayo, Prov. Loja, 10 Aug. 1965; AJG 1129 (US) 2 km west of Catamayo, Prov. Loja, 10 Aug. 1965; Foster 2589 (US) Portovelo, Prov. El Oro, ca. 600 m, 29 Nov. 1948; Rauh, Hirsch E 371 (US) Giran-Paisaje, Prov. El Oro, 800 m, no date; Rauh, Hirsch E 372 (US) epiphytic, Paisaje, Prov. El Oro, 800 m, no date.

NOTES: The degree of spreading of the spikes in this variety of divaricata, T. latifolia is partially dependent upon the time of collection. When in bud, the spikes are all erect, see illustration. At anthesis or thereafter, the spikes spread at nearly 90° to the main axis of the inflorescence. The indumentum is variable and from observations of the specimens collected to date, there seems to be a continuum from the coastal forms with densely gray, lepidote inflorescences, to the Andean forms with moderately

lepidote or nearly glabrous inflorescences. The strongly lepidote form extends well up the Río Chanchan valley and is also near Portovelo in the Río Grande valley.

Extremely variable in this species is the relative length of the scape compared to the leaf-rosette. AJG 651, a mature specimen from ca. 14 km south of Manglaralto on the coast has its scape exposed about 20 cm beyond the leaf-rosette. Also from the coastal area, near Colonche is AJG 856, a mature specimen with its short scape nearly totally obscured by the leaf-rosette. The same variability of scape-length occurs in the Andean representatives of the variety; for example, AJG 1155 from the Province of Azuay, with a very long scape and AJG 1105 from the Province of Chimborazo with its scape much exceeded by the leaf-rosette.

In specimens from both the coast and the Andes the holdfasts are well developed and usually have round or elliptic nodules which are probably insect produced. They are similar to the nodules found on the holdfasts of T. disticha H. B. K. and are mentioned in the notes under that species.

50. TILLANDSIA QUEROENSIS Gilmartin, spec. nov.

FIG. 35

A T. orbicularis L. B. Smith atque T. scepтрiformis Mez and Sodiro cui afinis, laminis foliorum triangulatis, apicibus filiformibus; spicis paucioribus, caulibus elongatis differt.

PLANT 70 cm to 1 m tall including inflorescence, long stemmed, growing in clumps of several individuals, terrestrial; LEAVES 30-45 cm long, blades 2.0-2.5 cm wide, narrowly triangular, densely, appressed-lepidote, apex filiform, sheath ca. 10 cm long by 4.0-5.0 cm wide, dark brown; SCAPE 5-6 mm in diameter, curved, exceeding leaf-rosette; SCAPE-BRACTS 4.0-21.0 cm long by ca. 1.5 cm wide, erect, imbricate, red; INFLORESCENCE 10-24 cm long by 3.0-4.0 cm wide at anthesis, bipinnate, lax below, dense above, having 4 to 6 spikes, subglabrous; PRIMARY BRACTS 3.0-6.0 cm long by ca. 1.6 cm wide, erect, red, elliptic, apex acute to apiculate; SPIKES 5.5-7.0 cm long by ca. 1.5 cm wide at anthesis, erect, ca. 1.0-2.0 cm apart, having 5 to 9 flowers per spike, stipe minimal to 1.5 cm long with 1 to 2 sterile bracts; FLORAL BRACTS ca. 2.5 cm long by 1.2 cm wide, imbricate, erect, elliptic-ovate, red, ecarinate to slightly carinate, glabrous to moderately lepidote without, moderately lepidote within, nerved, apex broadly acute, coriaceous; SEPALS 1.7-2.2 cm long by ca. 6 mm wide, elliptic, erect, pink, carinate, connate for 1-5 mm, acute.

strongly nerved, glabrous without, moderately lepidote within; PETALS 3.0-3.5 cm long, stamens included by 2-3 mm, distance between flowers 4-10 mm.

MATERIAL EXAMINED: AJG 1102 (US, TYPE) terrestrial, common locally, steep, rocky slope, km 18 Ambato-Cuenca, near pueblo of Quero, Prov. Tungurahua, ca. 2800 m, 8 Aug. 1965; AJG 1101 (US) same as 1102, 8 Aug. 1965; Naundorff s. n. (US) cultivated by Marnier-Lapostolle in France, central Andes, valley of Azogues, Prov. Cañar, 2500 m, no date, probably 1966.

NOTES: T. gueroensis has been collected to date, only in rather isolated areas. The TYPE is from an area south-southeast of Ambato in the Province of Tungurahua. Quero is in the extreme southern portion of the "hoya" Ambato. This region is between the Cerros Cariguairazo which rise to nearly 5000 m on the west and a ridge to the east which rises to some 4000 m. It has also been collected from the "hoya" Azogues.

Although the floral parts resemble somewhat those of T. orbicularis L. B. Smith and T. scepstriformis Mez and Sodiro, the plant as a whole does not appear very similar. The leaf-form and indumentum resemble that of T. incarnata H. B. K. Relative to T. incarnata, T. gueroensis has a much larger inflorescence, much larger leaves, and the sepals connate for only 1-5 mm.

51. TILLANDSIA GAYI Baker, 1889 (Handbook Bromel.) p. 179;
Smith, 1936, p. 561.

PLANT to ca. 65 cm tall with inflorescence; LEAVES 20-25 cm long, blade ca. 1.5 cm wide, silvery gray-green, narrowly triangular, involute toward apex, sheath 5.0-5.5 cm long by 3.0 cm wide, purple above, leaf surface covered with dense, spreading silvery scales, at least 10 to 12 scales per mm²; SCAPE ca. 3 mm in diameter, probably erect; SCAPE-BRACTS 3.5-10.0 cm long by 1.5 cm wide, silvery gray-green, erect with apices reflexed, imbricate below, scarcely imbricate above; INFLORESCENCE 17 cm long by 9.0 cm in diameter, pyramidal, glabrous except for primary bracts, having 8 spikes; PRIMARY BRACTS 2.2-3.2 cm long by 1.1-1.2 cm wide, erect, long-ovate, lepidote; SPIKES 5.0-6.0 cm long by 1.0 cm wide at anthesis, spreading at 30-40° angle to axis, linear, having 6 to 8 flowers, distance between spikes 1.2-2.0 cm, stipe ca. 1.5 cm long, usually with 1 to 2 sterile bracts; FLORAL BRACTS 1.3-1.5 cm long by 6-7 mm wide, ovate, glabrous without, densely, finely and inconspicuously lepidote within, not imbricate at anthesis, slightly carinate, apex acute, nerved, papery; SEPALS 1.2 cm long by 4 mm wide, ovate, glabrous without and within, erect, acute, carinate posteriorly, connate posteriorly for 4-6 mm, strongly nerved, papery in texture; PETALS 2.0 cm long by 4 mm wide, blades violet, stamens included by ca. 4 mm, filaments strongly plicate, anthers ca. 5 mm

long; OVARY 3 mm long by 2 mm in diameter, distance between flowers 5-6 mm.

MATERIAL EXAMINED Gay s. n. (P, TYPE; US, photo) Peru;
Teuscher 1834-56 cultivated in Montreal Bot. Gard. (US)
Cuenca, Prov. Azuay, 1956.

PERU.

52. TILLANDSIA OROYENSIS Mez, 1919 (Fedde. Repert. Spec. Nov.) p. 77; Mez, 1935, p. 537; Smith, 1936, p. 562.

PLANT 50 cm to 1 m tall, erect rosette; LEAVES 25-55 cm long, blade ca. 2.5 cm wide, narrowly triangular, densely gray-white, moderately appressed lepidote, apex caudate; sheath 9.0-12.0 cm long by 5.0-6.0 cm wide, elliptic; SCAPE 4-5 mm in diameter, scarcely exceeding leaf-rosette, erect; SCAPE-BRACTS 4.0-20.0 cm long by 1.5-2.0 cm wide, erect with reflexed narrow apices, imbricate throughout; INFLORESCENCE 20-50 cm long by 4.5-5.5 cm in diameter, erect, red, bipinnate, moderately densely to slightly lepidote, having ca. 17 spikes, ellipsoid to cylindrical; PRIMARY BRACTS mostly to 2.5 cm long, erect-spreading, apex acute to caudate, red, lepidote; SPIKES 3.0-5.0 cm long by 1.5-2.0 cm wide, erect, distance between spikes 1.5-3.0 cm, having 8 to 12 flowers, stipe minimal to 5 mm long, no basal sterile bracts; FLORAL BRACTS 1.0-1.2 cm long by ca. 7 mm wide, ovate, apex sharply acute, uncarinate, papery, obviously nerved, moderately lepidote without, densely brown-lepidote within, scarcely imbricate, erect-spreading, red; SEPALS 1.0-1.2 cm long by ca. 5 mm wide, ovate-elliptic, acute, posteriorly connate to 5 mm or equally subfree, red tipped, posteriorly carinate, strongly nerved, glabrous without and within; PETALS to 1.5 cm long; OVARY 8-9 mm long by 2-3 mm in diameter, stamens included in corolla by ca. 3 mm, not plicate or

slightly so; stigma barely exerted, distance between flowers 4-5 mm.

MATERIAL EXAMINED: Weberbauer 2523 (B, TYPE; US, photo) Peru; Asplund 17712 (US) Hacienda Pizhin, Prov. Azuay, ca. 2800 m, 23 Nov. 1955.

PERU.

53. TILLANDSIA INCARNATA H. B. K., 1816 (Novae Genera et Species, vol. 1, p. 291); Smith, 1957, pp. 137-138, fig. 40.

FIG. 36

PLANT 15-75 cm long, growing in dense tangled masses, outermost leaves shorter than others in rosette; LEAVES 7.0-24.0 cm long, blades 0.5-1.5 cm wide, narrowly triangular, densely, obviously lepidote with moderately spreading scales on both surfaces, apex filiform-acuminate; SCAPE ca. 2 mm in diameter, curving; SCAPE-BRACTS 2.0-6.0 cm long, erect, imbricate throughout, the lower with long filiform blades, the upper acute to apiculate; INFLORESCENCE 4.5-10.0 cm long by ca. 1.5 cm wide at anthesis usually simple or rarely digitate from a few spikes, having 5 to 18 flowers per spike, exceeding leaf-rosette; FLORAL BRACTS 2.1-2.6 cm long by ca. 0.8 cm wide, erect, imbricate, ovate to elliptic, apex acute, papery, ecarinate, strongly nerved, lepidote without, slightly lepidote to subglabrous within; SEPALS 1.4-1.6 cm long by ca. 5 mm wide, elliptic, acute, posteriorly connate for 1.0-1.2 cm, carinate posteriorly, subcoriaceous, nerved, lepidote without, glabrous to subglabrous within; PETALS 1.9-2.5 cm long, erect, rose to red, stamens included; OVARY ca. 5 mm long by 2 mm in diameter, stamens with filaments strongly plicate usually; CAPSULE ca. 2.5 cm long, distance between flowers 5-6 mm.

MATERIAL EXAMINED: Humboldt s. n. (US, photo of TYPE) Ecuador; Couthouy s. n. (GH) "Quitensian Andes;" Hitchcock 21610 (US) between Oña and Cuenca, Prov. Azuay, 2700-3300 m, 9-10 Sept. 1923; Asplund 17621 (US) epiphytic, Cuenca, Prov. Azuay, 2600 m, 20 Sept. 1955; Giler 33 (US), valley of Río Matadera, a few km west of Cuenca, epiphytic, Prov. Azuay, 2500 m, Feb. 1945; Teuscher 2034-56 (US) near Cuenca, cultivated Montreal Bot. Gard. Prov. Azuay, Dec. 1958; AJG 1107 (US) terrestrial, very common on cliffs, and steep rocky-loose dirt slopes, km 11 Cuenca-Loja, Prov. Azuay, 2600 m, 9 Aug. 1965; AJG 1161 (US) abundant on "capuli," 1-3 m from ground, no water in tank, km 34 Cuenca-Guayaquil, near village on cultivated land, Prov. Azuay, 2300 m, 13 Aug. 1965; Asplund 5999 (US) Chambo, on wall, Prov. Chimborazo, 10 May 1929; Asplund 10443 (US) Ibarra, Prov. Imbabura, 2225 m, 23 Jan. 1940; Acosta Solis 13360 (F) epiphytic on "guabo," Yaguarcocha, Prov. Imbabura, 15 Aug. 1949; Drew E-298 (US) terrestrial, small river 3 km north of Atuntaqui, on dry slopes of quebrada, Prov. Imbabura, ca. 2000 m, 27 June 1944; Benoist 2632 (P) Curibaya, Prov. Pichincha, 17 June 1930; Firmin 265 (US) valley of Gumbamba, Prov. Pichincha, 2800 m, 17 Oct. 1927; Asplund 8741 (US) on wall, Pifo, Prov. Pichincha, 15 Sept. 1939; AJG 1085 (US) terrestrial, on cliff, ashy soil, km 15 Quito-Otavalo, Prov. Pichincha, 2700 m, 6 Aug. 1965; Acosta Solis 13494 (F) epiphytic on cedro, Quito, Prov. Pichincha.

20 Aug. 1949; AJG 1086 (US) Parque El Ejercito, Quito, very common, Prov. Pichincha, ca. 2600 m, 6 Aug. 1964; Rimbach 78 (GH) "interandine highland," ca. 2800 m, 1932; Benoist 3712 (P) epiphytic on Acacia, near Guayllabamba, Prov. Tungurahua, 16 Jan. 1931; Rimbach 121 (US) near Riobamba, Prov. Tungurahua, 2800 m, 1932; Lehmann 147 (US) Guayllabamba, Prov. Tungurahua, 3000 m, Nov. 1880; Hitchcock 29705 (US) terrestrial, dry slopes and cliffs, Ambato, Prov. Tungurahua, 2600 m, 21 Sept. 1923; Asplund 7782 (US) Patate, on wall, Prov. Tungurahua, 2000 m, 22 July 1939; Asplund 8155 (US) valley of Rio Pillaro, between Ambato and Pillaro, on cliff, Prov. Tungurahua, 10 Aug. 1939; Acosta Solis 8633 (F) between Ambato and Pishilata, epiphytic on cactus and rocks, Prov. Tungurahua, 2500-2680 m, 25 Oct. 1944; Acosta Solis 9251 (F) between Guachi Bajo and Pishilata, Prov. Tungurahua, 2400-2700 m, 1 Dec. 1944; Balls 7191 (US) "loose recurving narrow leaves forming rosettes in great cushions to several feet across, growing in dry sandy soil on steep open, sunny slopes above Ambato, Prov. Tungurahua, 10 July 1939; Fagerland and Wibom 1007 (US) a little west of Ambato, Prov. Tungurahua, Nov. 1952; AJG 1089 (US) epiphytic, 3 m from ground, no water in tank, km 24 Ambato-Baños; Prov. Tungurahua, 2400 m, 7 Aug. 1965; AJG 1087 epiphytic, 2-4 m from ground, in pear orchard, km 23 Ambato-Baños, epiphytic on low shrubs, Prov. Tungurahua, ca. 2400 m, 7 Aug. 1965; AJG 1090 (US) km 24 Ambato-Baños, epiphytic on low shrubs,

Prov. Tungurahua, ca. 2400 m, 7 Aug. 1965; AJG 1094 (US)
dry open country, terrestrial, km 45 Ambato-Baños, Prov.
Tungurahua, ca. 2000 m, 7 Aug. 1965.

COLOMBIA.

NOTES: The length of the plant may vary from as short as 15 cm to as tall as 75 cm including the well developed stem in T. incarnata H. B. K. However, the inflorescence parts, the leaf dimensions, and shape are much less variable. The altitudes at which this species has been collected to date in Ecuador are from ca. 2000 m to 3000 m. The stamens are included as is the stigma but often the anthers reach the apices of the petal blades. Vegetative propagation in its natural habitat is common. The above 32 specimens bare witness to the abundance of T. incarnata in portions of the northern and central Ecuadorian Andes.

54. TILLANDSIA CONFINIS L. B. Smith, 1953 (Phytologia vol. 4, no. 4) p. 218, pl. 2, figs. 5-7.

PLANT 30-45 cm tall by ca. 20 cm in diameter from an erect rosette; LEAVES 20-35 cm long, blade narrowly triangular, densely appressed lepidote below, soon glabrous above, apex attenuate, sheath 12-14 cm long by 4.5-5.5 cm wide, concolorous with blade below, dark purple above; SCAPE ca. 3-4 mm in diameter, erect; SCAPE-BRACTS 8.0-15.0 cm long by ca. 2.3 cm wide, imbricate throughout, apex attenuate, erect, sheath somewhat purple; INFLORESCENCE 10-25 cm long by ca. 12 cm in diameter, bipinnate, lax, ellipsoid, glabrous, red-yellow, with ca. 5 to 8 spikes; PRIMARY BRACTS 3.0-5.5 cm long, apex caudate, erect, much shorter than axillary spikes; SPIKES 4.5-11.0 cm long by ca. 1.8 cm wide at anthesis, erect to spreading, ca. 0.5-1.0 cm apart, having 3-11 flowers per spike, stipe 0.5-2.6 cm long, with 2 to 3 sterile bracts; FLORAL BRACTS 2.4-2.5 cm long by ca. 1.4 cm wide, carinate, apex sharply acute, ovate, erect, imbricate, not nerved, lustrous, glabrous without, lepidote within; SEPALS 2.1-2.2 cm long by 4-5 mm wide, linear-ovate, connate posteriorly for ca. 1.5 cm, apex acute, carinate, papery, strongly lepidote within, slightly nerved; PETALS imperfectly known, stamens included by ca. 2-3 mm; CAPSULE ca. 3.0 cm long, distance between flowers 3-5 mm.

MATERIAL EXAMINED: Ferreyra 1686 (USM, TYPE; US, photo

and fragments) Peru, Prov. Loreto, ca. 1500-1600 m; Grubb
et al. 94 (US) epiphytic ca. 6 m from ground, 15 km south-
southwest of Tena, Talab, Prov. Napo-Pastaza, ca. 600 m,
7 Sept. 1960; Espinosa 1039 (GH) Hacienda Horta-Naque
Prov. Loja, 3000-3400 m, 11 Oct. 1946.

PERU.

55. TILLANDSIA CONFERTIFLORA André, 1888 (Énumération Bromél) p. 7; André, 1889, pp. 90-91, pl. 26 a.

PLANT 40-60 cm tall, erect rosette; LEAVES 35-45 cm long, blades 2.5-3.0 cm wide, narrowly triangular, densely lepidote both surfaces, apex filiform, sheath ca. 16 cm long by 7.0 cm wide, elliptic, dark brown; SCAPE ca. 9 mm in diameter, erect, much shorter than leaf-rosette; SCAPE-BRACTS 10-17 cm long by ca. 2.8 cm wide, imbricate throughout, apex caudate; INFLORESCENCE 9.0-20.0 cm long by 6.5-8.0 cm in diameter, erect, red, having 6 to 12 spikes, glabrous, dense, bipinnate; PRIMARY BRACTS 4.0-11.0 cm long by ca. 2.2 cm wide, erect, red, ovate, apex caudate, exceeding lower spikes; SPIKES 3.0-5.5 cm long by 1.5-2.5 cm wide at anthesis, erect, red, ca. 1.0 cm apart, imbricate, mostly obscuring rhachis, having 6 to 8 flowers per spike, stipe minimal with up to 3 sterile bracts; FLORAL BRACTS 1.8-2.4 cm long by 1.7 cm wide, erect, imbricate, red-purple, ovate, glabrous without, lepidote within, lustrous, apex acute, carinate, not nerved, coriaceous; SEPALS 2.0-2.2 cm long by 5-6 mm wide, connate posteriorly for 1.5 cm, acute, papery, carinate; PETALS ca. 2.8 cm long by 3-4 mm wide at blade, violet, stamens included by 2-3 mm, distance between flowers 3-4 mm.

MATERIAL EXAMINED: André 4475 (K, TYPE; US, photo) Andes of Central Ecuador, possibly Prov. Chimborazo, 2500-3000 m; Rauh P 308 (US) Peru, Dept. Piura, 1200 m, Aug.

1956; Acosta Solis 7895 (F) El Almendral, near Catacocha,
Prov. Loja, 1800-2200 m, 16 April 1944.

PERU.

TILLANDSIA subgenus TILLANDSIA

Tillandsia subgenus Tillandsia L. B. Smith, 1957 (Contrib. U.S. Nat. Herb. vol. 33) p. 159.

Platystachys Beer, 1857 (Bromeliaceen) p. 18, p. 80.

Tillandsia subgenus Platystachys Baker, 1887 (Handbook Bromel.) pp. 212 and 236.

Leaf-blades narrowly triangular to subulate, rarely lingulate. Leaf-sheaths usually dark-brown or red-brown, NOT purple. Petals mostly erect with inconspicuous blades. Style elongate and two times or more the ovary length. Stamens usually exceeding the petals; however in T. secunda, the same plant may have some flowers at anthesis with the stamens exserted and other flowers also at anthesis with stamens included.



A



B

KEY TO THE ECUADORIAN SPECIES OF TILLANDSIA

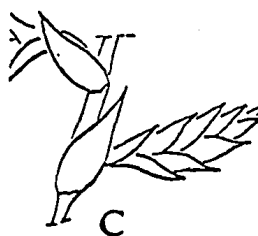
Subgenus Tillandsia

1. Leaf-blade less than 1.5 cm broad and filiform to very narrowly triangular, inflorescence simple or bipinnate with spikes erect (A)*, to spreading, plant not exceeding 45 cm in height.
2. Leaf-sheaths forming a pseudobulb at plant base (B).

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.



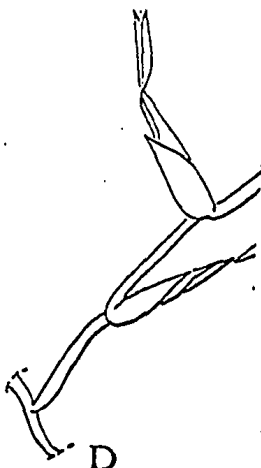
BB



C



CC

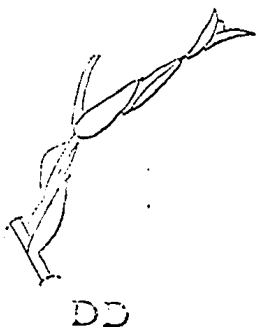


D

3. Floral bracts 1.2-1.5 cm long, leaves 2.0-40.0 cm long. : 1. T. bulbosa.
3. Floral bracts 2.0-2.6 cm long, leaves 6.0-12.0 cm long. : 2. T. pruinosa.
2. Leaf-sheaths NOT forming a pseudobulb at plant base (BB).
4. Inflorescence dense, bipinnate (C), spikes less than 5.0 cm long, floral bracts NOT more than 5 mm distant.
5. Floral bracts 1.0-1.2 cm long, leaf-sheaths pale or if darker than blade, then not ferrugineous. : 3. T. floribunda.
5. Floral bracts at least 2.0 cm long, leaf-sheaths ferrugineous. : 4. T. juncea.
4. Inflorescence lax, digitate to subdigitate (CC), spikes 4.0-8.0 cm long, floral bracts 0.7-1.0 cm distant.
6. Spikes with stipe minimal to 1.5 cm long, sterile bracts absent (D). : (8. T. straminea).*

* The description for T. straminea is found under the subgenus, Phytarrhiza, species number 8. It is keyed out here as well for the user's convenience.

6. Spikes with stipe conspicuous, 3.0-5.0 cm long with several sterile bracts (DD).



7. Leaf-sheaths pale, floral bracts glabrous : 5. T. flagellata.

7. Leaf-sheaths dark, floral bracts lepidote.

8. Capsules ca. 4.5 cm long, floral bracts ca. 3.5 cm long.

: (4. Vriesea pereziana var. pereziana).*

8. Capsules to 3.5 cm long, floral bracts ca. 2.5 cm long.

: (5. Vriesea pereziana var. canescens).*



1. Leaf-blades more than 1.5 cm broad or if less, then inflorescence bipinnate with spikes or branches spreading, NOT erect, plant from 25 cm to 3 m tall.

9. Flowers tending to be in a single row (secund) in whole or in part (E), plant 1-3 m tall, leaf-blades lingulate or at least 3.0 cm broad if triangular.



10. Branches of inflorescence 40-90 cm long, distance between flowers 1.5-2.0 cm, stamens consistently and obviously exserted (F). . . : 6. T. mima.

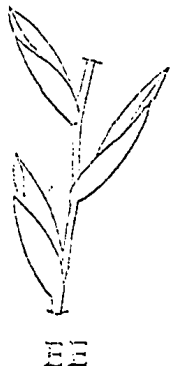
*

See key to Ecuadorian Vriesea, taxa numbers 4 and 5.



10. Branches of inflorescence 10-35 cm long, distance between flowers to 1.5 cm, stamens now exerted, now included (FF).

11. Leaf-blades ca. 9.0-10.0 cm wide, branch stipe 3.0-4.0 cm long with up to one sterile bract, sepals obovate. : 7. T. cucullata.



11. Leaf-blades ca. 4.0-6.0 cm wide, branch stipe to 13 cm long with 2-3 sterile bracts or more, sepals elliptic. : 8. T. secunda.

9. Flowers in two distinct rows (NOT secund) (EE), plant not more than 1 m tall, leaves narrowly triangular, blades usually less than 3.0 cm broad, if slightly more, then blade-apex long-attenuate to caudate.

12. Inflorescence with spikes spreading, laxly disposed, main rhachis exposed, plant to 40 cm tall, floral bracts to 2.2 cm long, leaf-sheaths olive or light brown, petals violet, to 3.5 cm long. : 9. T. valenzuelana.

12. Inflorescence with spikes erect, obscuring rhachis, plant to 1 m tall, floral bracts at least 2.5 cm long, leaf-sheaths dark red-brown, petals green,

- to 7.0 cm long.
13. Floral bracts to 3.5 cm long, nerved, inflorescence glabrous, often bright orange.
14. Sepals 1.8-2.0 cm long, leaf-blades 4.5-7.0 cm wide, petals 3.5-4.0 cm long. : (Vriesea tequendamae).*
14. Sepals 2.5-3.0 cm long, leaf-blades ca. 4.5 cm wide, petals 4.5-6.0 cm long. : 10 T. cygnea.
13. Floral bracts 4.0 cm long or more, inflorescence glabrous or lepidote, NOT bright orange.
15. Spike width 1.2-1.5 cm at anthesis, floral bracts densely lepidote. : 11. T. cernua.
15. Spike width 3.0-3.5 cm at anthesis, floral bracts only lepidote toward bract-apex or completely glabrous. : 12. T. spathacea.

*

See key to Ecuadorian Vriesea, species number 9.

1. TILLANDSIA BULBOSA Hooker, 1826 (Exotic. Flora) pl. 173; Smith, 1951, pp. 463-464, fig. 51; Smith, 1957, pp. 172-173.

PLANT usually 12-15 cm tall, growing in clumps of many individuals, leaf-sheaths forming a pseudobulb; LEAVES 2.0-40.0 cm long, blades 2-7 mm wide, subulate, dense-spreading-lepidote, outermost leaves of rosette shorter than those within rosette, spreading, sheath 1.5-5.0 cm long; SCAPE ca. 13 cm long including inflorescence, ca. 1 mm in diameter, erect; SCAPE-BRACTS ca. 3.0-8.0 cm, imbricate and foliaceous throughout; INFLORESCENCE 4.0-7.0 cm long by ca. 4.0 cm wide, simple or bipinnate with few spikes, red, lepidote; SPIKES 3.0-6.0 cm long by 1.1-1.2 cm wide, spreading, elliptic; FLORAL BRACTS 1.2-1.5 cm long by ca. 6 mm wide, imbricate, densely lepidote without, moderately lepidote within, ecarinate, very slightly nerved, apex acute, subcoriaceous, ovate; SEPALs 1.0-1.3 cm long by ca. 3 mm wide, erect, obovate, lepidote without and within, scarcely nerved, broadly acute to obtuse; PETALS ca. 3.5 cm long by 3 mm wide, erect, blades violet; CAPSULES to 4.0 cm long, exserted stigma greatly exceeding stamens, both exserted, distance between flowers 3-4 mm.

MATERIAL EXAMINED: AJG 599 (US) just west of San Lorenzo airstrip, Prov. Esmeraldas, 1° 16' N, less than 50 m, 9 Feb. 1962.

BRASIL, COLOMBIA, MEXICO, WEST INDIES.

2. PHILANDSIA PRUINOSA Swartz, 1797 (Flora Ind. Occid. vol. 1) pp. 594; Smith, 1951, pp. 458-460; Smith, 1957, p. 172.

PLANT 8-15 cm tall with inflorescence, base of leaf-rosette in form of pseudobulb up to 4.0 cm long; LEAVES 6.0-12.0 cm long, blades 2-5 mm wide, densely cinereous- or ferruginous-lepidote with spreading coarse scales, leaf-blades subulate, apices filiform to acuminate, contorted, recurved, sheaths 2.0-4.0 cm long, orbicular, conspicuous, dark brown; SCAPE up to 8.0-9.0 cm long with inflorescence, 1-2 mm in diameter; SCAPE-BRACTS foliaceous and imbricate throughout; INFLORESCENCE 2.5-6.5 cm long by 2.2 cm in diameter, usually simple, may be bipinnate with up to 3 spikes, each spike having up to 15 flowers; FLORAL BRACTS ca. 2.0-2.6 cm long by 1.5 cm wide, ovate, slightly nerved, imbricate, densely lepidote without and within, apex acute, carinate toward apex, pink at anthesis; SEPALS 1.3-1.9 cm long by 6 mm wide, erect, obovate, glabrous without, moderately lepidote within, carinate, broadly acute, united posteriorly for 3-6 mm; PETALS ca. 3.0 cm long, violet; CAPSULES 2.0-5.5 cm long, distance between flowers 3-4 mm.

MATERIAL EXAMINED: Hitchcock 21259 (US) Portovelo, Gold Mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. - 1 Sept. 1923.

BRASIL, COLOMBIA, CUBA, southern FLORIDA, MEXICO.

3. TILLANDSIA FLORIBUNDA H. B. K., 1815 (Nova Genera et Species, vol. 1) p. 292; Smith, 1936, pp. 549-550.

PLANT ca. 20 cm tall, occasionally to 40 cm, by ca. 25 cm wide, with well-developed rosette, epiphytic, growing in clumps of many individuals; LEAVES ca. 20 cm long, blades 4-5 mm wide, gray-green, numerous, very narrowly triangular, apex long-attenuate, erect to spreading; SCAPE ca. 21 cm long with inflorescence by 2-3 mm in diameter, erect, equaling or slightly exceeding leaves; SCAPE-BRACTS ca. 6.0-11.0 cm long by 7-9 mm wide, erect, blades filiform; INFLORESCENCE ca. 3.5 cm long by 1.0-2.0 cm in diameter, erect, bipinnate, flabellate, dense, pink, glabrous; PRIMARY BRACTS 1.4-1.5 cm long by 8-9 mm wide, erect, shorter than spikes, pink; SPIKES 2.0-2.5 cm long, elliptic, erect, 2-4 per inflorescence; FLORAL BRACTS 1.0-1.2 cm long by 6-7 mm wide, ovate, erect, imbricate, apex acute, slightly carinate, strongly nerved; SEPALs 0.9-1.0 cm long by 4 mm wide, erect, carinate, posteriorly united for ca. 3 mm, acute, not nerved, glabrous; PETALS ca. 2.0 cm long, violet; STAMENS barely included to exerted; CAPSULES ca. 2.7 cm long, distance between flowers 2-3 mm, in flower around August.

MATERIAL EXAMINED: Hitchcock 21360 (US) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, June 1966; Penland and Summers 1206 (GH) near Chinche, between San Pedro and Zaruma, Prov. Loja, 2000 m, 1 Aug.

1939; Rose and Rose 22424 (US) near Huigra, on Hacienda de Licay, Prov. Chimborazo, 1500-2000 m, 28 Aug. 1918; Asplund 7754 (US) between Huigra and Naranjapata, stony slope, Prov. Chimborazo, ca. 900 m, 30 July 1939; Camp E-3115 (US) Cañon of Río Chanchan near Huigra, scrubby area, Prov. Chimborazo, 1400-1600 m, 1945; Camp E-3860 (US) Cañon of Río Chanchan, between Naranjapata to below Huigra, Prov. Chimborazo, 700-1400 m, 19 June 1945.

PERU.

4. HELIANDSIA JUNCEA (Ruiz and Pavon) Poir., 1817 (Lam. Encycl. Supple. vol. 5, p. 309; Smith, 1957, pp. 164-166, fig. 47.

PLANT 20-40 cm tall, usually with scaly rhizomes, growing in clumps; LEAVES 15-34 cm long, blades 2-3 mm wide, filiform, densely lepidote, sheaths ca. 2.0 cm long by 1.5 cm wide, reddish-brown, conspicuous; SCAPE 17-36 cm long with inflorescence, 3-4 mm in diameter, erect; SCAPE-BRACTS ca. 4.0-12.0 cm long by 1.0 cm wide, densely imbricate throughout, foliaceous, erect; INFLORESCENCE 3.5-7.5 cm long by 3.0-10.0 cm wide, bipinnate, dense, usually with erect spikes, occasionally simple with single polystichously flowered spike; SPIKES to 4.0 cm long; FLORAL BRACTS ca. 2.5 cm long by 1.5 cm wide, broadly ovate, imbricate, carinate, in distichously flowered spikes, densely lepidote without, glabrous within; SEPALs 1.5-2.0 cm long, posteriorly connate for ca. $\frac{2}{3}$ sepal length, glabrous or sparsely lepidote without; PETALS to ca. 4.0 cm long, violet; CAPSULES 2.5-3.5 cm long, distance between flowers 5-8 mm.

MATERIAL EXAMINED: Rauh, Hirsch E 377 (US) Arenillas, Prov. El Oro, ca. 200 m, 26 Sept. 1957.

BOLIVIA, CENTRAL AMERICA, COLOMBIA, CUBA, FLORIDA, MEXICO, PERU.

5. TINLANDSIA FLAGELLATA L. B. Smith, 1958 (Phytologia
vol. 6, no. 5) pp. 258-259, pl. 1, figs. 9, 10.

PLANT 30-35 cm tall; LEAVES 30-35 cm long by 1.2-1.5 cm wide, blade triangular, apex filiform-attenuate, involute, densely lepidote; SCAPE ca. 28 cm long with inflorescence, ca. 3 mm in diameter, erect or suberect; SCAPE-BRACTS 2.0-25.0 cm long by 2.0 cm wide with contorted linear blades, imbricate; INFLORESCENCE ca. 14-15 cm long by 6.0-7.0 cm in diameter, erect, bipinnate, subdigitate, with ca. 7 spikes, glabrous; PRIMARY BRACTS ca. 2.2 cm long, apex acute, erect; SPIKES 4.0-7.0 cm long by ca. 1.3 cm wide, divergent to spreading from a long slender, erect stipe; FLORAL BRACTS 2.2-2.4 cm long by 8-9 mm wide, ovate, erect, imbricate, ecarinate, papery, apex acute, glabrous without and within; SEPALS 1.6-1.8 cm long by ca. 5 mm wide, erect, oblong-elliptic, apex obtuse, not nerved, free, glabrous without and within; CAPSULE 3.2-3.5 cm long, distance between flowers 6-8 mm.

MATERIAL EXAMINED: Hitchcock 21245 (US, TYPE) Gold mine near Zaruma, Portovelo, Prov. El Oro, 600-1000 m, 30 Aug. - 1 Sept. 1923.

6. TILLANDSIA MIMA L. B. Smith, 1945 (Caldasia vol. 3) p. 244, fig.; Smith, 1957, pp. 160-161, fig. 45.

PLANT ca. 3 m tall; LEAVES ca. 70 cm long, blades 5.0-6.0 cm wide, lingulate to triangular, apex attenuate, densely, minutely lepidote; SCAPE ca. 3 m tall with inflorescence, 1.5-2.0 cm in diameter; SCAPE-BRACTS erect, foliaceous, imbricate; INFLORESCENCE probably about 2 m long by 80 cm in diameter, erect, tripinnate, lax, glabrous; PRIMARY BRACTS shorter than sterile bases of branches; BRANCHES 40-90 cm long, spreading at nearly right angles with main axis; tertiary branches 12-20 cm long with 6-10 flowers except for terminal branch with ca. 36 flowers, often tending to be in single row, flowers with pedicels 4-5 mm long, distance between primary branches at least 6.0 cm; stipe of tertiary branches to 18 cm long with 2-3 sterile bracts; FLORAL BRACTS 2.0-2.5 cm long by 1.0-1.5 cm wide, erect to spreading, ovate, ecarinate, apex acute, strongly nerved, green and purple, barely imbricate; SEPALS 2.0-2.4 cm long by ca. 1.0 cm wide, elliptic, broadly acute, strongly nerved, glabrous, free; PETALS to 3.5 cm long, blue-violet, stamens and stigma much exserted; CAPSULE 4.5-5.0 cm long by 1.0-1.5 cm in diameter, distance between flowers 1.5-2.0 cm.

MATERIAL EXAMINED: Hitchcock 21218 (US) Portovelo, gold mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. - 1 Sept. 1923.

COLOMBIA.

7. TILLANDSIA CUCULLATA L. B. Smith, 1958 (Phytologia vol. 6, no. 4) pp. 193-194, pl. 1, figs. 3, 4.

PLANT ca. 3 m tall by estimated 1 m in diameter; LEAVES ca. 65 cm long, blades 9.0-10.0 cm wide, pale green, lingulate, apex acute to apiculate, subglabrous; sheath, ca. 20 cm long by 13 cm wide, conspicuous, dark brown, ovate; INFLORESCENCE ca. 2 m long by 16 cm in diameter, erect, glabrous, bipinnate, lax; PRIMARY BRACTS 5.0-5.5 cm long by 3.0-3.5 cm wide, spreading, ovate, apex acute to attenuate, subglabrous; BRANCHES 14-16 cm long by 3.5-4.0 cm wide, spreading, secund-flowered, flowers 10 to 12 per branch, with pedicels ca. 7 mm long, ca. 3.5 cm apart, stipe 3.0-4.0 cm long with one sterile bract, this just subtending the first fertile floral bract and at some distance from the axis; FLORAL BRACTS 2.5-3.4 cm long by 2.3 cm wide, erect, yellow, elliptic, ecarinate, glabrous without, lepidote within, apex acute, coriaceous, ovary obscurely nerved, erect but scarcely imbricate; SEPALs 2.2-2.3 cm long by ca. 1.4 cm wide, erect, obovate, obtuse, ecarinate, strongly nerved, coriaceous, glabrous without, densely punctulate within, free, green; PETALS ca. 2.6 cm long by 6 mm wide, scarcely lobed, purple; OVARY 1.2 cm long by 6-7 mm wide, stamens often included by 2-3 mm; distance between flowers ca. 1.2 cm, in flower around June-August.

MATERIAL EXAMINED: Camp E-4592 (US, TYPE) epiphytic,

"leaves in massive rosette, notably pale green, not mottled,"
1-3 km north of Sevilla de Oro, Prov. Azuay, 2800-3100 m,
27 July - 12 Aug. 1945.

NOTES: This species has apparently been collected only one time and may be restricted in its distribution to the area around Sevilla de Oro. Certainly for such a conspicuous plant to have been missed from other sites where collectors have worked seems unlikely.

8. TELLANDSIA SECUNDA H. B. K., 1816 (Nova Species et Genera vol. 1) p. 294.

FIG. 64

PLANT ca. 120 cm tall by ca. 75 cm in diameter; LEAVES ca. 50 cm long, blades 4.0-6.0 cm wide, triangular, sheath ca. 15 cm long; SCAPE ca. 110 cm long with inflorescence; SCAPE-BRACTS 12-30 cm long, imbricate, erect to spreading; INFLORESCENCE ca. 50 cm long with ca. 20 spikes, bipinnate, main rhachis dark red; PRIMARY BRACTS 3.0-8.0 cm long, apex acute; SPIKES 12-35 cm long by 1.5-2.0 cm wide at anthesis exclusive of petals, spreading out at nearly right angles with main axis, stipe 7-13 cm long with usually 3 or more sterile bracts; FLORAL BRACTS 2.7-3.0 cm long by ca. 1.9 cm wide, erect to spreading turning secund at anthesis, ecarinate, nerved, apex acute and twisted out exposing calyx, not imbricate; SEPALS ca. 2.7 cm long, nerved, ecarinate, equally short connate; PETALS ca. 4.5 cm long, with stamens exserted or not; CAPSULES ca. 3.5 cm long, distance between flowers ca. 1.0 cm, in flower around September.

MATERIAL EXAMINED: Humboldt 3094 (B, TYPE; US, photo) Guayllabamba, Prov. Pichincha, ca. 2100 m; André 2448 in part (GH) Río Pisque, Prov. Pichincha, June 1876; Asplund 2154 (US) valley of Río Pillaro between Ambato and Pillaro, on cliffs, Prov. Tungurahua, Aug. 1939; Fagerlin̄ and Wibom 1043 (US) just west of Ambato, valley of Río Ambato, Prov.

Tungurahua, 2 Nov. 1952; Rauh, Hirsch E244 (US) Río Apagio, Prov. (?), 3400 m, 7 Sept. 1954; Acosta Solis 14872 (F) Prov. Imbabura; Acosta Solis 14874 (F) Pámán, Prov. Imbabura, ca. 2000-1700 m; AJG 1083 (US) km 32 Quito-Otavalo, Prov. Pichincha, 7 Aug. 1965; AJG 1082 km 32 Quito-Otavalo, Prov. Pichincha, 7 Aug. 1965; AJG 1091 (US) barranco, terrestrial, moderately common, association with grasses, composites and Ericaceae, km 38 Ambato-Baños, Prov. Tungurahua, 2300 m, 7 Aug. 1965; AJG 1092 (US) moderately common, km 38 Ambato-Baños, terrestrial, Prov. Tungurahua, 2300 m, 7 Aug. 1965; AJG 1157 (US) moderately common, terrestrial, dry grassy slopes, km 110 Loja-Cuenca, Prov. Azuay, 2100 m, 12 Aug. 1965; Acosta Solis 6233 (F) Forest of El Olivo, Prov. Bolívar, ca. 2800 m, 7 Oct. 1943; Acosta Solis 6848 (F) Pucará de Telimbela, Prov. Bolívar, 2600-3000 m, 18 Nov. 1943.

NOTES: The degree of secund disposition of flowers is quite variable. In some specimens nearly all the flowers are secund, in others very few spikes have secund flowers. Some have secund disposition in bud, others do not. Specimen AJG 1157 has dimorphic flowers. Some flowers have the stamens exserted with the stigma not at all exserted, while upon the same specimen are flowers with the stigma exserted and the stamens included within the corolla.

9. TELEANPSIA VALENZUELANA A. Rich., 1850 (Sagra, Hist. Cuba, vol. 11) p. 267; Smith, 1957, pp. 168-169.

FIG. 65

PLANT ca. 25-40 cm tall, epiphytic; LEAVES 30-40 cm long, blades 1.0-2.5 cm wide, outermost much shorter, very narrowly triangular, filiform apices, densely appressed-lepidote, sheath 3.0-5.5 cm long by 3.0-4.0 cm wide, ovate, light brown; SCAPE 23-38 cm long with inflorescence, 5-7 mm in diameter, curved; SCAPE-BRACTS 10-11 cm long, erect to spreading, imbricate, pink or red when living, fading to olivaceous; INFLORESCENCE ca. 17-21 cm long by 10 cm in diameter, bipinnate, lax, with 9-14 spikes, lepidote; PRIMARY BRACTS 2.0-5.0 cm long by ca. 1.2 cm wide, with long filiform blade, spreading, sheaths much shorter than spikes, blades in part exceeding spikes; SPIKES 5.5-20.0 cm long by 1.1-1.3 cm wide, exclusive of petals or capsules, spreading, having 6 to 17 flowers, stipe erect, 2.5-5.0 cm long; FLORAL BRACTS ca. 2.0 cm long by 8 mm wide, coriaceous, nerved, subglabrous, pink or red, apex acute, erect to suberect, imbricate but exposing spike-rhachis; SEPALs 1.4-1.7 cm long by 4 mm wide, apex acute, green, pink tipped, glabrous, subfree; PETALS ca. 3.0 cm long, violet; OVARY ca. 8 mm long by 2 mm in diameter.

MATERIAL EXAMINED: AJG 840 (US) epiphytic, ca. 3 m from ground, in stream bottom association, road to Machala from Loja, ca. km 8, Prov. Loja, 2150 m, 24 Feb. 1963;

REG 857 (US) epiphytic, 20-40 km east of Colonche, Prov. Guayas, ca. 200 m, 18 Aug. 1963; AJG 858 (US) epiphytic, Cerro Montecristi, Prov. Manabí, ca. 400 m, 8 Sept. 1963; REG 802 (US) Cerro Montecristi, epiphytic, moderately common, Prov. Manabí, 350 m, 10 Aug. 1962.

BOLIVIA, CENTRAL AMERICA, COLOMBIA, FLORIDA, MEXICO,
VENEZUELA.

10. PHILLANDSIA CYGNEA Mez and Sodiro, 1904 (Bull. Herb. Boiss, series 2, vol. 4) p. 1128; Mez, 1935, p. 463.

FIG. 66

PLANT ca. 65 cm tall; LEAVES 35-50 cm long, blades 4.5 cm wide, triangular, densely lepidote, sheath, ca. 14 cm long by 9.0 cm wide; SCAPE decurved, much shorter than leaves; SCAPE-BRACTS imbricate throughout; INFLORESCENCE 25-30 cm long by 3.5-5.5 cm in diameter, bipinnate, dense, curving to erect, narrowly cylindrical; PRIMARY BRACTS to 5.5 cm long, mostly as long as or longer than spikes; SPIKES 5.0-8.0 cm long by 2.0-2.5 cm wide at anthesis, having 6 to 9 flowers per spike, erect, stipe minimal with 1 to 2 sterile bracts; FLORAL BRACTS 2.5-3.5 cm long by ca. 1.6 cm wide, carinate, ovate-elliptic, erect, imbricate, scarcely nerved, glabrous without and within, apex red; SEPALS ca. 2.5-3.0 cm long, elliptic, broadly acute, not nerved, free; PETALS 4.5-6.0 cm long, green, erect, stamens much exerted.

MATERIAL EXAMINED: Sodiro 19b (B, TYPE; US, photo) valley Nanegal, Prov. Pichincha; ASC 1165 (US) terrestrial, cloud forest, km 85 Cuenca-Guayaquil, common, Prov. Cañar, ca. 2800 m, 13 Aug. 1965.

NOTES: Contrary to Mez's (1935) description, the sepals are 2.5-3.0 cm long, not 2.3 cm long.

11. BEHLANDIA CERNUA L. B. Smith, 1956 (Phytologia vol. 5, no. 9) p. 401, pl. 1, figs. 1-3.

FIG. 67

PLANT 60-80 cm tall by 40-50 cm in diameter, epiphytic or terrestrial, growing in clumps; LEAVES 30-45 cm long, blades 2.5-3.5 cm wide, narrowly triangular, gray-green, densely moderately appressed lepidote, sheath 10-14 cm long by 4.5-6.0 cm wide, conspicuous, reddish brown when dry; 53-78 cm long with inflorescence, ca. 6 mm in diameter, erect, exceeded by leaf-rosette; SCAPE-BRACTS 7.0-22.0 cm long, erect, imbricate throughout, apex caudate; INFLORESCENCE 20-25 cm long by 4.0-6.0 cm in diameter, erect, pink to red, ellipsoid, densely lepidote, bipinnate, dense, having 11 to 14 spikes; PRIMARY BRACTS 5.0-13.0 cm long by ca. 2.8 cm wide, erect, pink, elliptic, apex acute to caudate; SPIKES 8.0-10.0 cm long by 1.2-1.5 cm wide at anthesis exclusive of petals, having 6 to 10 flowers per spike, erect, stipe 0.7-1.5 cm long with 1 or 2 sterile bracts; FLORAL BRACTS 3.8-4.0 cm long by 1.0-1.2 cm wide, erect, pink, elliptic, imbricate, apex acute, papery, uncarinate, strongly nerved, densely lepidote without, very slightly lepidote within but not toward margins; SEPALs 2.5-2.9 cm long by 7-8 mm wide, all free, erect, elliptic-ovate, slightly loosely white-lepidote without, glabrous within, linear-acute, strongly nerved, posteriorly carinate, papery; PETALS ca. 6.5 cm

long, stamens often included by ca. 1-2 mm; OVARY 8-9 mm long by 3-5 mm in diameter, distance between flowers 0.8-1.0 cm, in flower around September-December.

MATERIAL EXAMINED: Foster 2621 (US, TYPE) páramo, Prov. Azuay, ca. 4000 m, 3 Dec. 1948; AJG 1095 (US) in bud, Barranco, common, tank nearly filled with water, Km 46, Ambato-Baños, Prov. Tungurahua, 2000 m, 7 Aug. 1965.

12. TELIANDSIA SPATHACEA Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 1129; Mez, 1935, p. 483.

PLANT ca. 1 m tall; LEAVES 40-50 cm long, blades 4.0-5.0 cm wide, narrowly triangular, densely gray-lepidote, slightly involute, sheath ca. 16-17 cm long by 10 cm wide, dark reddish brown, broadly ovate, conspicuous; SCAPE ca. 1.0 cm in diameter, decurved; SCAPE-BRACTS 7.0-20.0 cm long by ca. 3.0 cm wide, erect, imbricate and foliaceous throughout; INFLORESCENCE 25-40 cm long by 5.5-7.5 cm in diameter, bipinnate, dense, cylindric; PRIMARY BRACTS 10-15 cm long by 4.0-4.5 cm wide, erect, imbricate, apex acute; SPIKES 10-12 cm long by 3.0-3.5 cm wide, erect, ca. 9 per inflorescence, having 6 to 7 flowers per spike; FLORAL BRACTS 5.0-5.5 cm long, apex acute, erect, subimbricate, slightly nerved, carinate, coriaceous, lepidote toward apex of bract; SEPALS ca. 5.0 cm long, acute, equally subfree; PETALS exceeding sepals by ca. 3.0 cm, distance between flowers 0.9-1.5 cm.

MATERIAL EXAMINED: Sodiro 19c (B, TYPE; US, photo) near crater Pululahua, north of Quito, Prov. Pichincha, 1895(?).

VRIESEA

VRIESEA Lindley, 1843 (Bot. Reg. vol. 29) p. 10, as "Vriesia."

Thecophyllum emend. sensu Mez, 1903 (Bull. Herb. Boiss. series 2, no. 3) p. 131, non André, 1889.

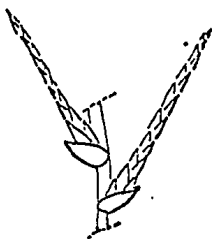
Leaves lingulate or narrowly triangular, inflorescence simple, bipinnate or digitate, floral bracts conspicuous, enfolding or concealing flower bases, petals free, white, green or violet when alive, with two basal nectar scales on inner surface of petals; style elongate, stigma and stamens slightly included to exserted.

KEY TO THE ECUADORIAN SPECIES OF VRIESEA



A

1. Leaf-blades triangular, densely, obviously lepidote, apices attenuate to filiform (A)*.



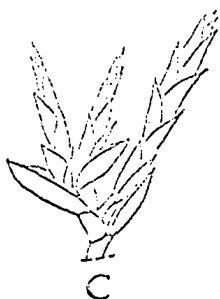
B

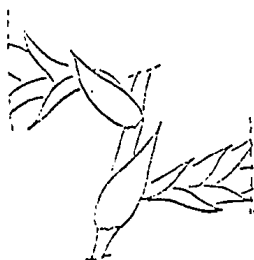
2. Inflorescence lax, bipinnate or digitate, occasionally simple, spikes or branches elongate (B), spikes NOT exceeding 2.8 cm in width at anthesis, or inflorescence simple and ca. 8 mm wide with few flowers.

3. Inflorescence simple, spikes ca. 8 mm wide, plant with well-developed stolons, growing in large connected masses. . . .
 : 1. V. espinosae.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

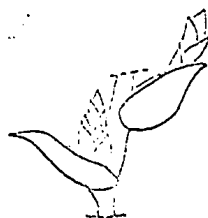
3. Inflorescence compound or if simple, spikes ca. 2.0 cm wide, plant stolonless.
4. Leaves 40-70 cm long, plant to 1 m tall, scape exceeding leaf-rosette, inflorescence erect to ascending. : 2. V. hitchcockiana.
4. Leaves 15-60 cm long, plant to 60 cm tall, scape much shorter than or equaling leaf-rosette, inflorescence nodding to recurved.
5. Floral bracts 3.5-4.5 cm long, inflorescence of 3 to 6 digitate spikes (C).
6. Scape-bracts NOT with filiform apices, scape obscured by leaf-rosette, sepals narrowly rounded, capsule to 3.0 cm long : 3. V. patula.
6. Scape-bracts with filiform apices, scape NOT obscured by leaf-rosette, sepals acute.
7. Capsules to 3.5 cm long, floral bracts to 3.5 cm long, leaves and floral bracts only slightly lepidote. : 4. V. pereziana var. pereziana.
7. Capsules 4.0-5.0 cm long, floral bracts ca. 2.5 cm long, leaves and floral bracts densely lepidote. : 5. V. pereziana var. canescens.





CC

5. Floral bracts 1.2-1.7 cm long, inflorescence bipinnate (CC), with ca. 15 spikes or more. : 6. V. heteranda.
2. Inflorescence dense, often fascicular (BB), or simple, flowers and spikes erect.



BB

8. Inflorescence simple.
9. Inflorescence 15-30 cm long and 4.0-5.0 cm wide, having ca. 25 flowers. : 7. V. barclayana var. barclayana.

9. Inflorescence 6.0-12.0 cm long and 3.0-3.5 cm wide, having up to 17 flowers. : 8. V. barclayana var. minor.



D

8. Inflorescence compound.
10. Primary bracts orbicular (D), apices rounded, or apiculate, at least the lower spikes obscured at anthesis. : 9. V. tecuendamae.

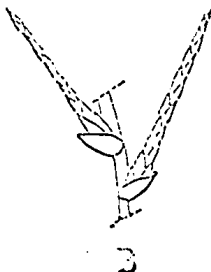


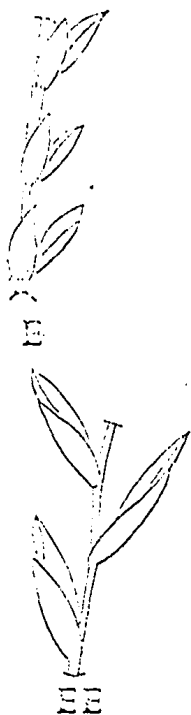
DD

10. Primary bracts ovate to triangular (DD), apices acute-attenuate, spikes exposed in part throughout inflorescence.
11. Leaves 40-70 cm long, inflorescence erect at anthesis, usually 20 cm long or more. : 10. V. cylindrica.
11. Leaves to 35 cm long or if longer, then petals with crenulate margins,

inflorescence curving at anthesis, 8-16 cm long or tripinnate and to 45 cm long.

12. Inflorescence to 2.5 cm in diameter, plant ca. 25 cm tall, leaves about equaling inflorescence. . . . : 11. V. fragans.
12. Inflorescence 3.0-9.0 cm in diameter, plant 30-90 cm tall, leaves exceeded by inflorescence.
13. Floral bracts to 1.2 cm long, inflorescence tripinnate, branches with spikes in fan-like fascicles. : 12. V. appendiculata.
13. Floral bracts 3.0-6.0 cm long, spikes all erect and adpressed to rhachis.
14. Floral bracts 4.0-4.5 cm long, sepals to 3.0 cm long. . . : 13. V. arpocalyx.
14. Floral bracts 6.0 cm long, sepals 4.5-5.0 cm long. : 14. V. drewii.
1. Leaf-blades lingulate, leaves NOT obviously densely lepidote, apices acute to apiculate (AA), petals white when fresh.
15. Inflorescence lax, spikes or branches elongate (B).
16. Plant with massive inflorescence, to 40 cm in diameter at anthesis, floral bracts 3.5-4.5 cm long, often turning





- secund and downward with flowers (E). . .
 : 15. V. sanguinolenta.
16. Plant with inflorescence not exceeding 12
 cm in diameter, spikes 1.2-2.0 cm wide at
 anthesis, floral bracts 2.5-2.7 cm wide
 at anthesis, remaining distichous (EE). .
 : 16. V. rubra.
15. Inflorescence dense, spikes in fascicles
 or inflorescence simple and dense.
17. Inflorescence bipinnate, spikes fascicu-
 lar, having 4 or more flowers per fas-
 cicle. : 17. V. capituligera.
17. Inflorescence simple, or bipinnate with
 1 or 2 flowers per axil.
18. Inflorescence ca. 12 cm long by 3.5 cm
 wide, compound, two flowers per primary
 bract axil, up to 15 flowers per inflo-
 rescence. : 18. V. paupera.
18. Inflorescence 20-40 cm long by 5.0-9.0
 cm wide, strictly simple, up to 40
 flowers per inflorescence, flowers often
 turning secund.
 : 19. V. gladioliflora.

1. VRIESEA ESPINOSAE (L. B. Smith) Gilmartin, comb. nov.

Tillandsia espinosae L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 19) pp. 498-499, fig. 65, d, e.

FIG. 68

PLANT ca. 30 cm tall, stemless, growing in clumps several meters in diameter, each plant connected to next one by a stolon ca. 12 cm long by 8 mm in diameter covered by many short, imbricate leaves; LEAVES 14-22 cm long, blades 0.7-1.2 cm wide, narrowly triangular, involute, densely silvery, gray, lepidote, apex attenuate to filiform; sheath ca. 2.0 cm long by 1.5 cm wide, pale brown; SCAPE ca. 2 mm in diameter, erect, scarcely exceeding leaf-rosette; SCAPE-BRACTS 2.0-2.5 cm long, erect, imbricate, apex subacute, nearly all of uniform length, red, elliptic; INFLORESCENCE 6.0-9.0 cm long by 8 mm wide, simple, distichous, having ca. 6 flowers, slightly lepidote, red; FLORAL BRACTS ca. 2.5 cm long by 1.0 cm wide, oblong-elliptic, ecarinate, enfolding flowers, bright red, slightly lepidote without, glabrous within, apex acute, papery; SEPALS 1.1-1.3 cm long by 5 mm wide, green, rose tipped, free, elliptic, obtuse, papery; PETALS 3.0-4.0 cm long, blade violet, with two scales ca. 1.0 cm long from petal base, stamens included; OVARY ca. 6 mm long by 2 mm in diameter, in flower around February to April, distance between flowers ca. 1.2 cm.

MATERIAL EXAMINED: Espinosa E-1205 (GH, TYPE; US,

photo and fragment) epiphytic, Huico, south of La Toma, Prov. Loja, 1400 m, Sept. 1946; Fagerlind and Wibom 617 (US) common epiphyte, between Puerto Cayo and Jua (Joaz), west of Jipijapa, Prov. Manabí, 13 Oct. 1952; Rauh, Hirsch E 5 (US) in Bombax woods, near Santa Rosa, Prov. El Oro, 200 m, 29 Aug. 1957; AJG 887 (US) epiphytic, common locally, ca. 2 km south of Jipijapa, Prov. Manabí, ca. 60 m, 18 March 1964.

NOTES: The petals of AJG 887 clearly show basal scales indicating that the species belongs in Vriesea. Although the description of the type specimen does not mention the stolons it is probable that the stolons were simply not collected. The other collections show the stolons between plants. The species seems to be restricted to xerophytic communities west of the Andes.

2. VRIESEA HITCHCOCKIANA (L. B. Smith) L. B. Smith, 1951
(Contrib. U.S. Nat. Herb. vol. 29, no. 10) p. 446

Tillandsia hitchcockiana L. B. Smith, 1930 (Contrib.
Gray Herb. vol. 89) p. 10, pl. 4, figs. 2-5.

FIG. 69

PLANT to 1 m tall, in xerophytic communities; LEAVES 40-70 cm long, blades 2.5-4.5 cm wide, narrowly triangular, gray-green, densely gray lepidote, apex attenuate, sheath 13-15 cm long by 5.0-6.0 cm wide, dark brown; SCAPE 6-8 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS 5.0-17.0 cm long by 2.5-3.0 cm wide at sheath, apex caudate, imbricate throughout; INFLORESCENCE 35-40 cm long by 10-15 cm in diameter, erect to ascending, bipinnate-subdigitate, lax, having 6 to 8 spikes; PRIMARY BRACTS 4.0-5.5 cm long, erect-ascending, elliptic, mostly shorter than sterile stipe of spikes, distance between primary bracts 3.0-4.0 cm; SPIKES 10-35 cm long by 2.0-2.7 cm wide, erect to spreading, purple, having 18 to 28 flowers per spike, stipe 3.0-8.0 cm long with 3 to 5 sterile bracts; FLORAL BRACTS 2.5-2.8 cm long by ca. 1.0 cm wide, apex acute, ovate, nerved, erect, imbricate but spike-rhachis exposed at anthesis, ecarinate, papery, glabrous without and glabrous within, purple when alive, often arching outward; SEPALS 2.0-2.2 cm long, free, ecarinate, nerved, elliptic, acute, glabrous without and within; PETALS ca. 3.2 cm long, blades ca. 4 mm broad, violet,

2 scales 0.7-1.0 cm long from petal base, stamens much exserted beyond corolla, stigma 5-6 mm longer than stamens; OVARY 6-8 mm long; CAPSULE ca. 3.0 cm long or more, distance between flowers ca. 1.0 cm throughout.

MATERIAL EXAMINED: Hitchcock 21323 (US, TYPE) epiphytic, between El Tambo and La Toma, Prov. Loja, 1000-2200 m, 3 Sept. 1923; AJG 1121 (US) epiphytic, very common, dry deciduous scrub, open forest, no water in tank, seeds very abundant, some on tree trunks minus the seed with coma only, the seeds seeming to have been eaten, km 25 Loja-Catamayo, Prov. Loja, 1900 m, 10 Aug. 1965; AJG 1124 (US) epiphytic, same type of community as AJG 1121, km 27 Loja-Catamayo, Prov. Loja, 1800 m, 10 Aug. 1965.

3. VRIESEA PATULA (Mez) L. B. Smith, 1955 (Phytologia vol. 5, no. 7) p. 288.

Tillandsia patula Mez, 1906 (Repert. Novae Species Fedde vol. 3) p. 35; Smith, 1936, pp. 548-549.

PLANT ca. 30 cm tall by ca. 24 cm in diameter; LEAVES 15-25 cm long, blades 1.5-2.0 cm wide, blade narrowly triangular, involute, coriaceous, densely gray-lepidote, sheath dark brown, apex attenuate to filiform; SCAPE 2-3 mm in diameter, erect to curved, much exceeded by leaf-rosette; SCAPE-BRACTS ca. 3.5 cm long, erect, imbricate, apex rounded acute; INFLORESCENCE simple or digitate, 10-30 cm long, having up to 6 spikes, lepidote; PRIMARY BRACTS 2.5-3.0 cm long, inconspicuous, like scape bracts, much shorter than stipe of spikes; SPIKES 10-27 cm long by 2.0-2.5 cm wide at anthesis, spreading, to 1.0 cm between spikes, having 7 to 10 flowers per spike, stipe 5.0-20.0 cm long with 3-7 sterile bracts; FLORAL BRACTS 3.5-4.5 cm long by 1.2 cm wide, elliptic-ovate, erect, imbricate but not obscuring spike rhachis, ecarinate, nerved, densely, silvery lepidote without, glabrous within, apex acute, often arching outward at anthesis; SEPALS 1.8-2.1 cm long by 5-6 mm wide, ovate, narrowly rounded, posteriorly slightly carinate, equally subfree, nerved, glabrous without and within; PETALS 5.0-6.0 cm long, green, turning yellow when dry, with two scales 1.6 cm from petal base; CAPSULES to 3.0 cm long, distance between flowers 0.3-1.2 cm.

MATERIAL EXAMINED: Weberbauer 2012 (B, TYPE; US, photo) Peru; Teuscher 1872-56, near Cuenca, road to San Lucas, Prov. Azuay, ca. 2800 m, cultivated by Teuscher in Montreal Botanical Garden, collected from cultivation July 1958.

PERU.

VRIESEA PEREZIANA (André) L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29) p. 444; Smith, 1957, pp. 179-180.

Tillandsia pereziana André, 1888 (Énumération Bromél.) p. 7; André, 1889, pp. 80-81, pl. 23.

PLANT ca. 35 cm tall; LEAVES 30-60 cm long, blades ca. 2.5 cm wide, densely or weakly lepidote, triangular, involute, sheaths 10-16 cm long, dark castaneous; SCAPE decurved, slender, about as long as the leaf-rosette; SCAPE-BRACTS barely imbricate, ovate, apex filiform; INFLORESCENCE pendent, subpinnate from 5 to 6 spikes; PRIMARY BRACTS lance-ovate, not much larger than floral bracts; SPIKES 10-15 cm long by ca. 2.0 cm wide; FLORAL BRACTS 2.5-3.5 cm long by 1.4-1.7 cm wide, divergent, ovate, slightly to strongly lepidote, apex acute; SEPALs 1.6-2.1 cm long, subpapery, elliptic, acute; PETALS 4.0-5.0 cm long, green, with two linear, largely adnate scales, stigma and stamens much exserted.

4. VRIESEA PEREZIANA var. PEREZIANA

Leaves and floral bracts slightly lepidote, floral bracts ca. 3.5 cm long.

MATERIAL EXAMINED: André 1348 (André, 1889, plate) near Tequendama waterfall, 2550 m, Colombia.

COLOMBIA.

5. VRIESEA PEREZIANA var. CANESCENS (André) Gilmartin

Plant very similar to Vriesea pereziana var. pereziana but leaves and floral bracts strongly lepidote, floral

bracts ca. 2.5 cm long.

PERU.

6. VRIESEA HETERANDA (André) L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29) p. 443; Smith, 1957, p. 181.

Tillandsia heteranda André, 1888 (Énumération Bromél.) p. 7; André, 1889, pp. 83-84, pl. 27.

PLANT to 35 cm tall; LEAVES 25-40 cm long, blades 1.2-1.8 cm wide, narrowly triangular, densely lepidote, apex attenuate to filiform, sheath ca. 6.0 cm long by 3.0 cm wide, dark castaneous; SCAPE ca. 4 mm in diameter, curved, exceeded greatly by leaf-rosette; SCAPE-BRACTS, imbricate throughout, foliaceous, erect; INFLORESCENCE 15-20 cm long by ca. 6.0 cm in diameter, bipinnate, lax, having ca. 15 spikes, lepidote; PRIMARY BRACTS 2.0-5.0 cm long, with caudate apices below, acute above, lepidote, always much shorter than spikes; SPIKES 3.0-9.0 cm long by ca. 1.0 cm wide at anthesis exclusive of petals, erect to spreading, distance between spikes to 1.5 cm, inflorescence rhachis mostly obscured by primary bracts, stipes to 3.0 cm with several sterile bracts; FLORAL BRACTS 1.2-1.7 cm long, exceeding sepals, ovate, apex acute, densely lepidote without, imbricate, erect, completely obscuring spike-rhachis at anthesis; SEPALS free, elliptic-oblong, acute, glabrous; PETALS ca. 1.8 cm long with two linear largely adnate scales; CAPSULE ca. 2.0 cm long, distance between flowers ca. 3-4 mm.

MATERIAL EXAMINED: Buchtien 7184 (B) Bolivia.

BOLIVIA, COLOMBIA.

VREESEA BARCLAYANA (Baker) L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 10) pp. 517-518, fig. 75.

Tillandsia barclayana Baker, 1887 (Journ. Bot. vol. 25) p. 239.

PLANT ca. 30-60 cm tall; LEAVES 40-50 cm long, blades 2.0-2.5 cm wide, narrowly triangular, densely gray-lepidote throughout, apex filiform, sheath 6.0-10.0 cm long by 5.0-6.0 cm wide, elliptic, dark castaneous; SCAPE ca. 6 mm in diameter, curving; SCAPE-BRACTS 4.0-20.0 cm long, erect with apices spreading, apices acute near inflorescence, long-caudate below, imbricate throughout, totally obscuring scape; INFLORESCENCE 5.0-30.0 cm long by 3.0-5.0 cm wide exclusive of capsules, simple, dense, distichous, having 9 to 25 flowers, curving, lepidote; FLORAL BRACTS 1.8-3.7 cm long by 1.5-2.5 cm broad, elliptic, apex acute, coriaceous, lepidote without especially toward apices, glabrous within, ecarinate, not nerved, lustrous, orange-yellow, erect, scarcely imbricate; SEPALS 1.8-2.3 cm long by ca. 1.0 cm wide, ovate, apex acute, glabrous without and within, coriaceous, ecarinate, not nerved; PETALS 3.0-4.0 cm long with stigma exerted and stamens equal to or slightly exceeding petals with two basal scales; CAPSULE ca. 6.0 cm long, distance between flowers 0.9-1.1 cm.

7. VREESEA BARCLAYANA var. BARCLAYANA

Plant 40-60 cm tall, inflorescence 15-30 cm long by 4.0-5.0 cm wide with 15-25 flowers, floral bracts 2.8-3.7

cm long.

MATERIAL EXAMINED: Barclay 622 (BM, TYPE; US, photo) near Valdivia, Prov. Guayas, near sea level, 1836; AJG 515 (US) epiphytic, 2.5 km southeast of Ayañgüe, cactus-deciduous scrub, common, Prov. Guayas, near sea level, 31 Nov. 1961; AJG 650 (US) epiphytic, open scrub, 12 km south of Manglaralto, Prov. Guayas, near sea level, 24 March 1962; Fagerliná and Wibom 622 (US) Puerto Cayo, west of Jipijapa, near coast, Prov. Manabí, near sea level, 13 Oct. 1952; Espinosa E 1840 (US) epiphytic, near river, Río Calera, west of Zaruma, Prov. El Oro, 820 m, 21 Aug. 1947.

8. VRIESEA BARCLAYANA var. MINOR Gilmartin, var. nov.

Tillandsia lateritia André, 1888 (Énumération Broméi.) p. 6; André, 1889, pp. 76-77, pl. 21; Mez, 1935, p. 553, pro parte.

A var. T. barclayana minoribus, ad 45 cm longis; inflorescentia brevioribus; bracteis florigeris 1.8-2.6 cm longis differt.

FIG. 70

Plant like the typical variety but smaller, 30-45 cm tall, inflorescence 5.0-12.0 cm long by 3.0-3.5 cm wide and having 9 to 18 flowers; floral bracts 1.8-2.2 cm long.

MATERIAL EXAMINED: André 4057 (K, TYPE; TYPE of T. lateritia) Sabanetas, at foot of Chimborazo, Prov. Bolívar, July 1876; Sodiro 171/26 (B; US, photo) near Sabanetas, Prov. Bolívar, July 1872; Camo E-3899 (US) between

Naranjapata and Huigra, saxicolous, Río Chanchan canyon, Prov. Chimborazo, 600-900 m, 19 June 1945; Hitchcock 21247 (US) epiphytic, on dry hill, Portovelo near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. - 1 Sept. 1923; AFG 863 (US) Km 79 Guayaquil-El Tambo, Prov. Guayas, 75 m, 21 Sept. 1963.

NOTES: The new variety, minor Gilmartin of Tillandsia peruviana is probably mostly related to geographic location, the smaller one being found somewhat inland. Possibly the two varieties may come together in Prov. El Oro. The TYPE of the variety, minor, is from well inland where the Andes begin to ascend and at about 700 m. The TYPE of the typical variety is from the coast not far from the Pacific Ocean.

9. VRIESEA TEQUENDAMAE (André) L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 10) p. 444; Smith, 1957, p. 184, fig. 51; Wurdack, 1964, p. 115, photo.

Tillandsia tequendamae André, 1888 (Énumération Bromél.) p. 8; André, 1889, pp. 103-104, pl. 36.

FIG. 71

PLANT ca. 50 cm tall, from erect rosette; LEAVES 40-60 cm long, outermost leaves shorter, to 7.5 cm long, blades 4.5-7.0 cm wide, narrowly triangular, densely gray-lepidote throughout, apex attenuate to filiform, sheath 7.0-15.0 cm long by 6.0-8.5 cm wide, dark reddish brown, conspicuous; SCAPE ca. 5-6 mm in diameter, exceeded by leaf-rosette, slightly to greatly curving; SCAPE-BRACTS 15-50 cm long by ca. 4.0 cm wide with long filiform blade, imbricate throughout, sheaths erect, blades spreading, reddish-brown; INFLORESCENCE 20-40 cm long by 5.0-6.0 cm wide, bipinnate or tripinnate and with two nearly equal digitate branches, dense, cylindrical, curving, glabrous; PRIMARY BRACTS 3.5-4.5 cm long by ca. 5.0 cm wide, orbicular, apex rounded to apiculate, coriaceous, imbricate; SPIKES 2.5-3.5 cm long by 1.8-2.0 cm wide, ca. 15 per inflorescence, erect, ca. 1.5-2.0 cm apart, having 4 to 10 flowers per spike, sessile; FLORAL BRACTS 2.2-2.4 cm long by ca. 1.8 cm wide, erect, imbricate, ovate, apex acute, carinate, coriaceous, not nerved, reddish to orange when alive, glabrous without and within; SEPALs 1.8-2.0 cm long by 0.9-1.0 cm wide,

ovate-elliptic, acute, scarcely nerved, glabrous without and within; PETALS 3.5-4.0 cm long with two inconspicuous scales ca. 1.1 cm long from petal base, green; CAPSULE ca. 3.0 cm long, distance between flowers ca. 6 mm.

MATERIAL EXAMINED: Espinosa E 355 (GH) epiphytic, Cajanuma south of Loja, Prov. Loja, ca. 2400 m, 7 May 1948; AWG 1181 (US) strongly windswept area, dwarf forest and cloud forest, all branches densely covered with leafy liverworts, tank of bromel filled with water and spongy, km 38 Catamayo-Loja, Prov. Loja, ca. 2500 m, 10 Aug. 1965.

NOTES: From a brief perusal of herbarium specimens of this species one might suspect that it would be adapted especially well to desiccation because of the densely, moderately appressed lepidote, coriaceous leaves. However, it seems to also thrive in very moist areas where the air circulation is good such as on windswept knolls or near water falls.

COLOMBIA.

10. VERBENA CINERIFRICA L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 10) pp. 445-446, fig. 46; Smith, 1957, pp. 183-184.

FIG. 72

PLANT 40-120 cm tall from erect-rosette; LEAVES 40-70 cm long, blades 4.0-6.5 cm wide, narrowly triangular, apices attenuate to filiform, densely gray-lepidote, slightly involute; SCAPES 0.6-0.9 cm in diameter, erect, slightly exceeding leaf-rosette at anthesis; SCAP-BRACTS 14-35 cm long by ca. 2.0 cm wide, sheath erect, filiform blades reflexed, imbricate throughout; INFLORESCENCE 13-65 cm long by 2.0-4.0 cm in diameter, erect, dense, bipinnate, glabrous, cylindrical; PRIMARY BRACTS 4.0-6.0 cm long, and lowermost with additional 7 cm long filiform blade or not, erect, from much shorter than spikes to subequaling spikes, sheaths ovate; SPIKES 3.5-8.0 cm long by 2.5-3.5 cm wide, erect, 10 to 16 spikes per inflorescence, ca. 0.5-1.5 cm apart, stipe minimal to 0.3 cm long with up to 3 sterile bracts; FLORAL BRACTS ca. 2.5 cm long by 1.5 cm wide, red, coriaceous, not nerved, imbricate erect, ovate, apex acute, ecarinate, glabrous without and within; SEPALS ca. 2.0 cm long by 0.7 cm wide, ovate, free, broadly acute, not nerved, coriaceous, ecarinate, glabrous without and within; PETALS 3.5-4.0 cm long by 0.9 cm wide, with two scales adnate with petal for ca. 7 mm, green with violet margins, stamens and stigma barely exserted; CAPSULES

3.5-4.0 cm long, distance between flowers ca. 2 mm, in flower May-November.

TERRESTRIAL EPHEMERAL: Roster 2643 (US; TYPE) epiphytic, Baños Domingo, Prov. Pichincha, ca. 300 m, 6 Dec. 1948; Witchcock 21355 (U.) epiphytic between El Tambo and La Torre, Prov. Loja, 1000-2200 m, 3 Sept. 1923; Witchcock 20756 (US) epiphytic, Fuigra, Prov. Chimborazo, 1200 m, 4-27 July 1923; Camp 2 3493 (US) "open deforested slope with small patches of scrub in the draws, directly above village of Fuigra, Canyon of Río Chanchan," Prov. Chimborazo, 1800-2100 m, 29-31 May 1945; Levi-Castillo s. n. (US) Río Chimbo, probably near Bucay, Prov. Chimborazo, estimate 1000 m, Nov. 1955; Levi-Castillo s. n. (US) Chanchan, probably near Río Chanchan, near Fuigra, "200 m" (?), Nov. 1955; Roster 2622 (US) terrestrial and on rocks, between Oña and Saraguro, Prov. Loja, ca. 1900 m, 4 Dec. 1948; USG 642 (US) epiphytic ca. 3 m from ground, near small stream in cleared land, ca. 1m 90 Durán-Cuenca, Prov. Cotacachi, 1750 m, 2 June 1965; USG 1147 (US) terrestrial on roadside, common, tank full of water, 1m 25 Loja-Cuenca, Prov. Loja, 1900 m, 12 Aug. 1965; USG 1170 (US) epiphytic, in small wooded area in midst of cultivated fields, km 134 Cuenca-Guayaquil, Prov. Cañar, 1500 m, 13 Aug. 1965; USG 1079 (US) epiphytic 2-5 m from ground, very common in jungle, pasture in avocado and orange trees, no water in tank, km 53 Santo Domingo-Quito, Prov. Pichincha, 1400 m,

4 Aug. 1965.

NOTES: The species seems to be quite variable as to size, varying from 40 cm tall to well over a meter. The bracts are red and the plant is very striking from a distance. Since the stamens and stigma both are slightly exserted it is likely that cross pollination occurs, this might help to explain the variability noted.

11. VRIESEA FRAGRANS (André) L. B. Smith, 1951 (Contrb. U.S. Nat. Herb. vol. 29, no. 10) p. 443; Smith, 1957, p. 183.

Tillandsia fragrans André, 1888 (Énumération Bromél.) p. 7; André, 1889, p. 83, pl. 29-a.

PLANT ca. 25 cm tall by ca. 15 cm in diameter from an erect-rosette; LEAVES ca. 20 cm long, blades 1.2 cm wide, narrowly triangular, involute, apex attenuate to filiform, densely silvery-gray lepidote throughout, outermost leaves to 6 cm long; SCAPE 2-3 mm in diameter, curving, exceeded by leaf-rosette; SCAPE-BRACTS 3.5-12.0 cm long, imbricate throughout but exposing scape; INFLORESCENCE 9.0 cm long by 2.5 cm in diameter, bipinnate, dense; PRIMARY BRACTS 1.0-2.3 cm long by ca. 0.7 cm wide, erect, elliptic with filiform blades, apex acute to attenuate, mostly shorter than spikes; SPIKES 2.5-3.0 cm long by ca. 1.5 cm wide, erect, ca. 8 per inflorescence, having 5 to 6 flowers per spike, distance between spikes ca. 1.5 cm; FLORAL BRACTS ca. 1.2 cm long, lepidote without, apex acute; SEPALS 1.0-1.1 cm long, acute, ovate-elliptic, glabrous; PETALS ca. 1.8 cm long, white, stamens and stigma included by 3-4 mm, distance between flowers 4-5 mm.

MATERIAL EXAMINED: André 4397 (André, 1889, pl. 29-a) Quebrada de Las Juntas, between Saraguro and Loja, Prov. Loja, ca. 2500, 1876.

12. VRIESEA APPENDICULATA (L. B. Smith) Smith, 1951

(Contrib. U.S. Nat. Herb. vol. 29, no. 10) p. 445.

Tillandsia appendiculata L. B. Smith, 1949 (Lloydia vol. 11) p. 307, fig. 6.

PLANT 30-90 cm tall; LEAVES 30-70 cm long, blades 2.0-3.0 cm wide, blades narrowly triangular, apex attenuate to filiform, densely gray lepidote throughout, sheath ca. 8.0 cm long by 5.0 cm wide, dark red-brown; SCAPE 5-6 mm in diameter, curved; SCAPE-BRACTS 10-20 cm long, imbricate throughout, with long, attenuate blades; INFLORESCENCE 15-45 cm long by 4.0-9.0 cm in diameter, tripinnate, dense, claviform, moderately lepidote, curved; PRIMARY BRACTS elliptic, erect; SPIKES 3.0-5.0 cm long by 1.0-1.3 cm wide, 3 to 5 flabellate spikes per branch; FLORAL BRACTS 1.0-1.2 cm long by ca. 6 mm wide, elliptic, unicarinate, nerved, densely and loosely lepidote without, subglabrous within, papery, apex acute; SEPALS ca. 1.0 cm long by 5 mm wide, broadly acute, posteriorly carinate, nerved, posteriorly united for 2-3 mm, subcoriaceous, glabrous without and within; PETALS 1.4 cm long, with blades 4 mm wide, blades violet to rose, naked(?); OVARY 4 mm long by 2 mm in diameter, style several times longer than ovary length, stamens and stigma included by 2-3 mm, distance between flowers ca. 2 mm.

MATERIAL EXAMINED: Espinosa E-353 (GH; US, photo and fragments) Cajanuma, south of Loja, Prov. Loja, ca. 2400 m,

7 May 1946.

NOTES: The above-cited Espinosa specimen was examined carefully and no petal scales whatsoever were observed. This would indicate that this specimen, which was cited by Smith (1949) as the cotype for Vriesea appendiculata L. B. Smith, belongs with Tillandsia as the species appendiculata was first published. However, since I have not seen the TYPE specimen, Steiermark 54780, I am unable at this time to reinstate the species in the genus Tillandsia.

13. VRIESEA ARPOCALYX (André) L. B. Smith, 1951 (Contrib. U.S. Nat. Herb. vol. 29, no. 10) p. 445.

Tillandsia arpoCALYX André, 1888 (Énumération Bromél.) p. 7; André, 1889, p. 101, pl. 38.

PLANT 30-50 cm tall; LEAVES 20-35 cm long, blades 2.0-2.5 cm wide, narrowly triangular, densely gray-lepidote throughout, coriaceous, apex attenuate, sheath ca. 9.0 cm long by 5.0 cm wide, very dark, red-brown; SCAPE 5 mm in diameter, curved, about equal to leaf-rosette; SCAPE-BRACTS 12-28 cm long by 3.0 cm wide, erect throughout with long filiform, spreading blades; INFLORESCENCE ca. 10 cm long by 4.0 cm in diameter, bipinnate, dense, moderately lepidote; PRIMARY BRACTS 4.0-7.0 cm long by 2.0-2.5 cm wide, erect, imbricate, apex acute, about 1/2 to 3/4 as long as spikes; SPIKES 5.0-9.0 cm long by ca. 2.0 cm wide, strictly erect, to 2.5 cm between spikes, stipes densely flocculose, with 1 to 2 sterile bracts just subtending first fertile bract, having ca. 3 to 4 flowers per spike; FLORAL BRACTS 4.0-4.5 cm long by 1.4 cm wide, papery, strongly nerved, apex attenuate, carinate, moderately lepidote without, glabrous within, red when alive turning straw colored; SEPALS ca. 3.0 cm long by 0.8 cm wide, ovate, attenuate, moderately carinate posteriorly, subcoriaceous, strongly nerved, glabrous without and within; PETALS 5.0-6.0 cm long by ca. 6 mm wide at blade, yellow-green when alive, turning brownish yellow when dry, stamens equaling petals,

stigma much exserted; OVARY ca. 8 mm long by 4 mm wide, style several times longer than ovary length, distance between flowers 0.8-1.0 cm, in flower around September.

MATERIAL EXAMINED: André 4474 (K, TYPE; US, photo) south of Riobamba, Prov. Chimborazo, ca. 2500 m; Hitchcock 21906 (US) "dry hills between Baños and Ambato," Prov. Tungurahua, ca. 1800 m, 26 Sept. 1923.

14. VRIESEA DREWII L. B. Smith, 1956 (Phytologia vol. 5, no. 9) pp. 401-402, pl. 1, figs. 4-7.

PLANT to 40 cm tall by ca. 20 cm in diameter; LEAVES 26-30 cm long, blades 2.5-3.0 cm wide, narrowly triangular, apex filiform, densely, obviously lepidote throughout, sheath ca. 7.0 cm long by 6.0 cm wide, blending into blade inconspicuously, dark castaneous; SCAPE ca. 4 mm in diameter, curved, exceeded by leaf-rosette; SCAPE-BRACTS 12-18 cm long with long blade, imbricate throughout and totally obscuring scape; INFLORESCENCE ca. 12 cm long by 5.5 cm in diameter, exclusive of petals, bipinnate, dense, lepidote, ellipsoid; PRIMARY BRACTS 5.0-8.0 cm long by ca. 3.5 cm wide, apex acute, papery, densely imbricate, shorter than spikes, erect; SPIKES to 10 cm long by 2.5 cm wide, with 4 to 5 flowers, erect, distance between estimated as ca. 2.0 cm; FLORAL BRACTS ca. 6.0 cm long by 2.0 cm wide, linear-lanceolate, apex attenuate, imbricate, erect, pale lepidote without, glabrous within, papery, carinate, very slightly nerved; SEPALS 4.5-5.0 cm long by 1.0 cm wide, elliptic, papery, carinate, equally free, sparsely lepidote without, glabrous within, acute; PETALS ca. 12 cm long, green-yellow when alive, with 2 scales ca. 2.0 cm long from petal base, stamens equaling petal apices, distance between flowers ca. 5 mm.

MATERIAL EXAMINED: Drew E-284 (US, TYPE) epiphytic, "wet rainforest" La Floresta, near Sigsipamba, Prov.

Imbabura, ca. 2800 m, 6 Sept. 1944.

15. VRIESEA SANGUINOLENTA Cogn. and Marchal, 1874 (Pl. Ornem.) pl. 52; Smith, 1957, pp. 191-192.

Tillandsia sanguinolenta Baker, 1889 (Handbook Bromel.) p. 226.

FIG. 73

PLANT ca. 1.5 m tall with inflorescence by ca. 85 cm in diameter; LEAVES 60-90 cm long, blades 5.0-10.0 cm wide, lingulate, apex acute to long apiculate, coriaceous, subglabrous, green or green with red spots, sheath ca. 15 cm long by 15 cm wide, ovate-elliptic, concolorous with blade or with overtones of purple; SCAPE ca. 1.2 cm in diameter, erect, about equaling leaf-rosette; SCAPE-BRACTS ca. 12 cm long by 4.5 cm wide, erect, imbricate, apex acute, obscuring scape totally; INFLORESCENCE 40-55 cm long by ca. 35 cm in diameter, bipinnate or nearly simple, lax; PRIMARY BRACTS 4.0-6.0 cm long, erect to spreading, covering the sterile stipe, apex acute; BRANCHES to 25 cm long by 4.5-5.5 cm wide at anthesis, terminal branch to 40 cm long, erect to spreading, ca. 6 branches per inflorescence, having 6 to 15 flowers, stipe to 6.5 cm long with 1 to 5 sterile bracts, often the terminal bract of branch sterile; FLORAL BRACTS 3.5-4.5 cm long by ca. 2.5 cm wide, ovate, carinate only toward apex, apex acute, coriaceous, not nerved, glabrous without, lepidote within, often secund with flowers and floral bracts turning downward; SEPALS 3.2-4.5 cm long by ca. 2.6 cm wide, broadly elliptic,

obtuse to broadly acute, ecarinate, coriaceous, not nerved, equally free, glabrous without and within; PETALS ca. 4.0 cm long, with basal scales, white; PEDICELS to 1.2 cm long; CAPSULE to 5.0 cm long, distance between flowers ca. 3.0 cm.

MATERIAL EXAMINED: Massange s. n. (LG; US, photo) Jan. 1880; Morren s. n. (LG; US, photo) 14 May 1885; Levi-Castillo s. n. (US) San Placido, Prov. Manabí, 12 June 1956; AJG 867 (US) 30 km east of Babahoyo, common, epiphytic, Prov. Bolivar, ca. 500 m, 20 Oct. 1963.

16. VRIESEA RUBRA (Ruiz and Pavon) Beer, 1857 (Bromeliaceen)
p. 98; Smith, 1951, p. 447; Smith, 1957, pp. 178-179.

Tillandsia rubra Ruiz and Pavon, 1802 (Flora Peruviana
vol. 3) p. 40, pl. 266.

PLANT ca. 1 m tall; LEAVES 50-75 cm long, blades 5.5-7.0 cm wide, lingulate, subglabrous, apex acute to apiculate, coriaceous, sheath ca. 10 cm long by 6.5 cm wide, nearly concolorous with blade; SCAPE 6-7 mm in diameter, erect, about equaling leaf-rosette; SCAPE-BRACTS 4.0-16.0 cm long, erect, imbricate throughout, apex acute to attenuate; INFLORESCENCE ca. 30 cm long by up to 12 cm in diameter, bipinnate, lax, with ca. 8 spikes, ovoid, glabrous; PRIMARY BRACTS ca. to 3.0 cm long, all shorter than midpoint of spike, apex acute, erect to spreading, ca. 2.0 cm apart; SPIKES 8.0-18.0 cm long by ca. 1.2-2.0 cm wide at anthesis, erect-spreading, with 9 to 17 flowers, stipe ca. 2.5 cm long with ca. 1 sterile bract; FLORAL BRACTS 2.5-2.7 cm long by ca. 1.0 cm wide, coriaceous, carinate, not nerved, glabrous without, inconspicuously punctulate within, apex acute, imbricate, erect; SEPALs 1.8 cm long by 4-5 mm wide, carinate, acute, subpapery, nerved, glabrous without and within, narrowly elliptic to obovate, equally free; PETALS ca. 2.8 cm long, white, with two basal scales, stamens and stigma included; CAPSULE ca. 2.0 cm long, distance between flowers 7-9 mm.

MATERIAL EXAMINED: Ruiz et Pavon (R. and P., 1802,

pl. 266) Peru; Steiermark 89667 (US) Venezuela; Lee Moore
BM 70 (US) cultivated by Marnier-Lapostolle in France,
Nov. 1966, probably from Prov. Zamora or Napo, no details
as to locality, 6 Oct. 1964.

COLOMBIA, PERU, VENEZUELA.

17. VRIESEA CAPITULIGERA (Grisebach) Smith and Pittendrigh, Journ. Wash. Acad. Sci. vol. 43) p. 402; Smith, 1966, pp. 127-128.

Tillandsia capituligera Grisebach, 1866 (Cat. Pl. Cub.) p. 254.

Tillandsia fastuosa André, 1888 (Énumération Bromél.) p. 8; André, 1889, pp. 104-105, pl. 37.

FIG. 74

PLANT 70 cm to over 1 m tall, leaves forming erect rosette; LEAVES 50-70 cm long, blades 4.5-9.0 cm wide, lingulate, apex acute to attenuate, moderately lepidote, much appressed, sheath 14-17 cm long by 9.0-11.0 cm wide, elliptic, dark castaneous; SCAPE 1.2-1.5 cm in diameter, erect, scarcely exceeding leaves; SCAPE BRACTS 15-30 cm long by 4.0 cm wide, erect, imbricate and foliaceous throughout, red or green; INFLORESCENCE 18-50 cm long by 7.0-10.0 cm in diameter, bipinnate, cylindrical, dense, red, glabrous; PRIMARY BRACTS 3.0-10.0 cm long by 2.0-5.0 cm wide, suborbicular blade with triangular apex, much exceeding the fascicles below and equaling those above; SPIKES 3.0-5.0 cm long by 2.0-3.5 cm wide, fascicular, spreading, ca. 14 to 35 spikes per inflorescence, distance between spikes 0.7-3.0 cm, ca. 4 to 12 flowers per spike, stipe to 1.2 cm long, no sterile bracts; FLORAL BRACTS 2.0-3.2 cm long by 1.2-1.6 cm wide, ovate, apex attenuate, carinate, strongly nerved, red, papery, glabrous without

and within; SEPALS 2.0-2.8 cm long by 0.7-0.8 cm wide, elliptic-obovate, acute, carinate, strongly to weakly nerved, free; PETALS 2.8-3.5 cm long having two scales near base, white, stamens included; CAPSULES ca. 2.3 cm long, seeds 7 mm long, slender, reddish, distance between flowers minimal.

MATERIAL EXAMINED: André 1746 (K, TYPE of T. fastuosa André; US, photo) Colombia; Sodiro 171/46 (GH) Nanegal valley, ca 78° 45' W, 0° 9' N, Prov. Pichincha; Sodiro s. n. (Quito; AJG, photo) near Chimborazo, 9, 1881; Asplund 16172 (US) below San Juan towards Chiriboga, on cliff, Prov. Pichincha, ca. 3150 m, 3 May 1955; Levi-Castillo s. n. (US) Abitagua near Mera, Prov. Napo-Pastaza, Feb.-March 1956; Levi-Castillo s. n. (US) near town of Río Verde between Baños and Mera along Río Pastaza, Prov. Napo-Pastaza, Feb.-March 1956; AJG 873 (US) epiphytic on "Aranyang," Eugenia, cloud forest, ca. 8 m from ground, common, between Santa Domingo and Quito, Prov. Pichincha, ca. 1500 m, 8 Dec. 1963; AJG 1136 (US) km 13 Loja-Zamora, dwarf forest, epiphytic ca. 1-5 m from ground, tank full of water, Prov. Loja, ca. 2500 m, 11 Aug. 1965.

18. VRIESEA PAUPERA (Mez and Sodiro) Smith and Pittendrigh, 1953 (Journ. Wash. Acad. Sci. vol. 43) p. 403.

Thecophyllum pauperum Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 876.

PLANT 50-70 cm tall; LEAVES 30-70 cm long, blades 2.0-3.5 cm wide, lingulate-linear, apex attenuate, papery, obscurely lepidote; SCAPE 0.8-1.1 cm in diameter, erect(?); SCAPE-BRACTS 4.5-28.0 cm long by 2.0-3.5 cm wide, erect, imbricate throughout, scape somewhat exposed just below inflorescence, apex attenuate; INFLORESCENCE ca. 12 cm long by 3.5 cm wide, lax below, glabrous; PRIMARY BRACTS 2.5-5.0 cm long, apex attenuate, spreading to reflexed; SPIKES with 2 flowers, fasciculate, much exceeded by primary bracts, distance between fascicles 0.5-2.5 cm; FLORAL BRACTS ca. 1.5 cm long, papery; SEPALs 0.8-1.0 cm long by 0.7-0.8 cm wide, orbicular, rounded, coriaceous, eciliate, free, glabrous without and within; PETALS yellow when dry; CAPSULE 2.6-2.9 cm long, distance between flowers minimal.

MATERIAL EXAMINED: Sodiro 171/18 (B, TYPE; US, photo) on slopes of Pichincha, Prov. Pichincha, July 1886; Foster 2640 (US) road between Esmeraldas and Santo Domingo, epiphytic, "dark humid jungle," Prov. Esmeraldas ca. 75 m, 8 Dec. 1948.

19. VRIESEA GLADIOLIFLORA (Wendl.) Ant. Wiener, 1880
(Illust. Gart. vol. 5) p. 98; Smith, 1957, pp. 189-190.
Tillandsia gladioliflora Wendl, 1863 (Hamb. Gartenz.
vol. 19) p. 31.

PLANT 60 cm to 1 m tall; LEAVES 45-60 cm long, blades 6.0-8.0 cm wide, lingulate, apex acute, purplish when young becoming deep green, glabrous above, obscurely lepidote beneath, sheath elliptic, inconspicuous; SCAPE ca. 1.4 cm in diameter, erect; SCAPE-BRACTS 4.0-12.0 cm long, strictly erect, imbricate throughout and obscuring scape, apex acute; INFLORESCENCE 20-40 cm long by 5.0-9.0 cm in diameter, simple, dense, erect, narrowly cylindrical, glabrous; FLORAL BRACTS 5.0-6.5 cm long by ca. 5.0 cm wide, very broad-ovate, apex obtuse to broadly acute, ecarinate, coriaceous, glabrous without and within, green with purple apices when alive turning buff when dry, sometime tending to secund; SEPALs 2.5-3.5 cm long by 1.8-2.2 cm wide, obovate, obtuse, coriaceous, ecarinate, not nerved; PETALS with suborbicular blade 4-7 mm long, greenish white when fresh, with two obovate scales at base, stamens and pistil included, distance between flowers 1.5-2.5 cm.

MATERIAL EXAMINED: Morren s. n. (LG, TYPE; US, photo) cultivated, origin(?); Levi-Castillo s. n. (US) La Reserva, Prov. Chimborazo, ca. 1500 m, Nov. 1955; Levi-Castillo s. n. (US) Chilicay, Prov. Chimborazo, ca. 1250 m, Nov. 1955.

Genus GUZMANIA

Guzmania Ruiz and Pavon, 1802 (Flora Peruv. vol. 3)
p. 37, pl. 261.

Sodirola André, 1877 (Bull. Soc. Bot. France vol. 24)
p. 167.

Thecophyllum André, 1889 (Bromél. Andreanae) p. 107.

Epiphytic usually, occasionally terrestrial, leaves entire; inflorescence simple or compound, spikes or branches with flowers always disposed polystichously; sepals usually at least slightly connate; petals agglutinated, green, yellow or white; stamens included; floral bracts nearly always ecarinate; capsule septicidal, seeds with basal, straight, usually brown coma, though in some species with simple inflorescences the coma may be white; stomata usually round in surface view; trichomes often only two-layered beyond the central four cells.

KEY TO THE ECUADORIAN SPECIES OF GUZMANIA

1. Inflorescence simple from a scape or compound and densely bipinnate or digitate, tending to be fasciculate, spikes or branches mostly obscured by primary bracts (A)*, or if only partially so then distance between primary bracts ca. 5 mm.



A

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

2. Inflorescence simple.

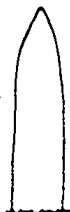
3. Plant with long trailing stem, leaf-blades linear to narrowly triangular (B), 0.3-1.0 cm wide, flowers few, 3 to 6 per inflorescence.



B

4. Sepals 1.4-2.0 cm long, equally connate for up to 6 mm, leaves narrowly triangular, blades 0.6-1.0 cm wide, petals yellow. . . . : 1. Guz. angustifolia.

4. Sepals 3.5-5.5 cm long, equally connate for ca. 2.0 cm, leaf-blades 2-5 mm wide, petals green. . . . : 2. Guz. pearcei.



BB

3. Plant essentially stemless, leaf-blades lingulate to linear-lingulate (BB), 1.0-8.0 cm wide, petals yellow or white.

5. Upper scape-bracts obscuring at least the lower portion of inflorescence (C), inflorescence dense, distance between flowers 1-3 mm, coma of seed brown.



C

6. Petals white, inflorescence small, 3.0-4.0 cm long by 1.5-2.0 cm in diameter, floral bracts 1.3-1.5 cm long, subcoriaceous, punctulate-lepidote within (D). : 3. Guz. fosteriana.



D

6. Petals yellow at least in part, inflorescence 3.0-7.0 cm long by 3.5-8.0 cm

in diameter, floral bracts 3.0-4.5 cm long, papery, glabrous within (DD).



DD

7. Leaves 20-25 cm long, inflorescence with ca. 10 flowers, floral bracts NOT cucullate.

8. Leaf-sheath concolorous with blade. : 4. Guz. minor var. minor.

8. Leaf-sheath dark brown. : 5. Guz. minor var. flammea.

7. Leaves 30-70 cm long, inflorescence with 10-50 flowers, floral bracts cucullate : 6. Guz. lingulata.



CC

5. Upper scape-bracts NOT at all obscuring inflorescence (CC), inflorescence dense to lax, distance between flowers 0.2-1.2 cm.

9. Flowers not more than 4-ranked, coma of seeds white, floral bracts with apices acute to apiculate (E).

10. Floral bracts coriaceous. : 7. Guz. laxa.

10. Floral bracts papery.

11. Floral bracts dimorphic, upper sterile bracts bright red, lower fertile bracts tending to be white with conspicuous longitudinal brown or purple stripes. . . . : 8. Guz. monostachya.



E

11. Floral bracts NOT dimorphic, terminal bracts fertile or sterile, but like lower bracts (not with stripes).
12. Floral bracts 4.0-5.5 cm long, NOT red, sepals at least 2.0 cm long at anthesis.
13. Inflorescence ca. 2.5 cm in diameter at anthesis, inflorescence with a few inconspicuous terminal sterile bracts
 : 9. Guz. fusispica.
13. Inflorescence ca. 3.5-4.5 cm in diameter at anthesis, inflorescence fertile to apex, no terminal sterile bracts. . . .
 : 10. Guz. bracteosa.
12. Floral bracts 2.5-4.0 cm long, usually red at least in part, sepals less than 2.0 cm long at anthesis.
14. Petals white, floral bracts 1.8-2.3 cm long with lowermost to 4.0 cm long, floral bract apices attenuate (F), inflorescence ca. 0.7-14.0 cm long by ca. 2.0-3.8 cm in diameter.
 : 11. Guz. fuernstebergiana.
14. Petals yellow or white, floral bracts 3.0-3.5 cm long, nearly the same length throughout, floral bracts-apices acute, NOT attenuate (FF), inflorescence ca.



F



FF

5.0-11.0 cm long by 4.0-6.0 cm in diameter

. : 12. Guz. melinonis.



EE

9. Flowers many-ranked, coma of seeds brown, floral bracts with apices obtuse (EE), or attenuate.



G

15. Floral bracts orbicular (G), apices obtuse, spike cylindric, 4 to 5 times as long as broad.

. : 13. Guz. bipartita.



GG

15. Floral bracts triangular, apices acute to broad-acute (GG), spikes ovoid to globose, 1/2 again to 3 times as long as broad, or inflorescence simple and cylindrical.

16. Plant at least 1 m tall, floral bracts 5.0-6.5 cm long, leaf-blades 6.0-8.0 cm wide. : 14. Guz. conifera.



H

16. Plant 40-100 cm tall, floral bracts 1.6-2.8 cm long, leaf-blades to 3.0 cm wide.

17. Floral bracts broadly triangular (H), obtuse, lustrous, dark when dry, with pale margins, petals white.

. : 15. Guz. coriostachya.



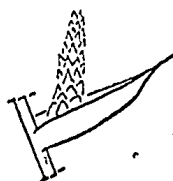
HH

17. Floral bracts narrowly triangular (HH), attenuate, stramineous when dry,

- concolorous, petals yellow.
. : 16. Guz. devansayana.
2. Inflorescence compound or if simple, then sunk into the center of the leaf-rosette, and NOT on a scape.
18. Inflorescence sunk into leaf-rosette, no scape apparent.
19. Leaves not exceeding 20 cm in length, blades to 2.5 cm wide, floral bracts to 2.2 cm long and having a tendency to be cucullate. : 18. Guz. sanguinea var. brevipedicellata.
19. Leaves 25-40 cm long, blades 3.0-4.5 cm wide, floral bracts ca. 3.0 cm long, NOT cucullate. :
17. Guz. sanguinea var. sanguinea.
18. Inflorescence compound upon a well developed scape.
20. Inflorescence digitate, of 2 spikes, each ca. 25 cm long, primary bracts inconspicuous (I).
. : 19. Guz. bipartita.
20. Inflorescence bipinnate, several to many spikes, these to 9.0 cm long, primary bracts conspicuous (II).
21. Inflorescence 4.0-26.0 cm long, primary



I



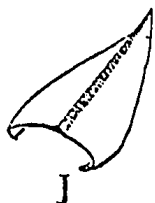
II

bracts equaling to slightly exceeding spikes, 2.5-9.0 cm long, not foliaceous, or if somewhat so then forming conspicuous involucre.

22. Upper scape-bracts forming a conspicuous involucre, inflorescence NOT exceeding leaf-rosette. . . . : 20. Guz. eduardii.
22. Upper scape-bracts NOT forming conspicuous involucre, inflorescence exceeding leaf-rosette.
23. Plant ca. 1 m tall or more, leaf-blade 8.0-10.0 cm broad, inflorescence 14-26 cm long, primary bracts lustrous. : 21. Guz. teuscheri.
23. Plant to 1/2 m tall, leaf-blades 2.0-4.5 cm wide, inflorescence 4.0-8.0 cm long, primary bracts NOT lustrous.
24. Plant small, squat, to 25 cm tall and ca. 1 m in diameter, leaf-blades to 4.5 cm wide, scape ca. 1.0 cm in diameter. : 22. Guz. osyana.
24. Plant large, NOT squat, to ca. 60 cm tall and about as broad as tall, scape slender, 4-5 mm in diameter.
25. Spikes ca. 2.5 cm long, having ca. 6 flowers, floral bracts strongly

carinate (J) : 23. Guz. septata.

25. Spikes 3.0-3.5 cm long, having 10-17 flowers, floral bracts NOT carinate (JJ) : 24. Guz. acuminata.



J

1. Inflorescence 15-40 cm long, primary bracts 2 to 7 times or more longer than spikes or fascicles, often foliaceous.

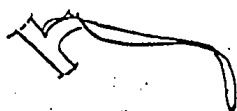


JJ

26. Leaves linear-lingulate, blades to 2.5 cm wide, sepals more than 3.5 cm long, petals 7.0-9.0 cm long. : 25. Guz. wittmackii.

26. Leaves lingulate, blades 3.0-10.0 cm wide, sepals to 3.0 cm long, petals 2.0-6.0 cm long.

27. Primary bracts to at least 30 cm long in part of inflorescence, totally obscuring fascicles (K), scape-bracts spreading to recurving limply and foliaceous throughout. : 26. Guz. squarrosa.



K

27. Primary bracts mostly not exceeding 13 cm in length, partially obscuring fascicles (KK), upper fascicles partially exposed, scape-bracts erect to spreading, NOT recurving limply.



KK

28. Floral bracts ca. 1.8 cm long, sepals

- ca. 1.7 cm long, leaf blades 8.0-10.0 cm wide. : 27. Guz. sodiroana.
28. Floral bracts at least 2.5 cm long, sepals 2.4-2.7 cm long, leaf-blades 4.5-6.0 cm wide.
29. Petals yellow, sepals usually connate for ca. 1.0 cm, primary bracts erect to spreading, overtopping fascicles throughout inflorescence. : 28. Guz. gloriosa.
29. Petals white, sepals usually connate for only ca. 3 mm, primary bracts arching to recurved, NOT much overtopping the fascicles toward apex of inflorescence : 29. Guz. variegata.
1. Inflorescence laxly compound (AA), never with fascicles, primary bracts NOT at all or scarcely obscuring spikes or branches, if slightly so then distance between primary bracts 0.5-3.0 cm.
30. Branches or spikes short, 2.0-11.0 cm long, usually less than 8.0 cm long, erect to spreading, or if spreading to reflexed, not exceeding 6.0 cm in length, inflorescence 7.0-55.0 cm long.
31. Primary bracts shorter than lower



spikes or branches.

32. Floral bracts strongly nerved.
 : 30. Guz. scherzeriana.

32. Floral bracts NOT strongly nerved.

33. Scape slender, 3-5 mm in diameter,
 petals green or white, 1.9-2.3 cm long,
 floral bracts 1.4-1.8 cm long.



L

34. Sepals obtuse, extending well beyond
 floral bracts (L)

- : 31. Guz. patula.



LL

34. Sepals acute to apiculate, NOT extend-
 ing well beyond floral bracts (LL)

- : 32. Guz. asplundii.

33. Scape moderately thick, 6-9 mm in diam-
 eter, petals yellow or white, 2.3-4.0
 cm long, floral bracts 1.3-2.5 cm long.

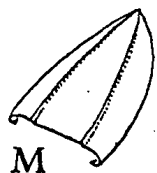
35. Petals white, ca. 2.3 cm long, sepals
 1.2-1.4 cm long, plant ca. 55 cm tall

- : 33. Guz. aequatorialis.

35. Petals yellow, 2.5-4.0 cm long, sepals
 1.7-2.3 cm long, plant ca. 80-100 cm
 tall.

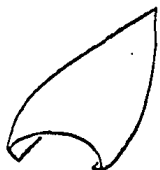
36. Scape-bracts and leaf-sheaths con-
 spicuously red-striate, inflorescence
 having ca. 5 spikes each with 16 to 30
 flowers. : 34. Guz. striata.

36. Scape-bracts and leaf-sheaths NOT conspicuously red-striate, inflorescence having 8 to 16 spikes, each with 16 to 30 flowers. : 34. Guz. striata.
36. Scape-bracts and leaf-sheaths NOT conspicuously red-striate, inflorescence having 8 to 16 spikes each with 12 to 16 flowers. : 35. Guz. morreniana.
31. Primary bracts exceeding or equaling lower spikes or branches.



M

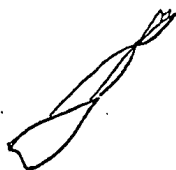
37. Floral bracts NOT strongly nerved, petals green or white, sterile bracts at base of spike wide-bicarinate (M) : 36. Guz. pleiosticha.



MM

37. Floral bracts strongly nerved, petals white or yellow, sterile bracts at base of spike NOT wide-bicarinate (MM).

38. Inflorescence tri- to quadripinnate : 37. Guz. paniculata.



N

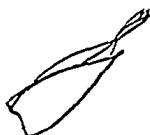
38. Inflorescence bipinnate.
39. Sepals extending well beyond floral bracts at anthesis (N), floral bracts 0.9-1.2 cm long by ca. 0.6-1.4 cm wide, apex obtuse or rounded, spikes ovoid to ellipsoid, 2.5-4.0 cm long by 2.0-2.5 cm wide at anthesis, sepals 1.2-1.7 cm

long.

40. Petals white when living, sepals connate for ca. 3 mm, inflorescence having ca. 16 spikes. : 38. Guz. multiflora.

40. Petals with lobes yellow when living, sepals connate for 1.0-1.3 cm, inflorescence having ca. 8 spikes. : 39. Guz. weberbaueri.

39. Sepals NOT extending beyond floral bracts at anthesis (NN), floral bracts 1.6-2.0 cm long by 1.0-1.4 cm wide, apex acute to apiculate or if obtuse then floral bracts nevertheless much exceeding 1.6 cm long, spikes fusiform to ovoid, 2.0-7.0 cm long by 1.5-2.2 cm wide at anthesis, sepals 1.6-2.2 cm long.



NN

41. Inflorescence ca. 7.0-13.0 cm long with 4 to 7 spikes, spikes erect to spreading : 40. Guz. calamifolia.

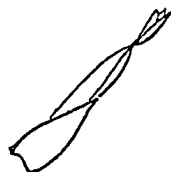
41. Inflorescence ca. 26-50 cm long with 10 to 30 spikes, spikes spreading.

42. Leaves 50-70 cm long, blades linear-lingulate, 2.0-2.5 cm wide, stipes ca. 1.0 cm long with 1 sterile bract, sepals ovate, acute. : 41. Guz. tarapotina.

42. Leaves 40-100 cm long, 4.0-7.0 cm wide, blades lingulate, stipe minimal, no sterile bracts, sepals obovate-elliptic, obtuse. : 42. Guz. elongata.
30. Branches or spikes well developed, 6.0-20.0 cm long or more, spreading or ascending, inflorescence 20-100 cm long.
43. Sepals NOT extending beyond floral bracts, (NN), leaf-blades 2.5-4.0 cm wide, floral bracts 3.5-5.5 cm long, obovate to oblong-elliptic.
44. Scape slender, ca. 4 mm in diameter, sepals acute, floral bracts yellow when living. . . . : 43. Guz. xanthobracteata.
44. Scape NOT slender, 0.9-1.3 cm in diameter, sepals obtuse, floral bracts red when living. . . : 44. Guz. amplexans.
43. Sepals much extending beyond floral bracts (N), leaf-blades 4.0-7.0 cm wide, floral bracts 0.7-2.6 cm long, ovate-elliptic.
45. Floral bracts strongly nerved, inflorescence tripinnate or bipinnate.
46. Floral bracts 2.4-2.6 cm long, obtuse, lepidote within, sepals 3.5-4.0 cm long. . . . : 45. Guz. ecuadorensis.



NN



N

46. Floral bracts 7-9 mm long, acute to broad-acute, glabrous to subglabrous within, sepals 1.0-1.2 cm long.



O

47. Inflorescence tripinnate, flowers per spike or branch 4 to 8, sepals symmetrical (O) : 46. Guz. diffusa.



OO

47. Inflorescence bipinnate, flowers per spike 10 to 20, sepals somewhat asymmetrical (OO) : 47. Guz. rhonhofiana.

45. Floral bracts NOT strongly nerved, if nerved then very inconspicuously so.

48. Axis of inflorescence lepidote, floral bracts 1.2 cm long. : 48. Guz. hitchcockiana.

48. Axis of inflorescence glabrous, floral bracts 1.8-2.0 cm long. : 30. Guz. scherzeriana.

14. GUZMANIA CONIFERA (André) Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 911; Smith, 1936, p. 572.

Caraguata conifera André, 1888 (Énumération Bromél.) p. 5; André, 1889, p. 47, pl. 15.

FIG. 81

PLANT stemless, ca. 1 m tall; LEAVES 60-80 cm long, blades 6.0-8.0 cm wide, lingulate, apex acute to apiculate, appressed lepidote, yellow-green, sheath 16-17 cm long by 10-11 cm wide, not conspicuous; SCAPE ca. 1.3 cm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS 12-20 cm long by ca. 4.5 cm wide, imbricate, the lower foliaceous, upper lanceolate and red, apex acute to attenuate; INFLORESCENCE 13-25 cm long by 8.0-15.0 cm in diameter, simple, flowers many ranked, dense, reminiscent of a large pine cone; FLORAL BRACTS 5.0-6.5 cm long by ca. 2.0 cm wide, triangular-acute, coriaceous, red when alive or red with yellow tips, glabrous without, minutely punctulate within, imbricate, erect; SEPALs 2.5-3.0 cm long by ca. 7 mm wide, erect, obovate-elliptic, coriaceous, dark brown with pale margins; CAPSULES 1.5-3.0 cm long, coma brown, distance between flowers less than 2 mm.

MATERIAL EXAMINED: Poortman 416 (P, TYPE; US, photo) near Zamora, Prov. Zamora, ca. 1500 m, Jan.-June 1882; AJG 1142 (US) km 16 Zamora-Loja, epiphytic, ca. 10 m from ground, not common locally; Prov. Zamora, ca. 1500 m, 11 Aug. 1965.

PERU.

NOTES: This extremely beautiful and conspicuous species was seen by the author only once, not far from the roadside. However, a woodcutter said that somewhat higher up the mountainside it was common, growing on trees and also on the ground. André, 1889, says that the floral bracts are red with yellow apices. AJG 1142 had its floral bracts completely red throughout.

15. GUZMANIA CORIOSTACHYA (Grisebach) Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 914; Smith, 1957, pp. 231-232, fig. 66.

Garaguata coriostachya Griseb., 1865 (Nachr. Ges. Wiss. Goett. vol. 1864) p. 21.

Guzmania michelii Mez, 1903 (Bull. Herb. Boiss. series 2, vol. 3) p. 226.

Tillandsia nigrescens André, 1888 (Énumération Bromél.) p. 8.

PLANT stemless, 40-100 cm tall with inflorescence; LEAVES 30-70 cm long, blades 1.5-3.0 cm wide, lingulate, very obscurely punctulate on both surfaces, apex attenuate; SCAPE 5-8 mm in diameter, erect; SCAPE-BRACTS 4.0-30.0 cm long, erect, lowermost foliaceous, imbricate throughout and obscuring scape, castaneous toward base of each bract, pale toward apices; INFLORESCENCE 5.0-8.0 cm long by ca. 3.0 cm in diameter, glabrous, dense, simple, having 30 to 60 flowers, flowers many ranked, ovoid to cylindrical, erect to slightly curving; FLORAL BRACTS 1.6-2.0 cm long by ca. 1.5 cm wide, suborbicular with broadly triangular obtuse apices, lustrous when dry, dark with pale margins, punctulate without, lepidote within, imbricate, reddish when alive, subcoriaceous; SEPALs 1.3-1.6 cm long by ca. 6 mm wide, erect, broadly acute-apiculate, all equally connate for ca. 4 mm, papery, punctulate without, slightly lepidote within; PETALS 2.1-2.5 cm long, white, lobes el-

liptic, obtuse; CAPSULE ca. 2.0 cm long, distance between flowers 1-2 mm.

MATERIAL EXAMINED: André 3327 (K, TYPE of T. nigrescens; US, photo) Colombia, ca. 1400 m; Langlassé 100a (B, TYPE of Guz. michelii; US, photo) Colombia, ca. 2000 m; Grubb et al. 1065 (US) "primary montane forest east of Borja," epiphytic, Prov. Napo Pastaza, ca. 1830 m, 28 July 1960; Harling 3696 (US) epiphytic, Mera, Prov. Napo Pastaza, ca. 1160 m, 26 Dec. 1958.

COLOMBIA, COSTA RICA, PANAMA, VENEZUELA.

16. GUZMANIA DEVANSAYANA Morren, 1883 (Belgic. Hortic. vol. 33) p. 113, pl. 8-9; Mez, 1935, p. 615.

FIG. 82

PLANT stemless, ca. 50 cm tall with inflorescence; LEAVES 30-60 cm long, blades 1.5-3.0 cm wide, lingulate, moderately densely lepidote, much appressed, apex acute, sheath ca. 10 cm long by 4.5-5.5 cm wide, concolorous with blade; SCAPE ca. 4 mm in diameter, erect, much shorter than leaf-rosette; SCAPE-BRACTS 8.0-20.0 cm long, erect, imbricate throughout, apex attenuate to apiculate, lowermost foliaceous; INFLORESCENCE ca. 6.0 cm long by ca. 4.5 cm in diameter at anthesis, simple, flowers many ranked, erect, dense, often red, glabrous; FLORAL BRACTS 2.3-2.8 cm long by 1.8-2.2 cm wide, erect, imbricate, narrowly triangular, apices attenuate, glabrous without and within, coriaceous, often red when alive, stramineous when dry; SEPALS ca. 1.5 cm long by 8 mm wide, obovate, obtuse-apiculate, all equally connate 4-6 mm, coriaceous, all three carinate, glabrous without, lepidote within; PETALS ca. 3.2 cm long, yellow; CAPSULE ca. 3.0 cm long, distance between flowers ca. 2 mm.

MATERIAL EXAMINED: Morren s. n. (K, TYPE; US, photo) cultivated, 22 April 1883; Drake 146 (NY; US, photo) a quebrada near Loja, Prov. Loja, probably ca. 2000 m, 1881; AJG 836 (US) epiphytic, moderately common, ca. 24 km east of Loja, road to Zamora, Prov. Zamora, ca. 2050 m, 21 Feb. 1963.

GUZMANIA SANGUINEA (André) Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 901; Smith, 1957, pp. 226-227, fig. 63.

Caraquata sanguinea André, 1888 (Énumération Bromél.) p. 5; André, 1889, pp. 45-46, pl. 17 a.

PLANT stemless, 20-25 cm tall by ca. 30 cm in diameter; LEAVES 20-40 cm long, blades 2.0-4.5 cm wide, lingulate, densely lepidote, may be purple below, green or red, spreading; SCAPE none or at least not at all apparent from without; INFLORESCENCE sunk in the leaf-rosette not visible or slightly so from side, having 7 to 35 flowers but usually only 4 to 6 flowers opening at one time, simple, dense; FLORAL BRACTS ca. 3.0 cm long by ca. 2.0 cm wide, acute to obtuse-apiculate, papery, slightly lepidote to glabrous without, glabrous within, nerved, exceeding or shorter than sepals; SEPALS 1.2-2.4 cm long by 7-8 mm wide, elliptic, papery, obtuse, connate for 2-5 mm; PEDICELS 0.3-1.2 cm long; PETALS 5.0-7.0 cm long at anthesis, lobes yellow, or orange with green apices; OVARY ca. 0.7-1.0 cm long; CAPSULES 3.5-4.5 cm long.

17. GUZMANIA SANGUINEA var. SANGUINEA

FIG. 83

Leaves mostly at least 25 cm long, blades at least 3.0 cm wide; floral bracts 3.0 cm long or more, apex abruptly acuminate; sepals 1.8-2.4 cm long, flowers not or scarcely showing at anthesis, petals yellow or yellow bordered with white.

MATERIAL EXAMINED: André 3369 (K, TYPE; US, photo)

Colombia, ca. 990 m; Wagner, Geo. s. n. (US) near coast, Prov. Manabí, ca. 100 m, June 1957; AJG 771 (US) Cerro Monte Cristi, epiphytic, moist "garua" forest, common, Prov. Manabí, ca. 400 m, 10 Aug. 1962; AJG 861 (US) epiphytic, 2-3 m from ground, common, wet, western slope of Cerro Monte Cristi, Prov. Manabí, ca. 350 m, 8 Sept. 1963.

TRINIDAD, COCOS ISLAND, COLOMBIA.

18. GUZMANIA SANGUINEA var. BREVIPEDICELLATA Gilmartin, var. nov.

FIG. 84

A var. sanguinea pedicellis brevioribus, foliis angustioribus, bracteis florigeris brevioribus, acutatis, subcucullatis, differt.

Leaves mostly not exceeding 20 cm in length, blades to 2.5 cm wide; floral bracts to 2.2 cm long, apex acute not at all abruptly acuminate; sepals to 1.7 cm long, flowers apparent from side of plant at anthesis, petals with lobes yellow or yellow with green apices.

MATERIAL EXAMINED: AJG 888 (US, TYPE) wet forest, ca. km 97 Duran-El Tambo, Prov. Cañar, ca. 2100 m, 22 March 1964; Wagner s. n. (US) Prov. Chimborazo, ca. 1500 m, 1957(?); Teuscher s. n. (US) near town of Ducur, Cuenca-Guayaquil road, probably Prov. Cañar, altitude(?), date(?); AJG 739 (US) epiphytic on "matapalo" cloud forest, 1 km east of Bucay, Prov. Chimborazo, ca. 300 m, 4 June 1962.

NOTES: The most outstanding distinction between the

two varieties of Guzmania sanguinea lies in the shape of the floral bracts. The typical variety has its apex apiculate to attenuate, the tip decidedly drawn out, and there is no sign of the bract being at all cucullate (hooded). In the variety here described, var. brevipedicellata, the floral bracts have a simple acute apex, with the tip not at all drawn out and they have a tendency to be cucullate. The typical variety has been collected in the Province of Manabí, of coastal Ecuador and in Colombia. Variety brevipedicellata has been collected on the western slopes of the Andes in Central Ecuador between 300 and 2100 m. Both varieties grow in damp areas and usually epiphytically.

20. GUZMANIA EDUARDII Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 947; Smith, 1957, pp. 217-218, fig. 60.

Caraguata morreniana André, 1887 (Revue Hortic. vol. 59) p. 12, pl.

Not Guzmania morreniana (Linden) Mez, 1896.

PLANT stemless, ca. 70 cm tall; LEAVES 40-75 cm long, blades 3.0-4.0 cm wide, lingulate, slightly lepidote beneath, nearly glabrous above, apex acute, sheath ca. 10 cm long by 5.0-6.0 cm wide, elliptic, dark castaneous; SCAPE ca. 3 mm in diameter, erect, much exceeded by leaf-rosette; SCAPE-BRACTS 6.0-16.0 cm long, imbricate throughout, erect, lowermost foliaceous, the upper ones red and forming an involcre; INFLORESCENCE 7.0-10.0 cm long by ca. 9.0 cm in diameter including subtending bracts, appears simple from a distance, actually bipinnate, having ca. 10 spikes, dense, spikes digitately disposed; PRIMARY BRACTS 3.0-9.0 cm long, red, like upper scape bracts, apex acute; SPIKES 4.0-8.0 cm long by ca. 2.0 cm wide, erect, distance between spikes ca. 5 mm, having 6 to 9 flowers per spike, stipe minimal; FLORAL BRACTS 2.3-3.2 cm long by 7-9 mm wide, elliptic, papery, nerved, glabrous without and within, apex acute to broad-acute; SEPALS 2.0-2.5 cm long by ca. 3 mm wide, papery, obovate-elliptic, connate equally for 5-9 mm, acute, strongly nerved, glabrous without, very inconspicuously lepidote within; PETALS ca. 4.0 cm long, usually white, distance between flowers 2-4 mm, in flower around May-July.

MATERIAL EXAMINED: André 3396 bis (K, TYPE; US, photo) Colombia, ca. 1000 m; Garcia-Barriga 11125 (US) Colombia, 500-600 m.

COLOMBIA.

NOTES: This species is easily confused with Guzmania lingulata. While Guzmania eduardii has not yet been collected in Ecuador it is likely that it will be found there. The basic differences between Guzmania lingulata and Guzmania eduardii are, the compound inflorescence in the latter, together with the smaller floral bracts, to 3.2 cm long, the high connate sepals and the white petals. However, this latter character of floral color may not hold consistently. Superficially the two species appear very similar both having conspicuous, red bracts subtending and partially obscuring the flowers. Guzmania eduardii, to date, appears to be from somewhat higher altitudes, ca. 1000 m, than does Guzmania lingulata. However, any definitive statements on the distribution must await further collections.

21. GUZMANIA TEUSCHERI L. B. Smith, 1960 (Bromel. Soc. Bull. vol. 9) p. 86, fig.

FIG. 85

PLANT stemless, to 120 cm tall by ca. 100 in diameter; LEAVES 55-80 cm long, blades 8.0-10.0 cm wide, lingulate, densely, appressed-lepidote, dark green, apex apiculate, sheath 18-24 cm long by ca. 15 cm wide, dark brown; SCAPE 1.1-1.4 cm in diameter, erect, slightly exceeding leaf-rosette; SCAPE-BRACTS 6.0-15.0 cm long by ca. 3.0 cm wide, densely imbricate, erect throughout, reddish brown when alive, lepidote, apices attenuate; INFLORESCENCE 14-26 cm long by ca. 4.5-6.0 cm in diameter when dry, when living to 8.0 cm in diameter, yellow, ellipsoid to cylindric, bipinnate, dense, slightly lepidote, having ca. 15 to 20 fascicles; PRIMARY BRACTS 3.0-6.5 cm long by ca. 4.0 cm wide, coriaceous, erect, with shiny, brown bases, apices acute, about equaling fascicles; FASCICLES 2.0-4.0 cm long by 2.5-3.0 cm wide, erect, having 6 to 10 flowers per fascicle, stipe to 1.0 cm long; FLORAL BRACTS 2.6-2.9 cm long by ca. 1.2-1.6 cm wide, ovate, rugose when dry, brown, shiny-brown below, slightly lepidote without, punctulate within, papery to subcoriaceous, apex acute; SEPALS 2.2-2.5 cm long by 6-8 mm wide, elliptic, acute, strongly nerved, subglabrous without, punctulate within, subcoriaceous to papery, subequally connate for 3-5 mm, posteriorly carinate; distance between flowers less than 2 mm.

MATERIAL EXAMINED: Teuscher 2106-56 (US) ca. 60 miles west-south-west of Guayaquil, probably on Guayaquil-El Tambo road, Prov. Cañar(?), cultivated in Montreal Bot. Gard., 1 April 1956; AJG 804 (US) epiphytic, ca. 10 m from ground or more, moist "garua" forest, near summit of Monte Cristi, Prov. Manabí, ca. 500 m, 10 Aug. 1963; AJG 1179 (US) cloud forest, between El Tambo and Guayaquil, Prov. Cañar, ca. 800 m, 14 Aug. 1965.

22. GUZMANIA OSYANA (Morr.) Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 914.

Caraguata osyana Morren, 1885 (Belgic. Hortic. vol. 35) p. 254, pls. 16-17.

PLANT to 25 cm tall and to 1 m in diameter, extremely squat; LEAVES ca. 45 cm long, blades 3.0-4.5 cm wide, lingulate, subglabrous, apex acute to apiculate; SCAPE ca. 10 cm long exclusive of inflorescence, by 1.0 cm in diameter; SCAPE-BRACTS 6.0-14.0 cm long by ca. 3.0 cm wide, erect and imbricate throughout, totally obscuring scape; INFLORESCENCE 7.0-8.0 cm long by 6.0-7.0 cm in diameter, bipinnate, dense, globose, erect; PRIMARY BRACTS 3.5-6.5 cm long by ca. 3.0 cm wide, erect, partly obscuring all spikes, apex attenuate; SPIKES ca. 2.5-5.5 cm long, few-flowered, erect; FLORAL BRACTS ca. 4.5 cm long; SEPALS ca. 3.0 cm long, connate for ca. 2 mm, elliptic, obtuse, not nerved; PETALS ca. 6.0 cm long.

MATERIAL EXAMINED: Wallis s. n. (LG, TYPE; US, photo) a specimen cultivated by Morren, Ecuador, no locality given.

23. GUZMANIA SEPTATA L. B. Smith, 1959 (Phytologia vol. 6, no. 8) pp. 437-438, pl. 2, figs. 3-5.

PLANT ca. 55 cm tall; LEAVES 35-45 cm long, blades 2.5-3.2 cm wide, appearing glabrous, apex acute, sheath 13-18 cm long by 5.0-6.5 cm wide, partially covered with fine brown appressed scales, dark castaneous at base, more or less red-striate above when alive, nodulose-septate in fine wavy cross-lines; SCAPE ca. 5 mm in diameter, erect, much exceeding leaf-rosette; SCAPE-BRACTS 5.0-20.0 cm long, densely imbricate and foliaceous, totally obscuring scape, erect, apices attenuate; INFLORESCENCE 5.0-6.0 cm long by ca. 4.0 cm in diameter, bipinnate, dense, subglobose, glabrous, green; PRIMARY BRACTS 2.5-4.0 cm long by ca. 2.0 cm long, erect, apex attenuate, mostly exceeding spikes; SPIKES ca. 2.5 cm long, having ca. 6 flowers, strobilate, erect, stipe minimal; FLORAL BRACTS ca. 1.4 cm long by 1.2 cm wide, strongly carinate, coriaceous, broadly ovate, subglabrous without, densely punctulate within, exceeded by sepals, not nerved; SEPALS ca. 1.5 cm long by 6 mm wide at anthesis, obovate to broadly elliptic, coriaceous, equally connate for 5 mm, broadly acute to obtuse, not nerved, posteriorly carinate, glabrous without, densely lepidote within; PETALS with lobes ca. 7 mm long, white, style exserted, stamens included, distance between flowers 1-2 mm.

MATERIAL EXAMINED: Asplund 19948 (S, TYPE; US, photo

and fragments) on tree trunk, Mera, Prov. Napo Pastaza, ca.
1100 m, 25 March 1956; Asplund 19679 (US) Shell Mera, Prov.
Napo Pastaza, ca. 900 m, 10 March 1956.

24. GUZMANIA ACUMINATA L. B. Smith, 1953 (Phytologia vol. 4, no. 5) pp. 359-360, pl. 2, figs. 3-5.

PLANT ca. 60 cm tall; LEAVES ca. 50 cm long, blades 2.0-2.5 cm wide, lingulate, glabrous above, densely lepidote beneath, apex acuminate, sheaths 10-12 cm long by ca. 6.0 cm wide, elliptic; SCAPE 4-5 mm in diameter, erect; SCAPE-BRACTS 8.0-30.0 cm long, imbricate throughout, foliaceous below, totally obscuring scape, apex acuminate; INFLORESCENCE 4.0-5.0 cm long by ca. 4.0 cm in diameter, densely bipinnate, glabrous, having ca. 5 spikes; PRIMARY BRACTS ca. 4.0 cm long, equaling or exceeding spikes, apex acuminate; SPIKES 3.0-3.5 cm long by 2.0-3.0 cm wide, spreading, having ca. 10 to 17 flowers per spike, stipe minimal to 8 mm long with one bicarinate sterile bract; FLORAL BRACTS 1.7-2.0 cm long by 0.9-1.1 cm wide, acute to apiculate, ecarinate, erect, imbricate, coriaceous, not nerved, ovate, equaling or exceeding sepals, green when alive; SEPALS 1.3-1.4 cm long by ca. 5 mm wide, coriaceous, not nerved, ecarinate, apex broadly acute to obtuse, subequally connate for 4-6 mm, glabrous without, densely lepidote within; PETALS 1.9-2.1 cm long, lobes white, distance between flowers ca. 3 mm.

MATERIAL EXAMINED: Foster 2218 (US, ISOTYPE) Colombia, Dept. Putumayo, ca. 1225 m; Asplund 20114 (US) epiphytic, in scrub, Shell Mera, Prov. Napo Pastaza, ca. 900 m, 3 April 1956.

COLOMBIA.

25. GUZMANIA WITTMACKII (André) Mez, 1896 (DC Monogr.

Phaner. vol. 9) p. 921; Smith, 1957, p. 221.

Thecophyllum wittmackii André, 1889 (Bromel. Andreanae)
p. 107, pl. 39 b; Mez, 1935, p. 418.

FIG. 86

PLANT ca. 80 cm tall; LEAVES 50-85 cm long, blades 2.0-2.4 cm wide, linear-lingulate, densely lepidote below, appearing glabrous above, apex attenuate, sheath ca. 10 cm long by 6.0 cm wide; SCAPE 3-4 mm in diameter, curved; SCAPE-BRACTS 20-50 cm long, foliaceous and densely imbricate throughout, suberect to spreading, red distally; INFLORESCENCE ca. 20 cm long by ca. 15 cm in diameter, pseudo simple or bipinnate, with few flowers in fascicles, lax, glabrous; PRIMARY BRACTS ca. 15 cm long by ca. 1.2 cm wide, linear to narrowly triangular, distance between bracts 2.0-3.5 cm, spreading, much exceeding and totally obscuring flowers, apex attenuate; SPIKES of one to few flowers, 7.0-9.0 cm long by 1.4 cm wide, stipe minimal; FLORAL BRACTS ca. 8.0 cm long by 1.5 cm wide, carinate(!) papery, glabrous without, lepidote within, enfolding the flower or spike of flowers; SEPALS ca. 4.0 cm long by 1.3 cm wide, papery to subcoriaceous, linear, carinate, free to connate for 5 mm; PETALS 7.0-9.0 cm long, white, distance between flowers ca. 4 mm.

MATERIAL EXAMINED: André 3298 (K, TYPE; US, photo) Colombia, ca. 900 m; Sodirol 171/44 (Quito; AJG photo) near

Balsapamba, between Guaranda and Babahoyo, Prov. Bolívar, estimate 1500 m, Oct. 1891; Sodirol 171/48 (GH) Ecuador; Haught 2897 (US) Cerro Cimalon, Hacienda Vainilla, Prov. Guayas, ca. 250 m, 7 Oct. 1939; Drew E-544 (US) epiphytic, near San Luis de la Vega, below Garcia Moreno, near confluence of Río Intag and Río Guayllabamba, Prov. Imbabura, ca. 1040 m, 9 Sept. 1944.

COLOMBIA.

NOTES: Guzmania wittmackii (André) Mez, is distinct from most other Ecuadorian species of the genus, Guzmania, in having definitely carinate floral bracts. Guz. septata is the only other Ecuadorian species of this genus with carinate floral bracts. Whether or not the petals are actually united in this species, was not possible to ascertain. The largely simple inflorescence precludes, as well, any decision as to the disposition of flowers, whether polystichous or distichous.

26. GUZMANIA SQUARROSA (Mez and Sodiro) Smith and Pittendrigh, 1953 (Journ. Wash. Acad. Sci. vol. 43, no. 12) p. 403; Smith, 1967, p. 180.

Thecophyllum squarrosum Mez and Sodiro, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 877.

Guzmania cryptantha L. B. Smith, 1942 (Caldasia no. 5) pp. 6-7, fig. 2; Smith, 1957, p. 225.

FIG. 87

PLANT ca. 80 cm tall; LEAVES 40-80 cm long, blades 3.0-6.5 cm wide, lingulate, arching limply, often reddish, densely lepidote, apex acute, sheath, 14-18 cm long by 9.0-10.0 cm wide, upper surface purple when fresh, ovate; SCAPE ca. 0.9 cm in diameter, erect; SCAPE-BRACTS 18-40 cm long, imbricate, foliaceous, arching limply like leaves and blending in gradually with leaf-rosette; INFLORESCENCE 15-30 cm long by ca. 25 cm in diameter including primary bracts, bipinnate, lax below to dense above, lepidote, often green and yellow or green and red when alive, having ca. 12 fascicles subtended by elongate primary bracts; PRIMARY BRACTS 5-40 cm long, foliaceous, much exceeding the very inconspicuous fascicles, lepidote; FASCICLES 2.5-5.0 cm long by 2.0-5.0 cm wide, erect to spreading, having 3 to 6 flowers, distance between fascicles 1.0-3.5 cm; FLORAL BRACTS 1.5-2.0 cm long by ca. 1.0 cm wide, papery, erect, imbricate, broadly acute to obtuse, about equaling sepals, lepidote without and within, green with often yellow apices

when alive; SEPALS 1.6-1.8 cm long by 4-5 mm wide, papery, strongly nerved, lepidote within and without, equally connate for 1.8-3.0 cm; PETALS 2.3-2.8 cm long, lobes yellow; OVARY 7-9 mm long by 3 mm in diameter, distance between flowers ca. 2 mm or less.

MATERIAL EXAMINED: Sodirol 171/47 (B, TYPE; US, photo) near Mt. Pichincha, Prov. Pichincha, Jan. 1901; Cuatrecasas 8472 (US, TYPE of Guz. cryptantha) Colombia; AJG 852 (US) Pilaló, wooded lot opposite Hotel Nuevo, epiphytic, 2-6 m from ground, common locally, Prov. Cotopaxi, ca. 2400 m, 26 July 1963.

COLOMBIA, BRITISH GUIANA, VENEZUELA.

27. GUZMANIA SODIROANA Mez, 1905 (Bull. Herb. Boiss. series 2, vol. 5) p. 114; Mez, 1935, p. 620.

PLANT to ca. 1 m tall; LEAVES to 1 m long, blades 8.0-10.0 cm wide, lingulate, apex attenuate, densely lepidote, sheath ca. 35 cm long by ca. 15 cm wide, elliptic, dark castaneous above; SCAPE ca. 1.4 cm in diameter, erect; SCAPE-BRACTS to ca. 30 cm long, erect to spreading, imbricate throughout, red when alive; INFLORESCENCE to 25 cm long by ca. 10 cm in diameter, bipinnate, dense, exceeding leaves, having ca. 11 spikes; PRIMARY BRACTS ca. 7.5 cm long by 4.0 cm wide, apices spirally recurving, exceeding and partially obscuring spikes; SPIKES ca. 4.0 cm long by ca. 2.5 cm wide, having ca. 12 to 16 flowers per spike, suborbicular; FLORAL BRACTS ca. 1.8 cm long, elliptic, coriaceous, broadly acute; SEPALS ca. 1.7 cm long, elliptic, narrowly obtuse, glabrous, not nerved, free.

MATERIAL EXAMINED: Sodiro 171/46 (B, TYPE; US, AJG, photo) in Nanegal valley, west of Otavalo, Prov. Pichincha, probably ca. 1000 m.

28. GUZMANIA GLORIOSA (André) Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 922; Smith, 1957, p. 224.

Caraguata gloriosa André, 1888 (Énumération Bromél.) p. 5; André, 1889, pp. 48-49, pl. 17 c.

PLANT ca. 1 m tall; LEAVES usually ca. 40-55 cm long, blades 5.0-6.0 cm wide, lingulate, acute to apiculate, densely lepidote below, sheath 7.0-9.0 cm long by 7.0-9.0 cm wide; SCAPE ca. 1.0 cm in diameter, erect; SCAPE-BRACTS to ca. 50 cm long by 4.0-5.0 cm wide, spreading, foliaceous and imbricate throughout, green toward their bases and red toward apices; INFLORESCENCE ca. 40 cm long by ca. 8.0-12.0 cm in diameter, cylindric, dense, bipinnate; PRIMARY BRACTS 10-35 cm long, foliaceous, much exceeding and partially obscuring fascicles, bases green, mid-portion yellow, apices red, sometimes without the yellow mid-portion and sometimes upper most bracts green; FASCICLES 4.0-5.0 cm long exclusive of petals, by ca. 2.0-2.5 cm wide, having ca. 4 to 5 flowers per fascicle, erect; FLORAL BRACTS 2.5-4.0 cm long by 1.2-2.0 cm wide; SEPALS ca. 2.4-2.6 cm long by ca. 6 mm wide, elliptic, broadly acute, nerved, connate up to 1.0 cm; PETALS ca. 6.0 cm long, lobes yellow.

MATERIAL EXAMINED: André 3791 (K, TYPE; US, photo) at Perucho, near Quito, Prov. Pichincha, 1830 m, July 1876; Hitchcock 21368 (US) epiphytic, between La Toma and Loja, Prov. Loja, 1800-2600 m, 4 Sept. 1923; Asplund 17156 (US) below San Juan towards Chiriboga, Prov. Pichincha, ca.

3000 m, 2 Aug. 1955; Naundorff s. n. (US) near Chiriboga, Prov. Pichincha, ca. 1500 m, cultivated by Marnier-Lapostolle, June 1963; AJG 737 (US) between Quevedo and Quito, ca. 112 km from Quito, cloud forest, terrestrial, Prov. Cotopaxi, 2700 m, 27 May 1962.

COLOMBIA.

NOTES: See notes under Guz. variegata.

29. GUZMANIA VARIEGATA L. B. Smith, 1960 (Phytologia vol. 7, no. 3) p. 108.

FIG. 88

PLANT 80 cm to over 1 m tall; LEAVES 50-75 cm long, blades 4.5-6.0 cm wide, lingulate, apex acute, nearly glabrous upper surface, lower surface inconspicuously punctulate, sheath 12-16 cm long by 9.0-10.0 cm wide, elliptic, when alive purple above, green below; SCAPE ca. 1.5 cm in diameter, erect, not much exceeding leaf-rosette; SCAPE-BRACTS 20-30 cm long or more by 4.0-7.5 cm wide, foliaceous, green or often with red base and green apex, apex acute; INFLORESCENCE 25-40 cm long by ca. 20 cm in diameter, bipinnate, lax, mostly glabrous, red and green, having ca. 10 to 15 fascicles; PRIMARY BRACTS 5.0-13.0 cm long by 3.5-5.0 cm wide, spreading to reflexed, often with red base and green apex, densely punctulate on lower surface, glabrous above, lowermost foliaceous and greatly exceeding fascicles, upper ones equaling fascicles; FASCICLES 5.0-7.0 cm long by 3.5-4.0 cm wide, short-stipate, having 10 to 16 flowers per fascicle; FLORAL BRACTS 3.0-3.7 cm long by 1.5-2.0 cm wide, elliptic, nerved, equaling or exceeding sepals, lepidote without and within, red when alive, apex obtuse; SEPALS 2.4-2.7 cm long by ca. 6 mm wide, elliptic, strongly nerved, obtuse, connate subequally for ca. 3 mm; PETALS 4.0-5.0 cm long, white, lobes erect, stamens included by ca. 2-3 mm; CAPSULES ca. 2.2 cm long, distance

between flowers less than 2 mm.

MATERIAL EXAMINED: Rauh E56/15/12 (US, TYPE) Peru, ca. 3800 m, Dept. Piura; Foster 2600 (US) Portovelo, road to Cachicaran, epiphytic, Prov. El Oro, ca. 700 m, 30 Nov. 1948; Teuscher 2120-56 (US) near Ducur, cultivated in Montreal, Prov. Cañar, Dec. 1958 collected from cultivation; Hitchcock 21179 (US) epiphytic, between La Chorita and Portovelo, gold mine near Zaruma, Prov. El Oro, 1000-2000 m, 28 Aug. 1923; AJG 848 (US) epiphytic, km 90 Duran-El Tambo, Prov. Cañar, 1750 m, 2 June 1963; AJG 890 (US) terrestrial on very steep hillsides, common, ca. km 94 Duran-El Tambo, Prov. Cañar, ca. 2100 m, 22 March 1964; AJG 1171 (US) terrestrial, roadcut, common, tank full of water, cloud forest, Prov. Cañar, ca. 1100 m, 13 Aug. 1965; Acosta Solis 7361 (F) road to Huamboya, near La Esperanza, Prov. Zamora, 2000-2600 m, 13 Feb. 1944.

PERU.

NOTES: The two species, Guzmania variegata and Guz. gloriosa are very similar and distinguishable largely by petal-color, being white in the former and yellow in the latter. The other characteristics that may be used for separation of these two species are perhaps not as reliable.

Guz. gloriosa is said to have primary bracts with the bases green, mid-portion yellow and the apices red; Guz. variegata is said to have red and green primary bracts. While the floral bracts and sepals are somewhat larger in

Guz. gloriosa, being to 4.0 cm long and to 3.3 cm long respectively these are very difficult criteria to apply unless the inflorescences that are being compared are exactly at the same stage of development. What appeared at first to be a good diagnostic character, the union of the sepals, to 1.0 cm in Guz. gloriosa and not much more than 3 mm in Guz. variegata, now seems unreliable. AJG 890 with white petals and primary and scape-bracts red with green apices has its sepals ca. 8 mm connate. Very possibly there is some interbreeding between the two species. The flowering times seem to overlap. Guz. gloriosa has been collected in flower from March to September. Guz. variegata has been collected in flower from June to December exclusive of AJG 890, a possible hybrid which was in flower in March. At any rate, to date, Guz. gloriosa has been collected in northern Ecuador from the provinces of Pichincha and Cotopaxi, from about 1500 to 3000 meters altitude and in southern Ecuador from the Province Loja, between 1800 and 2600 meters altitude as well as from Colombia. Guz. variegata has been collected in Peru at ca. 3800 meters and in Ecuador in the provinces of El Oro and Cañar from 700 to ca. 2100 meters, and from the Prov. of Zamora on the eastern slopes of the Andes between 2000-2600 m.

30. GUZMANIA SCHERZERIANA Mez, 1896 (DC Monogr. Phaner. vol. 9) p. 949; Smith, 1949, p. 296; Smith, 1957, pp. 207-208, fig. 57.

Guzmania herthae Harms, 1939 (Notizblatt Bot. Gart. und Mus. Berlin, vol. 14) p. 329.

FIG. 89

PLANT 50-80 cm tall, stemless; LEAVES 40-80 cm long, blades ca. 3.0-6.0 cm wide, linguulate, appressed lepidote, apex acute, sheath ca. 12-15 cm long by ca. 5.0 cm wide, ovate, dark castaneous or nearly concolorous with blade; SCAPE 5-10 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS erect, imbricate, the lower foliaceous; INFLORESCENCE 14-37 cm long by ca. 8.0 cm in diameter or more, bipinnate, glabrous, lax, having 7 tall branches; PRIMARY BRACTS broadly ovate, acuminate or acute, about equaling branch stipe; BRANCHES ca. 6.0-9.0 cm long, having 2 to 8 flowers, erect to spreading; FLORAL BRACTS 1.5-2.0 cm long by 8-9 mm wide, spreading, papery, obtuse, nerved, ecarinate, subglabrous without and within, ovate; PEDICELS 4-6 mm long; SEALS 2.0-2.7 cm long by ca. 6 mm wide, elliptic-ovate, obtuse, connate equally for 8-10 mm, nerved, carinate; PETALS ca. 3.3 cm long, yellow with green apices; CAPSULE 3.0-3.5 cm long, coma pale brown, distance between flowers 5-10 mm.

MATERIAL EXAMINED: Schultze-Rhonhof 1923 (B, TYPE of Guz. herthae; US photo) San Carlos de Los Colorados, Prov.

Pichincha, 27 Sept. 1935; Asplund 5568 (US) epiphytic, Hacienda Clementina on Río Pita, Cerro Mombe, Prov. Los Ríos, ca. 300 m, 29 March 1939; AJG 1059 (US) ca. 2 km northwest of Santo Domingo, La Mina de Toachi, rainforest, moderately common, epiphytic, Prov. Pichincha, 600 m, 3 Aug. 1965.

COLOMBIA, PANAMA.

31. GUZMANIA PATULA Mez and Wercklé, 1916 (Fedde Repert. Spec. Nov. vol. 14) p. 255; Smith, 1957, pp. 210-211.

FIG. 90

PLANT 40-65 cm tall, short-stemmed, with well developed holdfasts; LEAVES 25-45 cm long, blades 2.0-3.5 cm wide, lingulate, subglabrous, apex acute, sheaths 6.0-9.5 cm long by 4.5-5.5 cm wide, green with purple stripes, these disappearing in dry specimens; SCAPE ca. 3 mm in diameter, erect to curving, exceeding leaf-rosette; SCAPE-BRACTS 3.0-4.0 cm long by ca. 1.6 cm wide, imbricate below, not or scarcely so above, striate-purple, erect, apices attenuate; INFLORESCENCE 12-20 cm long by 7.0-10.0 cm in diameter, bipinnate, lax, having 4 or 5 branches, these 2.0-5.0 cm apart, glabrous; PRIMARY BRACTS 2.0-5.0 cm long by ca. 2.5 cm wide, erect to spreading, much shorter than branches, about as long as stipe, apex attenuate; BRANCHES 3.0-5.5 cm long by ca. 2.0 cm wide at anthesis, erect to spreading, having ca. 10-20 flowers per branch, stipe 1.0-2.5 cm long with one sterile bract, this bicarinate and on top side of stipe; FLORAL BRACTS ca. 1.5 cm long by 1.0 cm wide, ovate, broadly acute to obtuse, spreading, scarcely or not at all imbricate at anthesis, not at all nerved, coriaceous, purple when alive, glabrous without, lepidote within; PEDICELS ca. 3-4 mm long; SEPALs ca. 1.5 cm long by ca. 4 mm wide, exceeding floral bracts after anthesis, posteriorly carinate, strongly nerved, glabrous without,

lepidote within, obtuse; PETALS ca. 2.0 cm long, lobes green or white; CAPSULE ca. 1.5 cm long, distance between flowers 2-3 mm, in flower around September to December.

MATERIAL EXAMINED: Wercklé s. n. (B, TYPE; US, AJG photo) Costa Rica; Foster 2635 (US) epiphytic, road from Quito to Esmeraldas, Prov. Pichincha, ca. 1500 m, 8 Dec. 1948; AJG 862 (US) epiphytic, 2.5 m from ground, near summit of Cerro Monte Cristi, Prov. Manabí, ca. 550 m, 8 Sept. 1963; AJG 766 (US) Cerro Monte Cristi, ca. 450 m, Prov. Manabí, 10 Aug. 1962.

COSTA RICA, COLOMBIA, VENEZUELA.

32. GUZMANIA ASPLUNDII L. B. Smith, 1959 (Phytologia vol. 6, no. 8) p. 436, pl. 1, figs. 19-21.

PLANT 40-100 cm tall with inflorescence; LEAVES 35-80 cm long, blades 1.5-3.5 cm wide, linear or lingulate, apex attenuate, sheath 10-15 cm long by 5.0-5.5 cm wide, narrowly elliptic to elliptic, red-striate, dark brown toward base; SCAPE 3-5 mm in diameter, exceeding the leaf-rosette; SCAPE-BRACTS 4.0-35.0 cm long by ca. 1.6 cm wide, erect and imbricate throughout, apex attenuate, scape slightly exposed above, the lower ones foliaceous; INFLORESCENCE 12-23 cm long by 5.0-7.0 cm in diameter at anthesis, bipinnate with 5 to 12 spikes, lax, glabrous to subglabrous, pyramidal to cylindrical; PRIMARY BRACTS 2.0-4.0 cm long, erect to spreading, about 1/4 to 1/2 the spike length, apex attenuate; SPIKES 3.0-6.0 cm long by 1.0-2.5 cm wide at anthesis, erect to spreading, distance between spikes ca. 1.0-3.0 cm, flowers per spike 9 to 13, stipe minimal to 8 mm long with one sterile bract; FLORAL BRACTS 1.4-1.8 cm long by ca. 1.0 cm wide, elliptic-ovate, obtuse to acute, not at all nerved or scarcely so, erect, imbricate, coriaceous, appressed lepidote without with coalesced shiny scales, very pale lepidote within, pale green with brown base or purple; SEPALS 1.4-1.5 cm long by ca. 5 mm wide, glabrous without, punctulate within, acute to apiculate, ecarinate, subequally short-connate equaling floral bracts; PETALS 1.9-2.3 cm long, erect, green, stamens included;

OVARY ca. 5 mm long, distance between flowers 2-5 mm,
flowers around September to November.

MATERIAL EXAMINED: Asplund 18488 (S, TYPE; US, photo;
ISOTYPE, US) on rotten log, Mera, Prov. Napo Pastaza, ca.
1040 m, 17 Nov. 1955; Asplund 18704 (US) epiphytic, Mera,
forest near Mangayacu, Prov. Napo Pastaza, ca. 1100 m, 6
Dec. 1955.

33. GUZMANIA AECUATORIALIS L. B. Smith, 1959 (Phytologia, vol. 6, no. 8) pp. 435-436, pl. 1, figs. 15-13.

PLANT ca. 55 cm tall with inflorescence; LEAVES 35-45 cm long, blades 3.0-3.5 cm wide, lingulate, very inconspicuously lepidote, apex attenuate, sheath ca. 10 cm long, nearly concolorous with blade; SCAPE ca. 6 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS 5.0-14.0 cm long by ca. 2.3 cm wide, erect and imbricate throughout, with much purple when living, fading when dry; INFLORESCENCE ca. 7.0 cm long, ca. 5.0 cm in diameter, bipinnate, subdense, subglobose, obscurely punctulate-lepidote; PRIMARY BRACTS 2.0-3.5 cm long by ca. 1.7 cm wide, all shorter than spikes; SPIKES 3.0-4.0 cm long by ca. 1.6 cm in diameter, having ca. 9 to 12 flowers per spike, ca. 7 spikes per inflorescence, distance between spikes 0.5-1.0 cm, stipe minimal with up to one sterile bract; FLORAL BRACTS 1.3-1.7 cm long by ca. 1.0 cm wide, suborbicular, not nerved, subcoriaceous, slightly lepidote without and lustrous, pale lepidote within, giving glaucous appearance to inner floral bract surface, apex obtuse; SEPALS 1.2-1.4 cm long by 5-6 mm wide, elliptic-obovate, obtuse, connate equally for ca. 5 mm, nerved, ecarinate; PETALS ca. 2.3 cm long, white, distance between flowers 2-3 mm.

MATERIAL EXAMINED: Teuscher 2017-56 (US, TYPE) on mountain near Loja, Prov. Loja, 2700 m, 1956, flowered at Montreal Botanical Garden, May 1958; Teuscher 2022-56 (US)

Monte Cajanuma near Loja, Prov. Loja, cultivated Montreal
Bot. Gard., May 1959.

34. GUZMANIA STRIATA L. B. Smith, 1959 (Phytologia vol. 6, no. 8) p. 438, pl. 2, figs. 6-8.

PLANT ca. 80 cm tall with inflorescence; LEAVES 70-90 cm long, blades ca. 3.0 cm wide, obscurely lepidote beneath, apex caudate-attenuate, sheath 12-15 cm long by ca. 6.0 cm wide, red-striate except for dark brown base; SCAPE ca. 8 mm in diameter, erect to suberect, probably exceeded by leaf-rosette; SCAPE-BRACTS 6.0-26.0 cm long by ca. 2.0 cm wide, erect, apices attenuate to caudate, imbricate throughout, strikingly red-striate; INFLORESCENCE ca. 13 cm long by 8.0 cm in diameter, bipinnate-digitate, with ca. 5 spikes, subdense, nearly glabrous; PRIMARY BRACTS 3.0-4.0 cm long, erect to spreading, lowermost about 1/2 spike length, somewhat striate like scape bracts, apex apiculate; SPIKES 6.0-8.0 cm long by 2.0-2.5 cm in diameter, 16 to 30 flowers per spike, fusiform to elliptic, ca. 1.0-2.0 cm between spikes, erect to spreading, stipe minimal to 8 mm long; FLORAL BRACTS ca. 2.0 cm long by ca. 2.0 cm wide, thin-coriaceous, sublustrous, erect, imbricate, broadly elliptic to round, inconspicuously nerved, dark-margined when dry, red, obscurely lepidote; SEPALS 1.7-1.8 cm long by 0.9 cm wide, obovate, subequally short-connate, castaneous with pale margins when dry, broadly acute, slightly nerved; PETALS ca. 2.5 cm long, pale yellow, erect; OVARY ca. 6 mm long by ca. 3 mm in diameter, stamens barely included; CAPSULE not known, distance between flowers ca.

4-6 mm, flowering around March.

MATERIAL EXAMINED: Asplund 19979 (S, TYPE; US, photo and fragments) epiphytic near banks of Río Pastaza, Shell Mera, Prov. Napo Pastaza, ca. 900 m, 27 March 1956.

35. GUZMANIA MORRENIANA (Linden) Mez, 1896 (DC Monogr.

Phaner. vol. 9) p. 932; Mez, 1935, p. 623, fig. 114.

Massangea morreniana Linden, 1880 (Catalogue Expos. Brux.); Morren, 1883, p. 47.

FIG. 91

PLANT ca. 1 m tall; LEAVES 60-100 cm long, blade 3.0-4.0 cm wide, punctulate both surfaces, soon glabrous above, lingulate, apex attenuate, sheath ca. 16 cm long by 7.0 cm wide, concolorous with blade above, castaneous below; SCAPE ca. 9 mm in diameter, slightly exceeding leaf-rosette, erect; SCAPE-BRACTS 10-30 cm long by ca. 5.0 cm wide, erect and densely imbricate throughout, concolorous, apex attenuate; INFLORESCENCE 14-16 cm long by ca. 9.0 cm in diameter, bipinnate, lax, globose, glabrous, having 8 to 16 spikes, these erect before anthesis and spreading after; PRIMARY BRACTS 3.5-5.0 cm long by ca. 3.0 cm wide, shorter than spikes and not obscuring these, apex attenuate; SPIKES 5.0-9.0 cm long by ca. 3.0 cm wide at anthesis, spreading after anthesis, having ca. 12 to 16 flowers per spike, stipe to 8 mm long, having one sterile bract, this bicarinate; FLORAL BRACTS 2.4-2.5 cm long by ca. 1.4 cm wide, broadly ovate, acute to apiculate, coriaceous, not nerved, erect, imbricate, glabrous without, lepidote within, slightly exceeding sepals; SEPALS 2.0-2.3 cm long, by ca. 7 mm wide, acute, ecarinate, not nerved, coriaceous, glabrous without, lepidote within, subequally connate for 1-3 mm; PETALS ca.

4.0 cm long, yellow, distance between flowers ca. 3 mm;
CAPSULES 1.8-2.2 cm long.

MATERIAL EXAMINED: Linden s. n. (LG; US, AJG, photo)
Peru; AJG 1140, rain forest, very common, epiphytic, 4-5 m
from ground, tank full of water, km 45 Loja-Zamora, Prov.
Zamora, ca. 1500 m, 11 Aug. 1965.

PERU.

36. GUZMANIA PLEIOSTICHA (Griseb.) Mez, 1896 (DC Monogr.

Phaner. vol. 9) p. 930; Smith, 1957, pp. 209-210.

Tillandsia pleiosticha Grisebach, 1865 (Goett. Nachr.)
p. 19.

PLANT 1.0-1.5 m tall; LEAVES 50-90 cm long, blade 3.5-5.0 cm wide, lingulate, pale, moderately densely lepidote beneath, glabrous above, apex acute, sheath 9.0-18.0 cm long by 5.0-(?) wide, dark castaneous; SCAPE ca. 8 mm in diameter, erect; SCAPE-BRACTS 6.0-20.0 cm long by ca. 2.5 cm wide, erect, imbricate, but exposing scape slightly, apex acute to attenuate, green toward apices, brown toward bases; INFLORESCENCE ca. 36 cm long by ca. 7.0 cm in diameter, lax, bipinnate, having 8 to 12 spikes, cylindrical, glabrous, spikes 2.0-3.5 cm apart; PRIMARY BRACTS 2.5-6.0 cm long by ca. 2.5 cm wide, spreading, apices attenuate, lowermost nearly equaling spikes, upper ones much shorter than spikes; SPIKES 4.5-7.0 cm long by 2.0-2.5 cm wide, ellipsoid or fusiform, spreading, having 12 to 17 flowers per spike, stipe ca. 1.0 cm long with 1 to 2 sterile bracts, the upper sterile bracts bicarinate, the keels widely separated indicating that in bud the spikes are tightly appressed to inflorescence main axis; FLORAL BRACTS 2.0-2.2 cm long by 1.0-1.2 cm wide, ovate, coriaceous, not at all nerved, acute to slightly apiculate, slightly lepidote without, densely but finely lepidote within, erect, imbricate; SEPALS 1.1 cm long by 3-4 mm wide, obovate, obtuse,

strongly nerved, glabrous without and within; PETALS ca. 1.8 cm long, erect, lobes white or green, distance between flowers 3 mm.

MATERIAL EXAMINED: Asplund 19132 (US) epiphytic, Mera, near banks of Río Pastaza, Prov. Napo Pastaza, ca. 1000 m, 30 Jan. 1956.

COLOMBIA, GUIANA, VENEZUELA.

37. GUZMANIA PANICULATA Mez, 1905 (Bull. Herb. Boiss.

series 2, vol. 5) p. 116; Smith, 1936, pp. 575-576.

PLANT 60-80 cm tall; LEAVES ca. 85 cm long, blades ca. 2.0 cm wide, lingulate, sheath inconspicuous; SCAPE ca. 8 mm in diameter, erect; SCAPE-BRACTS imbricate, apices attenuate to caudate; INFLORESCENCE ca. 55 cm long by 14 cm in diameter at anthesis, tri- to quadripinnate, lax, having ca. 11-14 branches; PRIMARY BRACTS 2.5-12.0 cm long, erect to spreading, exceeding lowermost branches, much shorter than upper branches, apices caudate below, acute above, red with yellow apices; BRANCHES 6.0-11.0 cm long by 2.5-6.0 cm wide, erect-spreading, distance between branches 1.0-4.5 cm; SPIKES 4.0-6.0 cm long by 2.0-2.5 cm wide, erect to spreading, spikes per branch ca. 1 to 5, having 6 to 10 flowers per spike; FLORAL BRACTS 1.5 cm long by ca. 8 mm wide, ovate, broadly acute to obtuse, exceeding and enfolding sepals, strongly nerved, glabrous without, densely punctulate within, papery; SEPALS 8-10 mm long, connate for ca. 3 mm, elliptic, coriaceous, carinate, acute; PETALS ca. 2.1 cm long, yellow, distance between flowers ca. 4 mm.

MATERIAL EXAMINED: Drake 278 (K; GH, photo, fragments) near Loja, Prov. Loja, 9 Jan. 1882.

PERU.

38. GUZMANIA MULTIFLORA (André) Mez, 1896 (DC Monogr.

Phaner. vol. 9) p. 939; Smith, 1957, p. 213.

Caraguata multiflora André, 1888 (Énumération Bromél.)
p. 6; André, 1889, pp. 54-55, pl. 18 b.

PLANT 60-70 cm tall; LEAVES 70-90 cm long, blades 4.0-5.0 cm wide, lingulate, apex acute, sheath ca. 20 cm long, elliptic, striate-purple, castaneous toward base; SCAPE ca. 8 mm in diameter, about as long as or slightly exceeding leaf-rosette, erect; SCAPE-BRACTS 12-25 cm long, imbricate throughout, erect, apex acute, foliaceous; INFLORESCENCE ca. 30 cm long by ca. 6.5 cm in diameter, bipinnate, lax, cylindric, red, having ca. 16 spikes, glabrous; PRIMARY-BRACTS 2.0-6.0 cm long by ca. 2.5 cm wide, lower ones exceeding spikes, spreading to reflexed, upper ones about 1/2 as long as spikes, apex attenuate; SPIKES 3.0-4.0 cm long by ca. 2.0 cm wide, ovoid, flowers per spike 6 to 9, spreading to reflexed, distance between spikes 1.0-2.0 cm, stipe 6-8 mm long; FLORAL BRACTS ca. 0.9-1.1 cm long by ca. 6 mm wide, broadly elliptic, obtuse, spreading, scarcely imbricate, strongly nerved, exceeded by sepals, subglabrous without, lepidote within, yellow-red when alive; SEPALs 1.2-1.4 cm long by ca. 4 mm wide, exceeding floral bracts, obovate, truncate, strongly nerved, posteriorly carinate, connate for ca. 3 mm; PETALS ca. 1.8 cm long, white usually when alive; CAPSULES ca. 2.7 cm long, distance between flowers 4-5 mm.

MATERIAL EXAMINED: André 2970 (K, TYPE; US, photos)
at Niebli, foot of Pululahua, Prov. Pichincha, ca. 2000 m,
June 1876.

COLOMBIA.

39. GUZMANIA WEBERBAUERI Mez, 1905 (Bull. Herb. Boiss. series 2, vol. 5) p. 114; Smith, 1936, p. 576.

PLANT ca. 1 m tall; LEAVES ca. 90 cm long, blades 2.0-4.0 cm wide, lingulate, punctulate below, apex attenuate; SCAPE 5-7 mm in diameter, erect; SCAPE-BRACTS 7.0-20.0 cm long by ca. 2.5 cm wide, erect, apex attenuate, imbricate but scape exposed at least in part; INFLORESCENCE 10-30 cm long by ca. 4.0-5.5 cm in diameter, bipinnate, dense above, lax below, glabrous, having ca. 8 spikes, red when alive; PRIMARY BRACTS 3.0-5.0 cm long by ca. 2.5 cm wide, ascending, red when alive, apices attenuate, exceeding to equaling spikes; SPIKES 2.5-4.0 cm long by ca. 2.0-2.5 cm wide, erect to spreading, ellipsoid, distance between spikes 0.5-3.5 cm, having 5 to 9 flowers per spike; FLORAL BRACTS 1.0-1.2 cm long by 1.0-1.4 cm wide, rounded, nerved, subcoriaceous, much shorter than sepals, glabrous without and within; SEPALs 1.7 cm long by ca. 8 mm wide, equally connate for 1.0-1.3 cm, coriaceous, obovate, rounded, nerved, glabrous without and within; PETALS ca. 3.0 cm long, lobes yellow, distance between flowers ca. 2 mm.

MATERIAL EXAMINED: Weberbauer 1300 (B, TYPE; US, photo) Peru; Hitchcock 21861 (US) epiphytic, between Baños and Cashurco, 8 hours (walk) east of Baños, Prov. Tungurahua, 1300-1800 m, 25 Sept. 1923; Asplund 18353 (US) steep slope, Mera, Prov. Napo Pastaza, ca. 1100 m, 11 Nov. 1955.

PERU.

40. GUZMANIA CALAMIFOLIA Mez, 1896 (DC Monogr. Phaner, vol. 9) p. 931; Smith, 1957, pp. 208-209.

Caraguata acorifolia André, 1888 (Énumération Bromél.) p. 6; André, 1889, pp. 56-57, pl. 16 b, not Guz. acorifolia (Griseb.) Mez, 1896.

FIG. 92

PLANT 3.5-6.0 cm tall with inflorescence; LEAVES ca. 50 cm long, blades 0.5-1.2 cm wide, linear, apex attenuate, sheath narrow and inconspicuous; SCAPE 3-4 mm in diameter, erect or ascending, not exceeding leaf-rosette; SCAPE-BRACTS 10-40 cm long by ca. 1.5 cm wide, erect, imbricate throughout, subfoliaceous, apex filiform; INFLORESCENCE 7.0-13.0 cm long by ca. 5.0 cm in diameter, bipinnate with 4 to 7 spikes or rarely subdigitate, glabrous, lax to subdense; PRIMARY BRACTS 2.2-6.0 cm long by ca. 1.0 cm wide, erect to spreading, the lowermost about equaling the spikes, upper ones much shorter than spikes, apex attenuate to apiculate; SPIKES 2.0-6.0 cm long by ca. 1.5 cm wide, fusiform to ellipsoid, erect to spreading, distance between spikes ca. 1.5-2.0 cm, flowers per spike 7 to 11; FLORAL BRACTS ca. 1.8 cm long by ca. 1.0 cm wide, ovate, prominently nerved, acute to apiculate, yellow when alive, drying to pale brown, imbricate, erect, glabrous without, densely lepidote within; SEPALs ca. 2.0 cm long by 7-9 mm wide, not exceeding floral bracts, acute, narrowly elliptic, short-connate, posteriorly carinate, nerved,

coriaceous; PETALS ca. 1.9 cm long, erect, blades yellow;
CAPSULE 1.5 cm long, distance between flowers 3-5 mm, in
flower around May-July.

MATERIAL EXAMINED: André 3396 (K, TYPE; André, 1889,
illustration) Colombia, ca. 990 m; AJG 844 (US) epiphytic,
near bank of Río Zamora, between Cumberatza and Zumbi,
Prov. Zamora, ca. 750 m, 23 Feb. 1963.

COLOMBIA.

41. GUZMANIA TARAPOTINA Ule, 1907 (Verh. Bot. Ver. Brandenb. vol. 48) p. 147; Smith, 1936, p. 575.

PLANT ca. 1 m tall; LEAVES 50-70 cm long, blades 2.0-2.5 cm wide, linear-lingulate, appears glabrous, apex attenuate, sheath ca. 7.0 cm long by 4.0-4.5 cm wide, dark brown; SCAPE 0.9-1.0 cm in diameter, erect, shorter than leaf-rosette; SCAPE-BRACTS 5.0-50.0 cm long, imbricate throughout, foliaceous below, apices attenuate, scape totally obscured to partially showing; INFLORESCENCE ca. 26 cm long by ca. 7.0 cm in diameter, bipinnate, lax, green, having ca. 10 to 14 spikes, these 0.8-4.0 cm apart; PRIMARY BRACTS 1.8-8.5 cm long by ca. 1.7 cm wide, spreading, lowermost exceeding spikes, upper ones much shorter, apex attenuate; SPIKES 3.0-4.5 cm long by 1.6 cm wide at anthesis, spreading, having 10 to 15 flowers per spike, stipe ca. 1.0 cm long with ca. 1 sterile bract; FLORAL BRACTS ca. 2.0 cm long by ca. 1.4 cm wide, ovate-elliptic, apiculate, strongly nerved, papery, obscurely punctulate to glabrous without glabrous within; SEPALS ca. 1.6 cm long, by ca. 4 mm wide, not exceeding floral bracts, strongly nerved, posteriorly carinate, ovate, acute, glabrous to subglabrous without and within, distance between flowers 4-9 mm.

MATERIAL EXAMINED: Ule 6683 (B, TYPE) Peru, Dept. Loreto; Penland and Summers 202 (COCO; GH, photo) confluence of Río Mapoto with Río Pastaza, Prov. Tungurahua, ca.

300 m, 21 March 1939.

PERU.

42. GUZMANIA ELONGATA Mez and Sodiro, 1905 (Bull. Herb. Boiss, series 2, vol. 5) p. 115; Smith, 1932, p. 31; Diels, 1938, p. 143.

Guzmania drewii L. B. Smith, 1954 (Contrib. U.S. Nat. Herb. vol. 29, no. 11) pp. 526-527, fig. 82.

PLANT 1 m tall or more; LEAVES 40-100 cm long, blades ca. 4.0-7.0 cm wide, lingulate, densely lepidote, apex acute to attenuate; SCAPE ca. 9 mm in diameter, apparently erect; SCAPE-BRACTS 5.0-25.0 cm long, erect, imbricate throughout; INFLORESCENCE ca. 35 cm long by 6.5 cm in diameter, bipinnate, lax, exceeding leaf-rosette, having ca. 17 spikes, cylindric; PRIMARY BRACTS 2.5-8.0 cm long by 2.0-3.0 cm wide, lowermost extending well beyond spikes, uppermost less than 1/2 as long as spikes, spreading to reflexed, apex long attenuate; SPIKES 4.0-7.0 cm long by ca. 2.2 cm wide, spreading, ca. 14-19 spikes per inflorescence, distance between spikes ca. 1.0-2.7 cm, stipe minimal, no sterile bracts; FLORAL BRACTS 1.6-2.0 cm long by ca. 1.0 cm wide at capsule maturity, elliptic, strongly nerved, apex broadly acute to obtuse (Note, Mez's description of 1905 says more or less 9 mm long, but the type photo betrays this, while the specimen in bud has some floral bracts as short as 12 mm, the specimen in capsule has floral bracts to 2.0 cm long); SEPALS 1.8 cm long at capsule maturity, not exceeding floral bracts, 1.2 cm long in bud, obovate-elliptic, obtuse; PETALS ca. 1.7 cm long;

43. GUZMANIA XANTHOBRACTEA Gilmartin, spec. nov.

A Guzmania amplexans L. B. Smith, cui affinis, scapo gracili, bracteis florigeris obtusis chartaceis, sepalis brevioribus acutatis differt.

FIG. 93

PLANT ca. 1 m tall; LEAVES 80-110 cm long, blades 3.5-4.0 cm wide, linear-lingulate, very inconspicuously lepidote, apex attenuate, sheath ca. 9 cm long by 6.0 cm wide, dark brown; SCAPE ca. 4 mm in diameter, not exceeding leaves, curving; SCAPE-BRACTS 7.0-30.0 cm long by ca. 2.3 cm wide, erect, imbricate, apex attenuate to caudate; INFLORESCENCE 40-50 cm long by 15-20 cm in diameter, curving, yellow, subglabrous, bipinnate, lax; PRIMARY BRACTS 4.0-8.0 cm long, red, spreading to ascending, apex attenuate; SPIKES 10-14 cm long by 4.0-4.5 cm in diameter, obovate, ca. 5 to 10 per inflorescence, ca. 4.0 cm apart, ascending, flowers per spike 9 to 15, stipe 0.8-2.5 cm long with 1 to 2 sterile bracts; FLORAL BRACTS 3.5-4.0 cm long by ca. 1.5 cm wide, obovate, apiculate, imbricate, strongly nerved, papery, punctulate without, glabrous within, yellow when living; SEPALs 2.0-2.2 cm long by 5 mm wide, acute, obovate, coriaceous, carinate, glabrous without and within, connate equally for 5-7 mm; PETALS ca. 5.0 cm long, lobes green; OVARY 7-8 mm long by 2 mm in diameter, distance between flowers 4-5 mm.

MATERIAL EXAMINED: AJG 871 (US, TYPE) terrestrial on

CAPSULES ca. 2.1 cm long.

MATERIAL EXAMINED: Sodiro 171/44 (B, TYPE; US, AJG, photo) near Mt. Corazón, Prov. Pichincha, Dec. 1901; Drew E-198 (US, TYPE of Guz. drewii) epiphytic, along trail between Toldadas and Río Arturo, east of Cayambe, "wet forest," Prov. Imbabura, ca. 3050 m, 15 May 1944; Asplund 17101 (US) steep shrubby slope, northwest side of Mt. Corazón-Río Pilaton drainage, Prov. Pichincha, 3200 m, 27 July 1955; Asplund 18970 (US) cliff, below San Juan towards Chiriboga, Prov. Pichincha, ca. 2800 m, 31 Dec. 1955.

NOTES: Comparison of the type specimen photo of Guz. elongata Mez and Sodi-ro with the type specimen of Guz. drewii L. B. Smith does not uphold any distinctions between these two taxa. Therefore, the later described Guz. drewii has been reduced to taxonomic synonymy under Guz. elongata. To date it has been collected on the western slopes of the Andes southwest of Quito and near the continental divide east of Cayambe at altitudes from 2800 to 3200 m.

road cut, well developed "woody" base with numerous long fibrous roots coming off laterally 5.0-10.0 cm above base, ca. km 100 Guayaquil-El Tambo, road to Cuenca, Prov. Cañar, ca. 1850 m, 16 Nov. 1963; Drew E-540 (US) epiphytic(?), above Garcia Moreno, above Río Intag, near confluence of Río Intag and Quinendé, Prov. Imbabura, 1530 m, 8 Sept. 1944.

NOTES: This very colorful species has only been collected twice to date which is surprising in view of its showy red and yellow inflorescence. The duration of its flowering may be very short therefore. The well-developed nearly "woody" base noted in AJG 871, may indicate that the plant is a perennial which flowers only at long intervals, living vegetatively the remainder of the time.

44. GUZMANIA AMPLECTENS L. B. Smith, 1949 (Contrib. U.S. Nat. Herb. vol. 29, no. 7) pp. 292-293, fig. 16; Smith, 1957, p. 210.

PLANT ca. 1 m tall; LEAVES 40-50 cm long, blades ca. 2.5 cm wide, lingulate, subdensely lepidote throughout with small appressed scales, sheaths ca. 14 cm long, elliptic, distinct, dark castaneous; SCAPE 0.9-1.3 cm in diameter, erect; SCAPE-BRACTS 10-30 cm long by ca. 2.7 cm wide, imbricate, lower foliaceous, blades attenuate; INFLORESCENCE ca. 35 cm long by ca. 8.0 cm, bipinnate, lax, having ca. 6 spikes, these up to 5.0 cm apart; PRIMARY BRACTS to 6.0 cm long, mostly ca. 1/2 as long as spikes or less, apex attenuate to acute; SPIKES ca. 10 cm long by 2.0-3.0 cm in diameter, erect to spreading, having 6 to 8 flowers per spike; FLORAL BRACTS ca. 4.8 cm long, much exceeding sepals, at first enfolding spike, later enfolding merely a single flower, oblong-elliptic, obscurely pale-appressed-lepidote, bright red except for orange apex when living, subcoriaceous with papery margins; SEPALS ca. 3.0 cm long, obtuse, elliptic, sparsely white-lepidote, posteriorly carinate, connate for ca. 8 mm posteriorly and for ca. 4 mm anteriorly; PETALS not known; distance between flowers ca. 7-9 mm.

MATERIAL EXAMINED: Foster 2169 (US, TYPE; photo)
Colombia, ca. 840 m.

COLOMBIA.

NOTES: Although Guz. amplectens L. B. Smith has not yet been collected in Ecuador, it is likely to be found there. It has been collected in southern Colombia less than 50 km north of the Ecuadorian border on the western slopes of the Andes.

45. GUZMANIA ECUADORENSIS Gilmartin, spec. nov.

A Guz. amplectens L. B. Smith, cui affinis, sepalis longioribus bracteis florigeris excedentibus, inflorescentia tripinnata differt.

PLANT ca. 1 m tall; LEAVES ca. 1 m long, blades 6.0-7.0 cm wide, lingulate, apex pungent; SCAPE erect, 1.6 cm in diameter; SCAPE-BRACTS 8.0-15.0 cm long at least, imbricate, apex attenuate; INFLORESCENCE ca. 35 cm in diameter, tripinnate, lax, branches ca. 4.0 cm apart; PRIMARY BRACTS 6.0-9.0 cm long, apex attenuate, red; BRANCHES ca. 20 cm long by ca. 12 cm in diameter, having 1 to 3 secondary branches; SECONDARY BRANCHES 8.0-10.0 cm long by 4.0-5.0 cm wide, spreading to nodding, flowers per branch 8 to 12, stipe ca. 1.5 cm long; FLORAL BRACTS 2.4-2.6 cm long by 1.1 cm wide, ovate-elliptic, spreading to erect, not imbricate, strongly nerved, glabrous without, lepidote within, papery, apex obtuse; SEPALs 3.5-4.0 cm long by ca. 4 mm wide, linear, obtuse, coriaceous, mostly ecarinate, spreading to erect, glabrous without and within; PEDICELS ca. 6 mm long; PETALS ca. 5.0 cm long, lobes ca. 7 mm wide, yellow when alive, stamens and stigma included equally by ca. 5 mm.

MATERIAL EXAMINED: Acosta Solis 6219 (F, TYPE) Osoloma, road to Tablas, Prov. Bolivar, 2500 m, 7 Oct. 1943.

NOTES: This new species, Guzmania ecuadorensis, differs from Guz. amplectens in the sepals which greatly exceed the floral bracts and in the well-developed tripinnate

inflorescence, as well as having sepals which are to 4.0 cm and largely ecarinate. It differs from Guz. xanthobracteata in the tripinnate inflorescence and also the size of the sepals. The former has sepals 2.0-2.2 cm long. Also the petals are green in Guz. xanthobracteata and they are yellow here. It has been collected in Central Ecuador. There is apparently some affinity to Guzmania candelabrum André from southern Colombia. However, the sepals are ca. 2.0 cm long and the floral bracts are only ca. 1.3 cm long in Guz. candelabrum André.

46. GUZMANIA DIFFUSA L. B. Smith, 1948 (Caldasia vol. 5)
p. 2, fig.; Smith, 1957, pp. 204-205.

PLANT 1-2 m tall; LEAVES 30-80 cm long, blades 4.0-8.0 cm wide, lingulate, apex attenuate, sheaths inconspicuous; SCAPE 8-9 mm in diameter, erect; SCAPE-BRACTS at least 6.0 cm long, foliaceous, densely imbricate; INFLORESCENCE 40-100 cm long by ca. 18 cm in diameter, tripinnate, very lax; PRIMARY BRACTS 3.0-6.0 cm long, lepidote, spreading, shorter than branches, red or yellow when alive, apex attenuate; BRANCHES ca. 10 cm long, ca. 4.0 cm apart, yellow, spreading; SPIKES ca. 2 to 3 per branch, 4.5-8.0 cm long, by ca. 2.0 cm wide, stipe 1.0-2.0 cm long, no sterile bracts, flowers per spike 4 to 8; FLORAL BRACTS ca. 7 mm long by 3-4 mm wide, nerved, ovate, glabrous without and within, apex broadly acute; SEPALS ca. 1.2 cm long by 3 mm wide, obovate, symmetrical, obtuse, nerved, glabrous without and within, coriaceous; PETALS ca. 2.2 cm long, white or yellow, distance between flowers 0.5-1.0 cm.

MATERIAL EXAMINED: Drew E-365 (US) epiphytic, Camp Arellan, east of Volcan de Cayambe, Prov. Imbabura, ca. 2760 m, 22 July 1944.

COLOMBIA.

47. GUZMANIA RHONHOFIANA Harms, 1939 (Notizbl. Bot. Gart. und Mus. Berlin vol. 14) p. 329; Smith, 1949, pp. 295-296; Smith, 1957, p. 208.

FIG. 94

PLANT 50-100 cm tall by ca. 60 cm in diameter; LEAVES 30-50 cm long, blades 4.5-5.5 cm wide, lingulate, appearing glabrous above, punctulate below, apex acute to attenuate, sheath 10-15 cm long by 7.0-8.5 cm wide, narrowly ovate; SCAPE 5-8 mm in diameter, erect, exceeding leaf-rosette; SCAPE-BRACTS ca. 3.5-5.0 cm long by ca. 2.0 cm wide, erect, not at all imbricate, red or green when alive, exposing scape throughout, apices acute to attenuate; INFLORESCENCE 25-50 cm long by ca. 20 cm in diameter, bipinnate, lax, glabrous, having 7 to 14 branches, these 3.0-4.0 cm apart, ellipsoid; PRIMARY BRACTS ca. 2.0 cm long by ca. 1.2 cm wide, spreading, apex attenuate, mostly shorter than the stipe of the branches; BRANCHES 10-18 cm long by ca. 2.0 cm wide at anthesis and exclusive of capsules, ascending, having 10 to 20 flowers per branch, stipe 2.5-4.0 cm long with usually one sterile bract; FLORAL BRACTS 7-9 mm long by ca. 6 mm wide, acute, ovate, glabrous without, subglabrous within, papery, nerved, spreading, not at all imbricate, green when alive; SEPALS 1.0-1.2 cm long by 4-5 mm wide, obovate and somewhat asymmetrical, obtuse, carinate, connate for ca. 3 mm; PETALS ca. 1.8 cm long; CAPSULES ca. 2.4 cm long, seeds ca. 4 mm long, distance between flowers

0.6-1.0 cm.

MATERIAL EXAMINED: Schultze-Rhonhof 1981 (B, TYPE; US, photo) San Carlos, Prov. Pichincha(?) ca. 150 m, 19 Oct. 1935; Foster 2188 (US) Colombia; AJG 866 (US) km 9 Santo Domingo-Quinendé, road side, epiphytic, Prov. Pichincha, ca. 480 m, 11 Oct. 1963; AJG 869 (US) 20 km east of Santo Domingo, new road to Quito, common locally, epiphytic, Prov. Pichincha, ca. 650 m, 25 Oct. 1963; AJG 1060 (US) at turn-off for road to Quinendé, on an orange tree at finca, common locally, tank full of water, Prov. Pichincha, ca. 600 m, 3 Aug. 1965; AJG 1071 (US) epiphytic, outskirts of Santo Domingo, on cultivated land, Prov. Pichincha, ca. 600 m, 3 Aug. 1965.

COLOMBIA.

NOTES: To date, Guzmania rhonhofiana has been collected only in western-northern Ecuador and in southwestern Colombia in wet forest at altitudes from ca. 100 to 1200 meters. It is noteworthy and gratifying to observe that the mature dimensions of floral parts occur while the plant is still in bud. In AJG 1060, the primary bract and floral bract dimensions of an old inflorescence with its capsules dehisced, approximated those of a budding inflorescence of another plant of this species.

48. GUZMANIA HITCHCOCKIANA L. B. Smith, 1935 (Contrib. Gray Herb. vol. 106) pp. 148-149, pl. 1, fig. 1.

FIG. 95

PLANT ca. 1 m tall; LEAVES 90-120 cm long, blades 5.0-6.0 cm wide, apparently glabrous above, densely lepidote below, apex attenuate to acute, sheath ca. 18 cm long by 10 cm wide, concolorous with blade to castaneous; SCAPE estimate 1.2 cm in diameter, probably erect; SCAPE-BRACTS not known; INFLORESCENCE probably ca. 60 cm long, ca. 20 cm in diameter, bipinnate, very lax, main rhachis lepidote, distance between spikes ca. 4.0-5.0 cm; PRIMARY BRACTS ca. 6.0-8.0 cm long by 2.5 cm wide, blade narrowly triangular, spreading, sheath amplexicaulous; SPIKES 9.0-13.0 cm long by 3.0-4.0 cm wide, spreading, having 8 to 12 flowers per spike, stipe ca. 5.5 cm long, no sterile bracts; FLORAL BRACTS 1.2 cm long by 0.9-1.0 cm wide, ovate, broadly acute to obtuse, slightly nerved, subcoriaceous, lepidote without and within, spreading, not at all imbricate; SEPALS 1.7-2.0 cm long, oblong, obtuse, densely lepidote, connate for nearly 1.0 cm, distance between flowers ca. 1.0; CAPSULES ca. 3.0 cm long.

MATERIAL EXAMINED: Hitchcock 20436 (US, TYPE) epiphytic, Teresita, 3 km west of Bucay, Prov. Guayas, ca. 270 m, 5-7 July 1923; Foster 2641 epiphytic, near Santo Domingo, Prov. Pichincha, ca. 600 m, 8 Dec. 1948; AJG 1056 (US) immature specimen, in bud, ca. 2 km northwest of Santo

Domingo, rain forest, Prov. Pichincha, 550 m, 3 Aug. 1965;
Naundorff s. n. (US) cultivated by Marnier-Lapostolle in
France, no. 61, Selva Negra, Prov. Pichincha, ca. 600 m,
Nov. 1966(?).

Genus MEZOBROMELIA

Mezobromelia L. B. Smith, 1935 (Proc. Amer. Acad. vol. 70) p. 151.

Leaves entire; flowers polystichous, perfect; sepals symmetric; petals tightly joined, bearing two scales on inner surface; filaments connate with petals; ovary superior.

MEZOBROMELIA FULGENS L. B. Smith, 1948 (Lloydia vol. 11, no. 4) pp. 303-304, fig. 1.

PLANT ca. 1 m tall; LEAVES ca. 50 cm long, blades ca. 7.0 cm wide, lingulate, minutely lepidote, apex rounded-apiculate, sheath concolorous with blade; SCAPE erect, stout; SCAPE-BRACTS densely imbricate, lowermost foliaceous, upper ones broadly elliptic; INFLORESCENCE to 60 cm long, tripinnate, red when alive; PRIMARY BRACTS to 6.0 cm long, slightly exceeding sterile bases of branches; PRIMARY BRANCHES 10-17 cm long, spreading; SECONDARY BRANCHES to ca. 6.0 cm long, few-flowered, flowers turning secund and downward; FLORAL BRACTS 1.9-2.2 cm long by ca. 1.5 cm wide, erect, purple when alive, ovate, glabrous without and within, ecarinate, nerved, apex broadly acute; SEPALS 1.9-2.1 cm long by ca. 1.0 cm wide, connate for 4-5 mm equally, ecarinate, elliptic, obtuse, about equaling floral bracts; PETALS ca. 4.5 cm long, joined, but separable when dry, yellow-green when alive, with dentate scales reaching ca. 5 mm from petal base, stamens included

by 4-5 mm, distance between flowers ca. 7 mm.

MATERIAL EXAMINED: Dodson and Thien 675 (US, fragment)
km 14 Loja-Zamora, Prov. Zamora, 2300 m, 18 Sept. 1961.

CATOPSIS

Catopsis Grisebach, 1864 (Flora Brit. West Indies) p. 599.

Stemless, monoecious or dioecious; leaves entire, 10-15 leaves and seldom more per rosette, minutely appressed-lepidote; scape conspicuous; inflorescence usually bipinnate, rarely simple or tripinnate, equaling or exceeding leaves, its branches polystichous-flowered; flowers small or minute, perfect or unisexual; floral bracts ecarinate; sepals free, usually with rounded apices and strongly asymmetric, glabrous without; petals free, not having nectar scales; stamens included, filaments unequal; style shorter than ovary; capsule septicidal; seeds with coma apical and folded at maturity, bases of seeds projecting from capsule.

KEY TO THE ECUADORIAN SPECIES

1. Floral bracts ca. 0.5 cm long, sepals 6-7 mm long, leaf-blades with rounded, apiculate apices, sepals glabrous without and lepidote within. : 1. Catopsis sessiliflora.
1. Floral bracts 0.9-1.2 cm long, sepals ca. 1.5 cm long, leaf-blades with acuminate apices, sepals glabrous without and within : 2. Catopsis nutans.

1. CATOPSIS SESSILIFLORA (Ruiz and Pavon) Mez, 1896 (DC. Monogr. Phaner. vol. 9) p. 625; Smith, 1957, pp. 244-245, fig. 71.

Tillandsia sessiliflora Ruiz and Pavon, 1802 (Flora Peruv. vol. 3) p. 42, pl. 271, fig. b.

PLANT 15-35 cm tall; LEAVES 6-20 cm long, blades 1.2-2.5 cm wide, lingulate, apex rounded and apiculate, outermost leaves shorter than those from center of rosette, sheath ca. 6.0-8.0 cm long by 3.5-4.5 cm wide, elliptic; SCAPE ca. 1 mm in diameter, slightly exceeding leaf-rosette; SCAPE-BRACTS ca. 0.9-1.2 cm long, apex acute to abruptly acuminate, very distant; INFLORESCENCE 7.0-12.0 cm long by up to 8.0 cm in diameter when compound, simple, or bipinnate to digitately compound with ca. 3 to 4 branches, lax, glabrous; PRIMARY BRACTS like scape-bracts, much shorter than naked sterile base of spike; SPIKES 2.0-9.0 cm long by ca. 1.5-2.0 cm wide, having 8 to 12 flowers per spike, distance between spikes 2.0-3.0 cm; FLORAL BRACTS ca. 0.5 cm long, much exceeded by sepals, broadly ovate, nerved, papery, glabrous without and within, apex obtuse; SEPALS 6-7 mm long by ca. 6 mm wide, suborbicular, papery, asymmetrical, nerved, glabrous without, lepidote within; PETALS lanceolate-ovate; CAPSULE ca. 1.2 cm long, distance between flowers 0.4-1.0 cm.

MATERIAL EXAMINED: Drew E-542 (US) epiphytic, along trail to San Luis de la Vega, below Garcia Moreno, Prov.

Imbabura, ca. 925 m, 9 Sept. 1944; Rauh, Hirsch E 12 (US)
Pasaje, Prov. El Oro, 300 m, 29 Aug. 1954; Asplund 19488
(US) on tree trunk in scrub, Prov. Napo-Pastaza, ca. 1100
m, 20 Feb. 1956; AJG 1078 (US) epiphytic on orange tree,
much water in tank, km 19, Santo Domingo-Quito, Prov.
Pichincha, ca. 800 m, 4 Aug. 1965.

Southern BRASIL, southern MEXICO, PERU, WEST INDIES.

NOTES: A variety dioica of Catopsis sessiflora has been described by L. B. Smith from British Honduras material. This variety does not seem to have been collected in Ecuador to date.

2. CATOPSIS NUTANS (Swartz) Grisebach, 1864 (Flora Brit. West Indies) p. 599; Smith, 1957, pp. 243-244.

Tillandsia nutans Swartz, 1788 (Prodromus) p. 56.

PLANT 14-40 cm tall; LEAVES 10-24 cm long, blades 1.8-2.5 cm wide, lingulate to triangular, white cretaceous toward base, apex acuminate, sheaths ca. 4.5-12.0 cm long, elliptic; SCAPE ca. 1 mm in diameter, about as long as leaf-rosette, decurved; SCAPE-BRACTS ca. 1.5-2.5 cm long, erect, not imbricate; INFLORESCENCE ca. 4.0-10.0 cm long by ca. 3.0-4.0 cm in diameter, simple or few-branched; PRIMARY BRACTS shorter than sterile base of spike; SPIKES to 2.0 cm long, laxly 3 to 15-flowered, rhachis nearly straight; FLORAL BRACTS 0.9-1.2 cm long, broadly ovate or elliptic, from slightly to much shorter than sepals, papery, glabrous without and within, nerved, erect to spreading, apex acute; SEPALS ca. 1.5 cm long by 0.9 cm wide, obtuse, glabrous without and within, papery, nerved; PETALS with distinct spreading blades; CAPSULE 1.5-2.1 cm long, distance between flowers 0.5-2.0 cm apart.

MATERIAL EXAMINED: Hitchcock 21249 (US) epiphytic, on dry hill, Portovelo, gold mine near Zaruma, Prov. El Oro, 600-1000 m, 30 Aug. - 1 Sept. 1923.

COLOMBIA, southern MEXICO, VENEZUELA, WEST INDIES.

Subfamily BROMELIOIDEAE

Bromeliaceae Harms, 1930 (Engler and Prantl, Pflanzenfam. ed. 2, vol. 15 a) p. 132; Smith, 1957, p. 245.

Leaves rosulate, usually spinose-serrate, often succulent; ovary nearly always totally inferior, fruit baccate, seeds naked; cotyledon of young seedling remaining inconspicuous; stomata round in surface view, scattered.

KEY TO THE ECUADORIAN GENERA OF THE BROMELIOIDEAE



A

1. Petals with nectar scales (A)*, fruit rather dry, scape conspicuous in Ecuadorian species. : Genus AECHMEA, p.

1. Petals NOT with nectar scales (AA), or if present then fruit compound; fruit definitely fleshy, plant with or without conspicuous scape.



AA

2. Ovaries coalescing with one another to form a fleshy, compound fruit. : Genus ANANAS, p.

2. Ovaries NOT coalescing with one another and NOT forming a fleshy compound fruit; petals naked (AA).



B

3. Petals free and NOT adnate to stamen filaments, sepals strongly asymmetric (B) : Genus STREPTOCALYX, p.

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

3. Petals united or adnate to filaments,
 sepals symmetric (BB).



BB

4. Inflorescence central, scape present or
 absent. : Genus BROMELIA, p.

4. Inflorescence central or lateral, lateral
 in Ecuadorian species; scape absent. . .
 : Genus GREIGIA, p.

Genus AECHMEA

Aechmea Ruiz and Pavon, 1794 (Flora Peruv.) p. 47, nomen conservandum.

Leaves rosulate, blades usually lingulate; scape conspicuous in most Ecuadorian species; inflorescence simple or compound; flowers usually sessile; sepals often strongly asymmetric with large wing; petals free, bearing 2 scales, second series of stamens more or less joined to petals; pollen grains with 2 or 4 pores or sometimes aborted; style shorter than stamens, stigma-lobes linear, often twisted; seeds small, rugose, dark.

KEY TO THE ECUADORIAN SPECIES OF AECHMEA

1. Inflorescence simple, plant 30-100 cm tall.
2. Inflorescence lax, having 12 to 15 flowers, petals blue. : 1. Aechmea drakeana.
2. Inflorescence dense, having 25 or more flowers.
3. Inflorescence strobilate (A)*, ca. 12-14 cm in diameter, sepals 3.0 cm long or more, floral bracts lanceolate-triangular (B), margins serrulate, 6.0 cm long or more.



A



B

* Such capital letters in parenthesis in the keys refer to the diagrams accompanying the particular key.

4. Sepals subequally short-connate, leaves with appressed ferruginous scales beneath : 2. Aechmea strobilacea.

4. Sepals free, leaves pale-lepidote beneath : 3. Aechmea magdalenae.



AA

3. Inflorescence elongate (AA), 3.0-4.0 cm in diameter, sepals 0.5-1.9 cm long, floral bracts with subulate blades (BB), margins entire, minute or lacking to 1.6 cm long.



BB

5. Floral bracts very minute or lacking, scape-bracts NOT imbricate (C) : 4. Aechmea nudicaulis.



C

5. Floral bracts 1.0-1.6 cm long, basal scape-bracts imbricate (CC).



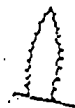
CC

6. Leaves laxly serrate (D), inflorescence of ca. 40 flowers, petals yellow when alive. : 5. Aechmea fraseri.



D

6. Leaves densely serrate (DD), inflorescence of ca. 100 flowers, petals lilac-rose when alive. : 6. Aechmea involucrata.



DD

1. Inflorescence compound, plant 30 cm to 2 m tall.

7. Flowers fasciculate, primary bracts cucullate, inflorescence subglobose.

8. Plant to ca. 1 m tall, leaves to 2 m

long, blades 5.0-10.0 cm wide, floral bracts with serrate margins and exceeding the sepals. . . . : 3. Aechmea magdalенаe.

8. Plant to 3 m tall, leaves ca. 1 m long, blades 3.0-5.0 cm wide, floral bracts with margins entire and slightly exceeded by the sepals. : 7. Aechmea nidularioides.

7. Flowers spicate, primary bracts NOT cucullate, inflorescence NOT subglobose.

9. Flowers pedicellate (E), inflorescence tripinnate throughout. : 8. Aechmea mexicana.

9. Flowers sessile (EE), inflorescence bipinnate, digitate or tripinnate below.

10. Floral bract margins, sepal margins serrulate (F), floral bracts NOT distichous. : 9. Aechmea hoppii.

10. Floral bract margins, sepal margins entire (FF), floral bracts distichous.

11. Sepals exceeding floral bracts, ca. 1.3 cm long, petals orange when alive : 10. Aechmea tessmani.

11. Sepals NOT exceeding floral bracts or if slightly so then not more than 7 mm long, petals yellow or rose when alive.



E



EE



F



FF



12. Scape-bracts imbricate (CC), inflorescence bi- tripinnate, pyramidal to oblong, floral bracts green, strongly nerved.
 : 11. Aechmea pyramidalis.
12. Scape-bracts NOT imbricate (C), inflorescence digitate to bipinnate, if tripinnate then ellipsoid, floral bracts often red, not or scarcely nerved.
13. Inflorescence ca. 4.0 cm long, subdigitate or bipinnate with ca. 4 spikes, sparsely white-flocculose.
14. Petals ca. 5 mm long, leaves 15-35 cm long, scape ca. 1 mm in diameter, scape-bracts entire.
 : 12. Aechmea andradei.
14. Petals ca. 1.5 cm long, leaves 35-60 cm long, scape ca. 3 mm in diameter, scape-bracts serrulate.
 : 13. Aechmea abbreviata.
13. Inflorescence 6.0-36.0 cm long, mostly bipinnate with 8 to 15 spikes or more, lepidote but soon glabrous.
15. Spikes to 5.0 cm long, inflorescence ellipsoid, distance between flowers 0.4-1.0 cm.
 : 14. Aechmea penduliflora.

15. Spikes 2.0-3.5 cm long, inflorescence
 ovoid to cylindrical, distance between flow-
 ers 4-6 mm.
16. Leaf-blades ca. 6.5 cm wide, often spotted
 purple, scape about equaling leaf-rosette,
 upper scape-bracts entire.
 : 15. Aechmea leucocarpa.
16. Leaf-blades 3.0-6.0 cm wide, NOT purple
 spotted, scape exceeding leaf-rosette,
 upper scape-bracts serrulate.
 : 16. Aechmea angustifolia.

1. AECHMEA DRAKEANA André, 1888 (Revue Hortic. vol. 60)
p. 401; André, 1889, pp. 14-15, pl. 6 a.

FIG. 96

PLANT ca. 60 cm tall with well-developed holdfasts; LEAVES 30-60 cm long, blades 4.5-6.0 cm wide, margins laxly serrulate; SCAPE about equaling leaf-rosette, ca. 2 mm in diameter, erect; SCAPE-BRACTS 4.0-10.0 cm long by ca. 1.0 cm wide, erect, entire, imbricate, apices acute, papery when dry; INFLORESCENCE ca. 10 cm long by 3.0-3.5 cm in diameter exclusive of petals, lax, simple, having 12 to 15 flowers; FLORAL BRACTS 0.2-1.2 cm long, mostly not exceeding ovary, subulate apices, papery, inconspicuous; SEPALS 7-9 mm long, coriaceous, mucronate, glabrous without and within, carinate; PETALS ca. 3.2 cm long, blue when alive, having 2 short basal scales; OVARY ca. 5 mm long by 6 mm in diameter.

MATERIAL EXAMINED: Poortman 134 (K, TYPE; US, photo) near Saraguro, Prov. Loja, Jan. 1882. Penland and Summers 180 (US) Río Margarhitas below Baños, Prov. Tungurahua, 1225 m, 20 March 1939; AJG 838 (US) epiphytic, moderately common, ca. 8 km down Río Zamora from Cumberatza, Prov. Zamora, 780 m, 22 Feb. 1963; AJG 1143 (US) epiphytic on "Caino" spiny trunked tree ca. 18 m tall, moderately common, well-developed rain forest, km 16 Zamora-Loja, Prov. Zamora 1500 m, 11 Aug. 1965; Dodson and Thien 823 (US, fragment) km 42 road to Zamora, fallen trees, Prov. Zamora,

1400 m, 29 Sept. 1961; Asplund 19812 (US, photo and fragment) Macas, epiphytic on shore of Río Upano, Prov. Zamora, ca. 800 m, 18 March 1956.

2. AECHMEA STROBILACEA L. B. Smith, 1959 (Phytologia vol. 6, no. 8) p. 435, pl. 1, figs. 13-14.

PLANT ca. 1 m tall; LEAVES 1-2 m long or more, blades 5.0-6.0 cm wide, laxly serrate toward base, densely serrulate toward apex, covered beneath with appressed ferruginous scales, sheaths ca. 14 cm long, elliptic, margins serrulate; SCAPE not much over 10 cm long, very inconspicuous, ca. 1.3 cm in diameter; SCAPE-BRACTS erect, densely imbricate, ovate, acute, serrulate; INFLORESCENCE 17 cm long by 14 cm in diameter, erect, simple, dense, strobilate, densely ferruginous-lepidote; FLORAL BRACTS 6.0-7.0 cm long, lance-triangular, long-acuminate, densely serrulate, dull red, apical portion reflexed, densely lepidote, nerved; SEPALS ca. 3.6 cm long, lance-triangular, subulate-acuminate, subequally short-connate, posterior ones sharply carinate, distance between flowers less than 2 mm.

MATERIAL EXAMINED: Asplund 19480 (US, ISOTYPE; S, TYPE; US, photo and fragments) terrestrial, Vera Cruz, forest, Prov. Napo Pastaza, ca. 900 m, 18 Feb. 1956.

3. AECHMEA MAGDALENAE (André) Baker, 1889 (Handbook Bromel.)
p. 65; Smith, pp. 273-274, fig. 81.

Chevalliera magdalena André, 1888 (Énumération
Bromél.) p. 3; André, 1889, pp. 7-8, pl. 3.

PLANT ca. 1 m tall; LEAVES to 2 m long, blades 5.0-10.0
cm wide, linear, margins with dark uncinatae spines to 5 mm
long, densely and finely pale-lepidote beneath, glabrous
above, sheaths short and inconspicuous, scarcely wider
than blades, serrulate; SCAPE erect ca. 2.0 cm in diameter;
SCAPE-BRACTS foliaceous, imbricate, upper ones massed below
inflorescence and reflexed; INFLORESCENCE 12-14 cm in di-
ameter if simple or compound and to 35 cm in diameter,
from a few unequal heads, dense; PRIMARY BRACTS terminal
ones sterile, middle ones with one flower, lower with
several flowers in axil; SPIKES sessile, globose; FLORAL
BRACTS to 6.5 cm long, serrulate, apex acuminate, pungent;
FLOWERS to 5.0 cm long, compressed dorsally; SEPALS 3.5-3.8
cm long, narrowly triangular, asymmetric, acuminate, pun-
gent, coriaceous, rigid, free; PETALS ca. 4.0 cm long with
linear claw and elliptic, acute blade, bearing 2 minute
truncate scales well above the base; OVARY broadly el-
liptic, seeds curved, ca. 6 mm long, dull black.

MATERIAL EXAMINED: Steiermark 53980 (US) dry brushy
and open slopes, trail between Portovelo and Zaruma, Prov.
El Oro, 640-1155 m, 22 Aug. 1943.

CENTRAL AMERICA, COLOMBIA, MEXICO, VENEZUELA.

4. AECHMEA NUDICAULIS (L.) Grisebach, 1864 (Flora Brit. West Ind.) p. 593; Smith, 1936, pp. 590-591; Smith, 1957, pp. 297-298.

Bromelia nudicaulis L., 1753 (Species Plantarum) p. 286.

FIG. 97

PLANT 30-70 cm tall, an erect cylindrical rosette; LEAVES 20-80 cm long, blades 5.0-10.0 cm wide, laxly but conspicuously serrate, broadly obtuse to apiculate, coriaceous, densely pale lepidote beneath, glabrous above, sheaths ca. 22 cm long by 10 cm wide, purple or castaneous; SCAPE not exceeding leaf-rosette, ca. 3 mm in diameter, erect; SCAPE-BRACTS 7.0-8.0 cm long, not imbricate below, erect, massed below inflorescence, red; INFLORESCENCE 5.0-25.0 cm long, simple, cylindrical, dense, ca. 4.0 cm in diameter, having ca. 25 flowers, densely flocculose, becoming glabrous; FLORAL BRACTS very minute or lacking, subulate; SEPALS 0.5-1.0 cm long, free, strongly asymmetric; PETALS ca. 1.2 cm long, yellow, bearing 2 fimbriate scales; OVARY subglobose, distance between flowers 2-4 mm.

MATERIAL EXAMINED: Fagerlind and Wibom 621 (US) Puerto Cayo, Prov. Manabí, 13 Oct. 1952; AJG 815 (US) Toalla, near base of Cerro Monte Cristi, southwest side of cerro, epiphytic, Prov. Manabí, near sea level, Aug. 1962.

MEXICO, WEST INDIES, VENEZUELA, COLOMBIA.

5. AECHMEA FRASERI Baker, 1889 (Handbook Bromel.) p. 61.

PLANT ca. 65 cm tall; LEAVES ca. 60-100 cm long, blades 4.0-5.5 cm wide, margins laxly serrate; SCAPE exceeded by leaf-rosette, ca. 3 mm in diameter, erect; SCAPE-BRACTS 5.0-12.0 cm long by 1.5 cm wide, erect, imbricate, papery when dry, margins conspicuously serrate; INFLORESCENCE 6.5-8.0 cm long by 3.0-3.5 cm in diameter, ovoid, simple, dense, having ca. 40 flowers; FLORAL BRACTS ca. 1.6 cm long by ca. 4 mm wide, subulate apex, slightly exceeded by sepals, erect, ecarinate, papery, spreading, lepidote without and within; SEPALS ca. 1.3 cm long by ca. 4 mm wide, strongly mucronate, mucro ca. 3 mm long; PETALS ca. 1.2 cm long, yellow when alive; OVARY 6-7 mm long by 5 mm in diameter; FRUIT pink, distance between flowers ca. 3 mm.

MATERIAL EXAMINED: Fraser s. n. (BM, TYPE; US, photo) "Andes of Ecuador," 1860; Camp E-3465 (US) terrestrial, cañon of Río Chanchan, ca. 5 km north of Huigra, "moist, forested valleys in the afternoon fogbelt," Prov. Chimborazo, ca. 1520-1980 m, 19-28 May 1945.

6. AECHMEA INVOLUCRATA André, 1888 (Énumération Bromél.)
p. 4; André, 1889, pp. 13-14, pl. 5 a.

FIG. 98

PLANT ca. 80 cm tall; LEAVES ca. 60 cm long, blades ca. 6.0 cm wide, margins densely serrate, sheaths ca. 30 cm long by 12 cm wide, margins serrate; SCAPE ca. 1.1 cm in diameter; SCAPE-BRACTS 5.0-6.5 cm long, imbricate, somewhat massed beneath the inflorescence, margins serrate; INFLORESCENCE 16-20 cm long by ca. 3.5 cm in diameter, simple, having ca. 100 flowers, dense; FLORAL BRACTS ca. 1.0 cm long, blade very narrow and inconspicuous; SEPALS 1.5-1.9 cm long, free, strongly asymmetric, mucro ca. 2 mm long; PETALS ca. 3.5 cm long, lilac-rose when alive; OVARY 4-5 mm long by 3-4 mm in diameter, distance between flowers ca. 3 mm.

MATERIAL EXAMINED: André 4296 (K, TYPE; US, photo) between Riobamba and Loja, July-Sept. 1876; Steyermark 54102 (US) along trail between Portovelo and Río Cabra, passing Minas Nuevas, Huertas and arriving at Cachicaran, Prov. El Oro, 640-1643 m, 23 Aug. 1943; Foster 2593 (US) epiphytic and saxicolous, Minas Nuevas, road to Cachicaran, Prov. Loja, ca. 608 m, 30 Nov. 1948.

7. AECHMEA NIDULARIOIDES L. B. Smith, 1953 (Phytologia vol. 4, no. 5) pp. 356-358, pl. 1, figs. 7-11; Smith, 1957, pp. 274-275.

PLANT ca. 130 cm tall; LEAVES 90-130 cm long, blades 3.0-5.0 cm wide, margins laxly serrate; sheaths 10-14 cm long, broadly elliptic; SCAPE ca. 15 cm long by 5 mm in diameter, much exceeded by leaf-rosette; SCAPE-BRACTS erect, densely imbricate, green, spinulose-serrate; INFLORESCENCE 15 cm long by 6.5-7.5 cm in diameter, bipinnate, dense, subglobose, mostly glabrous; PRIMARY BRACTS ca. 7.0 cm long, red, margins entire, imbricate, ovate, all but the lowest cucullate at the apex, glabrous toward bases, covered toward the apex with white appressed scales; BRANCHES aborted, few-flowered; FLORAL BRACTS ca. 1.6 cm long by ca. 0.9 cm wide, papery, broadly elliptic, apiculate, slightly exceeded by sepals, entire, densely pale-lepidote; SEPALS ca. 2.3 cm long, connate for ca. 3 mm, nerved, obovate, asymmetric, slightly lepidote; PETALS ca. 3.5 cm long, having 2 dentate scales at the base, cucullate, stamens included, distance between flowers less than 2 mm.

MATERIAL EXAMINED: Harling 3247 (US) ca. 2 km along road from Puyo to Tena, epiphytic on rotten log, Prov. Napo-Pastaza, 900 m, 12 Nov. 1958.

COLOMBIA.

8. AECHMEA MEXICANA Baker, 1879 (Journ. Bot. vol. 8) p. 165; Baker, 1889, pp. 50-51; Padilla, 1965, p. 44, fig. Aechmea bernoulliana Wittmack, 1891 (Engler's Bot. Jahrb, vol. 32) p. 1; sensu Smith, 1931, p. 41.

FIG. 99

PLANT ca. 1 m tall by ca. 1.5 m in diameter; LEAVES ca. 1 m long, blades ca. 6.0 cm wide, margins serrulate, spines ca. 1 mm long, sheath ca. 20 cm long by 12 cm wide; SCAPE much exceeded by leaf-rosette, 0.8-1.3 cm in diameter; SCAPE-BRACTS ca. 1.4 cm long, papery; INFLORESCENCE ca. 30-35 cm long by 8.0-9.0 cm in diameter, tripinnate, lax, having ca. 25 branches, deltoid, lepidote; PRIMARY BRACTS very inconspicuous, thread-like; PRIMARY BRANCHES 3.5-7.0 cm long by ca. 3.0 cm in diameter, distance between branches 0.8-3.0 cm; SECONDARY BRANCHES ca. 3.0 cm long having 3 to 6 flowers; PEDICELS 0.7-1.0 cm long; FLORAL BRACTS ca. 5 mm long, less than 1 mm wide, dropping early; SEPALs 4-5 mm long, strongly asymmetrical, connate, mucronate, mucra 2-3 mm long; PETALS ca. 9 mm long, violet when fresh; OVARY ca. 1.0 cm long by 5 mm in diameter, distance between flowers 5-7 mm.

MATERIAL EXAMINED: Bourgeau 3106 (K, TYPE; US, photo) Mexico; Foster 2711 (US, photo in situ) Ecuador(?); AJG 832 (US) ca. 20 km south of Puerto Lopez, interior road to Manglaralto, Prov. Manabí, ca. 100 m, 4 Feb. 1963; Eggers 15489 (US; AJG, photo) El Recreo, 1/2° south latitude, Prov. Manabí.

MEXICO, BRITISH HONDURAS, GUATEMALA, PANAMA.

NOTES: The specimen, Eggers 15489 (US), cited in Smith (1931, p. 41), appears clearly to me to be an Ae. mejicana Baker. Unfamiliarity with the TYPE and the other specimens of Ae. bernoulliana Wittmack which are cited by Mez (1934, p. 120) precludes on my part for the time being, any judgment as to the correct taxonomic status of Ae. bernoulliana Wittmack.

9. AECHMEA HOPPII (Harms) L. B. Smith, 1953 (Phytologia vol. 4) p. 213, pl. 1, figs. 1, 2; Smith, 1957, pp. 270-271, fig. 80.

Streptocalyx hoppii Harms, 1935 (Notizblatt Bot. Gart. und Mus. Berlin, vol. 12, no. 115) p. 526.

PLANT 40-50 cm tall; LEAVES 60-100 cm long, blades 3.0-4.0 cm wide, linear, margins laxly serrulate, sheaths ca. 15 cm long, elliptic; SCAPE exceeded by leaf-rosette, ca. 1.0 cm in diameter, erect; SCAPE-BRACTS 5.0-25.0 cm long, imbricate, densely serrulate; INFLORESCENCE 12-30 cm long by ca. 7.5 cm in diameter, bipinnate, dense, having ca. 30 spikes, ellipsoid, subglabrous; PRIMARY BRACTS 3.0-7.0 cm long by ca. 3.0 cm wide, margins densely serrate, red when alive, exceeding spikes, erect to spreading; SPIKES ca. 3.0-3.5 cm long, erect to spreading having ca. 6 to 8 flowers per spike; FLORAL BRACTS ca. 0.9 cm long by 1.4 cm wide, not distichous, margins densely serrate, ecarinate, papery, glabrous without and within, orbicular, apiculate, slightly shorter to equaling sepals; SEPALS 1.3-1.5 cm long, free, margins serrulate, broadly obovate, apiculate; PETALS 1.7-2.9 cm long, obtuse, white when alive, having 2 long obtuse scales at base; OVARY 6-8 mm long, ovules obtuse, distance between flowers ca. 3 mm.

MATERIAL EXAMINED: Hopp 1016 (B, TYPE; US, photo) Archidona, ca. 10 km north of Tena, Prov. Napo Pastaza, 900-1000 m, January 1931; Hopp 1065 (B; US, photo) Archidona,

west Ecuador, Prov. Napo Pastaza, 1931; Lugo 213 (US) Mera, Prov. Napo Pastaza, 17 April 1940; Asplund 19407 (US) Mera, among Axonopus scoparius in pasture, Prov. Napo Pastaza, 1100 m, 16 Feb. 1956; Asplund 19303 (US) Puyo, on tree trunk about 2 km east of village, Prov. Napo Pastaza, ca. 900 m, 9 Feb. 1956; Asplund 19478 (US) Vera Cruz, Prov. Napo Pastaza, ca. 900 m, 18 Feb. 1956.

COLOMBIA.

10. AECHMEA TESSMANNII Harms, 1927 (Notizblatt Bot. Gart. und Mus. Berlin vol. 9) p. 1153; Smith, 1936, pp. 587-588; Smith, 1957, p. 281.

PLANT ca. 1 m tall; LEAVES 50-70 cm long, blades 6.0-10.0 cm wide, margins serrate with spines 3-5 mm long, appressed-white-lepidote, apex cuspidate; SCAPE erect, 8-9 mm in diameter; SCAPE-BRACTS ca. 4.5 cm long, not imbricate throughout; INFLORESCENCE 18-30 cm long by ca. 18 cm in diameter, erect, having ca. 14 spikes, reddish, glabrous, bipinnate, lax; PRIMARY BRACTS 5.0-11.0 cm long, red, spreading to reflexed, margins serrulate, the lowest about equaling spikes, upper ones much shorter; SPIKES 7.0-15.0 cm long by ca. 2.5 cm wide, spreading, distance between spikes ca. 1.5-3.5 cm, having ca. 9 to 12 flowers per spike, stipe ca. 2.5 cm long having no sterile bracts; FLORAL BRACTS ca. 1.6 cm long by 0.9 cm wide, lustrous, slightly nerved, erect, imbricate, entire, distichous, glabrous without and within, ovate, apex obtuse; SEPALS ca. 1.3 cm long, exceeding floral bracts, obovate-oblong, obtuse, nearly free; PETALS ca. 2.0 cm long, orange when alive; OVARY ca. 6 mm long by 5 mm in diameter, distance between flowers, 4-6 mm.

MATERIAL EXAMINED: Tessmann 3937 (B, TYPE; US, photo) Peru; Asplund 18533 (US) Mera, epiphytic in scrub, Prov. Napo Pastaza, 1100 m, 20 Nov. 1955; Grubb et al. 1692 (US) "in crown of emergent tree at 140 ft." Shinguipino forest,

between Río Napo and Río Tena, 8 km southeast of Tena, 30
Sept. 1960.

COLOMBIA, PERU.

11. AECHMEA PYRAMIDALIS Bentham, 1844 (Bot. Voyage Sulpher)
p. 173; Smith, 1957, p. 287; Smith, 1957, p. 287.

Aechmea edmonstonei Baker, 1889 (Handbook Bromel.)
p. 38.

FIG. 100

PLANT 1-2 m tall; LEAVES 60-80 cm long, blades 4.0-7.0 cm wide, margins laxly serrate, sheaths ca. 16 cm long by 7.0 cm wide, elliptic; SCAPE erect to curving, exceeding leaves, 0.7-1.0 cm in diameter; SCAPE-BRACTS 10-25 cm long, erect, imbricate, red when alive, lepidote; INFLORESCENCE 40 cm or more long by ca. 30 cm in diameter, broadly pyramidal, white-pilose, tripinnate, lax, having ca. 18 branches; PRIMARY BRACTS 1.0-10.0 cm long, lowermost red; PRIMARY BRANCHES to 25 cm long by ca. 7.0 cm wide, these to 6.0 cm apart, stipe ca. 4.0 cm long, no sterile bracts; SPIKES 2.0-3.5 cm long, having 7 to 10 flowers, spreading; FLORAL BRACTS ca. 8 mm long, apex elongate-triangular, entire, distichous, strongly nerved, dark green, spinose-acuminate, broadly convex, spreading, not imbricate, glabrous; SEALS ca. 5 mm long including the mucro, strongly asymmetric, broadly elliptic, short-connate; PETALS 0.8-1.0 cm long, usually yellow; OVARY ca. 4 mm long, distance between flowers 2-3 mm.

MATERIAL EXAMINED: Remy s. n. (P) between Guaranda and Bodegas, Prov. Bolivar, 1856; Edmonstone s. n. (K, TYPE of Ae. edmonstonei; US, photo) Guayaquil; Hitchcock

21120 (US) epiphytic, between Santa Rosa and La Chorita, Prov. El Oro, 0-100 m, 27 Aug. 1923; Rauh, Hirsch E 376 (US) bombax woods, Arenillas, Prov. El Oro, 29 Sept. 1954; Asplund 15581 (US) on tree trunk, Quevedo, Prov. Los Rios, 20 Feb. 1955; AJG 846 (US) ca. 15 km north of Manglaralto, road to Puerto Lopez, abundant on ground and on trees, Prov. Manabí, ca. 70 m, 31 March 1963; AJG 1055 (US) epiphytic in Samanea (or Pseudosamanea) ca. 4 m from ground, tank with about 1 pint water, moderately common, km 98 Guayaquil-Quevedo, Prov. Los Rios, ca. 100 m, 2 Aug. 1965.

COLOMBIA.

12. AECHMEA ANDRADEI Gilmartin, spec. nov.

A Aechmea abbreviata L. B. Smith, cui affinis, laminis brevioribus, marginibus foliorum armatioribus; bracteis florigeris amplioribus differt.

FIG. 101

PLANT 30-50 cm tall; LEAVES 15-35 cm long by ca. 5.0 cm wide, margins serrate, spines ca. 4 mm long, sheaths ca. 7.0 cm long by 5.0 cm wide, densely lepidote below; SCAPE ca. 1 mm in diameter, curving, exceeding leaf-rosette; SCAPE-BRACTS ca. 2.8 cm long, erect, not imbricate, entire; INFLORESCENCE ca. 4.0 cm long by 3.0 cm in diameter, bipinnate, having ca. 4 spikes, lax, axis flocculose; PRIMARY BRACTS to 3.5 cm long, red, margins entire; SPIKES ca. 1.4 cm long with 2 to 3 flowers, spreading; FLORAL BRACTS distichous, entire, ca. 7 mm long, broadly ovate, green toward base, red toward apex, lepidote; SEPALs 5.5 mm long, asymmetric, nerved, yellow; PETALS ca. 5 mm long, bearing fimbriate basal scales, yellow when alive; OVARY ca. 5 mm long, distance between flowers 5-6 mm.

MATERIAL EXAMINED: AJG 870 (US, TYPE) ca. 125 km west of Santo Domingo road to Esmeraldas, growing on ground, Prov. Esmeraldas, ca. 0° 30' north, 79° 27' west, ca. 50 m, 11 Oct. 1963.

NOTES: The species seems to bear some relation to Aechmea abbreviata but the size and configuration of the floral bracts as well as the much shorter and broader

leaves and the greater degree of spineyness of the leaf-blades distinguish it. It is also superficially reminiscent of Aechmea angustifolia.

13. AECHMEA ABBREVIATA L. B. Smith, 1959 (Phytologia vol. 6, no. 8) pp. 434-435, pl. 1, figs. 8-12.

PLANT 30-47 cm tall; LEAVES 35-60 cm long, blades 2.5-3.5 cm wide, laxly serrate, spines from 3 mm long toward leaf base to almost imperceptible near apex, with coarse white, appressed scales on both surfaces; sheaths 6.0-10.0 cm long, elliptic, margins entire; SCAPE about as long as leaf-rosette, ca. 3 mm in diameter, erect, white flocculose; SCAPE-BRACTS ca. 3.5 cm long, erect, not imbricate except just below inflorescence, obscurely serrulate, red; INFLORESCENCE ca. 4.0 cm long by 5.0 cm in diameter, subdigitate, 5-branched, sparsely white-flocculose; PRIMARY BRACTS like scape bracts but entire, lowest nearly equaling spikes; SPIKES to 4.0 cm long, densely distichous-flowered; FLORAL BRACTS entire, ca. 4 mm long, not or scarcely nerved, broadly ovate; SEPALS 4-5 mm long, nerved, truncate, oblong, having a minute terminal mucro; PETALS ca. 1.5 cm long, pale yellow except for white apical third, bearing 2 long fimbriate scales; OVARY ca. 6 mm long, subglobose, distance between flowers 4-5 mm.

MATERIAL EXAMINED: Asplund 18472 (S, TYPE; US, photo and fragment) on tree trunk, Mera, towards Puyo, Prov. Napo Pastaza, ca. 1000 m, 17 Nov. 1955.

14. AECHMEA PENDULIFLORA André, 1888 (Énumération Bromél.) p. 3; André, 1889, pp. 9-10, pl. 4 a; Smith, 1957, pp. 289-290, fig. 85.

Aechmea inermis Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 620.

Billbergia paniculata Mart. ex Schult, 1830 (In R. and S. Syst. Veg. vol. 7, part 2) p. 1268.

PLANT ca. 50 cm tall; LEAVES 40-70 cm long, blades 2.0-4.0 cm wide, margins laxly serrate, teeth nearly straight, sheaths 10-12 cm long by ca. 6.0 cm wide, margins entire; SCAPE ca. 3 mm in diameter; SCAPE-BRACTS 3.0-5.0 cm long, not imbricate, red, erect, apex acuminate; INFLORESCENCE 7.0-15.0 cm long by ca. 7.0 cm in diameter, bipinnate to tripinnate, subdensely ellipsoid, soon glabrous except for primary bracts, having ca. 8 to 12 spikes; PRIMARY BRACTS to 6.0 cm long, spreading, lepidote, lowermost about equaling spikes; SPIKES to 5.0 cm long, having ca. 6 to 10 flowers, spreading, 0.5-2.2 cm apart, stipe to 2.0 cm long; FLORAL BRACTS 2-5 mm long, entire, thin, very slightly nerved, lepidote; SEPALs 6-7 mm long, free or subfree, subovate, obtuse, entire or obscurely mucronulate; PETALS ca. 1.3 cm long, bearing 2 fimbriate scales above base; OVARY ellipsoid or subglobose, distance between flowers 0.4-1.0 cm.

MATERIAL EXAMINED: André 378 (K, TYPE; US, photo) Colombia; Asplund 9364 (US) between Tena and Napo, Prov.

Napo Pastaza, 16 Oct. 1939.

COSTA RICA, Amazonian BRASIL, COLOMBIA, PERU,
VENEZUELA.

15. AECHMEA LEUCOCARPA André, 1888 (Énumération Bromél.)
p. 3; André, 1889, pp. 10-11, pl. 4 b; Smith, 1957, p.
285.

FIG. 102

PLANT 30-100 cm tall; LEAVES 25-40 cm long, blades ca. 6.5 cm wide, lingulate, spotted purple, broadly acute and cuspidate, laxly serrate with straight or slightly curved spines, sheath 13-15 cm long by 8.0-9.0 cm wide, elliptic; SCAPE ca. 6 mm in diameter, about equaling leaf-rosette; SCAPE-BRACTS 3.0-4.5 cm long, not at all imbricate, erect, upper ones entire, acute; INFLORESCENCE 6.0-15.0 cm long by 3.0-5.0 cm in diameter, bipinnate, dense, subovoid; PRIMARY BRACTS 3.0-5.0 cm long, spreading, lowermost about equaling spikes, others very inconspicuous; SPIKES 1.5-3.5 cm long, divergent, having 4 to 8 flowers; FLORAL BRACTS ca. 5 mm long, ovate, distichous, entire, mucronulate, scarcely nerved, lepidote; SEPALs ca. 5 mm long, free, strongly asymmetric; PETALS ca. 9 mm long, yellow; BERRY ca. 6 mm long, white, globose, distance between flowers 4-6 mm.

MATERIAL EXAMINED: Sodiro 171/3 (B; US, AJG photos) Pallatanga river valley, west of Guamote, Prov. Chimborazo, Nov. 1891; AJG 1061 (US) epiphytic on orange tree in finca near turn-off for road to Quinendé, ca. 1 km west of Santo Domingo, Prov. Pichincha, ca. 600 m, 3 Aug. 1965.

COLOMBIA.

16. AECHMEA ANGUSTIFOLIA Poeppig and Endlicher, 1838 (Nova Genera and Species vol. 2) p. 43, pl. 159; Smith, 1957, pp. 284-285, fig. 84.

FIG. 103

PLANT 50-85 cm tall; LEAVES 50-85 cm long, blades 3.0-6.0 cm wide, spinose-serrate, concolorous, sheaths 10-17 cm long by 7.0-8.0 cm wide, forming an ellipsoid tank, often purple on upper surface, margins of sheath entire; SCAPE 3-4 mm in diameter, exceeding leaf-rosette, white-flocculose, becoming glabrous; SCAPE-BRACTS ca. 4.5 cm long, erect, red when alive, not at all imbricate, upper ones softly serrulate; INFLORESCENCE 13-36 cm long by ca. 5.0 cm in diameter, bipinnate, cylindric, fertile throughout, dense or lax; PRIMARY BRACTS to 7.0 cm long, the lowest, like scape-bracts, exceeding spikes, others abruptly reduced to about the size of floral bracts, margins serrate; SPIKES 2.0-2.5 cm long by ca. 1.4 cm wide, spreading at about right angle to axis, having ca. 10 flowers, rhachis undulate, compressed; FLORAL BRACTS 4-5 mm long by 4-5 mm wide, spreading, distichous, entire, red when alive, round to broadly ovate, flocculose, not or scarcely nerved; SEPALS ca. 5 mm long by 4 mm wide, spreading, strongly asymmetric; PETALS 8-10 mm long, bearing 2 scales adnate to well above the base; OVARY 5-6 mm long, distance between flowers ca. 4 mm.

MATERIAL EXAMINED: Hitchcock 21132 (US) epiphytic,

between Santa Rosa and La Chorita, Prov. El Oro, 0-100 m, 27 Aug. 1923; Drew E-633 (US) epiphytic, lower Intag Valley, above Río Chalguayaco, below Magnolia, Prov. Imbabura, 1220 m, 17 Sept. 1944; Foster 2633 (US) epiphytic, near Santo Domingo, Prov. Pichincha, ca. 608 m, 8 Dec. 1948; Asplund 17595 (US) vicinity of Guayaquil, Cerro Azul, epiphytic, Prov. Guayas, 10 Sept. 1955; AJG 803 (US) 34 km east of Quevedo, streambed, epiphytic, Prov. Los Ríos, ca. 270 m, 18 August 1962; AJG 847 (US) terrestrial, ca. 15 km north of Manglaralto, Prov. Manabí, ca. 70 m, 31 March 1963; AJG 868 (US) epiphytic, ca. 8 m from ground on horizontal limb, 20 km east of Santo Domingo, Prov. Pichincha, 25 Oct. 1963; AJG 1069 (US) epiphytic, 2-3 m from ground, common, outskirts of Santo Domingo, Prov. Pichincha, ca. 600 m, 3 Aug. 1965; AJG 1066 (US) epiphytic, 2-5 m from ground, common, outskirts of Santo Domingo, Prov. Pichincha, ca. 600 m, 3 Aug. 1965; AJG 1067 (US) epiphytic, ca. 2 m from ground, outskirts of Santo Domingo, Prov. Pichincha, ca. 600 m, 3 Aug. 1965; AJG 1076 (US) epiphytic, ca. 2 m from ground, no water in tank, pasture, several km up road from Santo Domingo, common, Prov. Pichincha, ca. 700 m, 4 Aug. 1965.

BOLIVIA, COLOMBIA, COSTA RICA, PERU.

Genus ANANAS

Ananas Miller, 1754 (Gardener's Dictionary, abridged, ed.4).

Plant not producing stolons; leaves densely rosulate, scarcely enlarged at base; scape evident, erect; inflorescence densely strobiliform, usually crowned with a coma of sterile foliaceous bracts, often producing slips at base of inflorescence; flowers sessile; sepals free, slightly asymmetric, petals free, erect, violet or red, each bearing 2 slenderly funnelform scales; stamens included, pollen grains ellipsoid with two pores; ovaries fused with each other and with the fleshy bracts to form a syncarp.

KEY TO THE ECUADORIAN SPECIES OF ANANAS

1. Leaves erect, unarmed except for terminal spine, floral bracts small, unarmed. : 1. Ananas lucidus.
1. Leaves NOT erect but spreading to recurving, serrate throughout the margins usually, floral bracts serrate or serrulate, or unarmed.
 2. Syncarp, 15 cm long or more at maturity, very fleshy, floral bracts exposing apices of ovaries. : 2. Ananas comosus.
 2. Syncarp, to 15 cm long, moderately fleshy, floral bracts to 3.5 cm long and covering the ovaries. : 3. Ananas bracteatus.

1. ANANAS LUCIDUS Miller, 1768 (Gardener's Dictionary, ed. 8, no. 4; Smith, 1967, p. 164.

Ananas erectifolius L. B. Smith, 1939 (Bot. Mus. Leaflets, Harvard vol. 1) p. 78, pl. 1.

LEAVES ca. 1 m long or more, mostly straight, unarmed except for terminal spine; SCAPE elongate, slender; SCAPE-BRACTS foliaceous, erect; FLORAL BRACTS small, entire; SEPALS ca. 7 mm long, obtuse, wide-ovate; PETALS ca. 1.7 cm long; SYNCARP less than 15 cm long at maturity, mostly dry.

MATERIAL EXAMINED: Acosta Solis 6446 (F) Limon, Prov. Bolivar, 800 m, 19 Oct. 1943.

BRAZIL, PARAGUAY.

2. ANANAS COMOSUS (L.) Merrill, 1917 (Interpr. Rumph. Amboin.) p. 133.

Bromelia ananas L., 1753 (Sp. Pl.) p. 285.

Ananas sativus Schultes in Roemer and Schultes, 1830 (Syst. Veg. vol. 7, part 2) p. 1283.

LEAVES coarsely and laxly spinose-serrate; scape short, stout; SCAPE-BRACTS foliaceous, serrate; INFLORESCENCE many-flowered; FLORAL BRACTS exposing the apices of the ovaries, margins serrate or entire; SYNCARP well over 15 cm long at maturity with copious palatable flesh.

NOTES: No herbarium specimens of Ananas comosus (pineapple, or "piña") have been examined. However, many specimens in the field (under cultivation) have been examined with special reference to their relative gustatory properties.

3. ANANAS BRACTEATUS Roemer and Schultes, 1830 (Syst. Veg. vol. 7) p. 1284.

Ananas saenaria sensu Mez, 1934 (Pflanzenreich vol. 4) p. 104.

LEAVES 1 m long or more, marginal spines subdistant, up to 10 mm long; SCAPE evident; SCAPE-BRACTS bright red, spreading above; INFLORESCENCE to 15 cm long and 12 cm in diameter, ovoid; FLORAL BRACTS to 3.5 cm long, bright red, margins minutely serrate; FLOWERS to 2.5 cm long, violet turning red.

MATERIAL EXAMINED: Acosta Solis 5317 (F) between Guayllanac and Hacienda "La Carmela," Prov. Chimborazo, 1100-1350 m, 14 Aug. 1943.

BRAZIL, PARAGUAY.

Genus STREPTOCALYX

Streptocalyx Beer, 1854 (Flora vol. 37) p. 348.

Leaves densely rosulate; scape elongate to almost none; inflorescence central, bi- tripinnate, densely sub-globose to laxly paniculate; flowers sessile; sepals free, 18-23 mm long, asymmetric; petals free, narrow, naked; stamens and pistil included; pollen grains with 2 or 4 pores; ovary with distinct epigynous tube, ovules numerous; seeds ellipsoid or ovoid, naked.

KEY TO THE ECUADORIAN SPECIES OF STREPTOCALYX

1. Spikes of two flowers only, scape exceeding leaf-rosette, floral bract margins entire, leaves 60-75 cm long. : 1. Strep. geminiflorus.
1. Spikes with 3 to 6 flowers, scape very short or none, floral bract margins serrulate, leaves 40-120 cm long. : 2. Strep. longifolius.

1. STREPTOCALYX GEMINIFLORUS Harms, 1935 (Notizblatt, Bot. Gart. und Mus. Berlin vol. 7, no. 115) pp. 527-528.

PLANT ca. 50 cm tall; LEAVES ca. 60-75 cm long, blades ca. 2.5 cm wide, linear, margins serrate, sheaths ca. 14 cm long by 5.5 cm wide, margins entire; SCAPE exceeding leaf-rosette; SCAPE-BRACTS foliaceous, all imbricate; INFLORESCENCE ca. 8.0 cm long by ca. 9.0 cm in diameter, bipinnate, dense, having ca. 40 to 60 flowers; PRIMARY BRACTS 5.0-6.5 cm long, serrate-margined; SPIKES having only two flowers, much exceeded by primary bracts; FLORAL BRACTS 1.5-2.3 cm long, apices mucronate, glabrous, margins entire; SEPALS ca. 1.4 cm long, oblong, mucronulate; PETALS blue; OVARY triangular.

MATERIAL EXAMINED: Diels 1109 (B, TYPE; US, photo) valley of the Río Pastaza, near Río Negro, epiphytic, Prov. Napo Pastaza, 15 Sept. 1933.

2. STREPTOCALYX LONGIFOLIUS (Rudge) Baker, 1889 (Handbook Bromel.) p. 31; Smith, 1957, pp. 252-253.

Bromelia longifolia Rudge, 1805 (Guyan. vol. 1) p. 31, pl. 49.

PLANT ca. 70 cm tall; LEAVES 40-120 cm long, blades ca. 2.0 cm wide, with marginal spines ca. 2.5 mm long and straight, sheaths ca. 11 cm long by 5 cm wide, elliptic, dark castaneous, with margins entire; SCAPE very short or none; INFLORESCENCE 7.0-15.0 cm long by 5.5-8.5 cm in diameter, bipinnate, dense, ovoid or ellipsoid, pale ferruginous lepidote except for petals, having ca. 8 spikes; PRIMARY BRACTS 2.5-6.0 cm long by ca. 3.5 cm wide, about as long as spikes, margins inconspicuously serrulate, ovate or elliptic, apices round and apiculate; SPIKES ca. 6.0 cm long by 2.5 cm wide, imbricate, erect, having 3 to 6 flowers; FLORAL BRACTS 1.7-3.0 cm long, margins serrulate, broadly ovate to orbicular, rounded, covering the ovary, lepidote without and within, coriaceous; SEPALS ca. 1.5 cm long, by 6-8 mm wide, free, mucronulate, coriaceous; SEPALS ca. 1.5 cm long by 6-8 mm wide, free, mucronulate, coriaceous, lepidote without and within; PETALS 2.5-3.0 cm long, white; OVARY 1.2-1.4 cm long by 8-9 mm wide.

MATERIAL EXAMINED: Asplund 9441 (US) epiphytic, between Tena and Archidona, Prov. Napo Pastaza, 19 Oct. 1939.

BRAZIL, COLOMBIA, PERU.

BROMELIA

Bromelia L., 1753 (Spec. Plant.) p. 285.

Coarse terrestrial plants; leaves with large curved spines along the margins; inflorescence sessile or scapose, always compound; sepals free to connate, obtuse to acuminate, rarely mucronate; petals usually not having a claw, united into a tube by the filaments but with margins free, naked, usually fleshy; stamens included; berry succulent, large; seeds few to many, flattened, naked.

KEY TO THE ECUADORIAN SPECIES OF BROMELIA

1. Scape present, inflorescence narrowly pyramidal, berry ca. 3.5 cm long.
 : 1. Bromelia pinguin.
1. Scape absent, inflorescence sunk into center of leaf-rosette, berry ca. 8.0 cm long. . .
 : 2. Bromelia plumieri.

1. BROMELIA PINGUIN L., 1753 (Spec. Plant.) p. 285; Smith, 1957, pp. 262-263.

PLANT ca. 1 m tall by 2 m in diameter or more; LEAVES 1-2 m long, blades 3.5-4.5 cm wide, linear, minutely appressed-lepidote beneath, margins with stout teeth to 1.0 cm long, apex acuminate, sheath ca. 20 cm long by 10 cm wide; SCAPE well developed, ca. 2.0 cm in diameter; SCAPE-BRACTS foliaceous, sheaths roseate and subinflated; INFLORESCENCE many-flowered, narrowly pyramidal, farinose; PRIMARY BRACTS like scape-bracts but upper ones with margins entire; BRANCHES to 12-flowered; FLORAL BRACTS 1.0-3.0 cm long, linear-subulate from a short broad base; FLOWERS to 6.0 cm long, distinctly pedicellate; SEPALS 1.5-3.0 cm long, narrowly triangular, erect, pale; PETALS ca. 3.0 cm long, by ca. 6 mm wide, rose with white margins, densely white-tomentose at apex; OVARY ca. 2.0 cm long, slenderly ellipsoid; BERRY ca. 3.5 cm long, ovoid, strongly verrucose, acidulous, aromatic.

MATERIAL EXAMINED: Acosta Solis 10673 (US) between Portoviejo and Manta, Prov. Manabí, 20-100 m, 28 July 1945.

COLOMBIA, GUIANA, MEXICO, WEST INDIES.

2. BROMELIA PLUMIERI (E. Morr.) L. B. Smith, 1967 (Phytologia vol. 15, no. 3) p. 173.

Karatas plumieri E. Morren, 1872 (Belgic. Hort. vol. 22) p. 131.

Bromelia karatas L., 1753 (Sp. Pl.) p. 285, pro parte.

PLANT ca. 2 m tall; LEAVES 1.5-3.0 m long, blades 3.0-5.0 cm wide, linear, acuminate, densely serrate with stout brown teeth 5-8 mm long, sheaths broadly triangular, entire or somewhat serrate toward sheath, apex densely lepidote with elongate coarse dark brown scales; SCAPE lacking; INFLORESCENCE surrounded by cinnabar-red inner leaves; PRIMARY BRACTS like the inner leaves but with shorter blades; FLORAL BRACTS attaining middle of sepals, membranaceous, narrowly oblanceolate, papery, coarsely lepidote; FLOWERS 6.0-9.0 cm long; PEDICELS up to 2.0 cm long, stout; SEPALS ca. 3.0 cm long, free, narrowly lanceolate, erect, coarsely brown-lepidote; PETALS to 4.0 cm long, glabrous, fleshy, rose with white base and margins; OVARY triangular-prismatic, densely brown-lepidote; FRUIT fusiform, ca. 8.0 cm long by ca. 2.0 cm in diameter.

MATERIAL EXAMINED: Steiermark 54254 (GH) between Portovelo and Zaruma, Prov. El Oro, 760-915 m, 1 Sept. 1943.

BRAZIL, COLOMBIA, MEXICO, WEST INDIES.

Genus GREIGIA

Greigia Regel, 1865 (Gartenflora vol. 14) p. 137.

Stemmed or stemless; leaves evenly distributed along the stem, leaf-blades narrowly triangular, partially or totally serrate or serrulate; scape lacking; inflorescence lateral or central, simple or compound, dense; sepals free or nearly so, mostly symmetric; flowers sessile; petals connate, fleshy, naked; filaments adnate to petals; anthers narrow, acute, pollen grains large, spherical, smooth; fruit fleshy.

KEY TO THE ECUADORIAN SPECIES OF GREIGIA

1. Leaf-blades slightly serrulate, more so toward apex, less so toward sheath, inflorescence having ca. 12 flowers, leaf-sheath ca. 11 cm long. . . : 1. Greigia sodiroana.
1. Leaf-blades conspicuously serrate, usually more so toward sheath and less serrate toward apex, inflorescence with flowers numerous, leaf-sheaths 4.0-7.0 cm long. : 2. Greigia mulfordii.

1. GREIGIA SODIROANA Mez, 1904 (Bull. Herb. Boiss. series 2, vol. 4) p. 619.

PLANT ca. 40 cm tall; LEAVES 60-100 cm long, blades 2.5-3.5 cm wide, apex attenuate, margins slightly serrulate, mostly more serrulate toward apex than toward sheath, sheath ca. 11 cm long by 5.0 cm wide; INFLORESCENCE sessile and lateral, having ca. 12 flowers; OUTER BRACTS ca. 4.0 cm long, margins serrulate or nearly entire, papery, transparent margins otherwise dark castaneous when dry; FLORAL BRACTS ca. 2.2 cm long by ca. 6 mm wide, carinate, lepidote, margins papery and transparent, apex acute; SEPALS ca. 2.3 cm long, ca. 5 mm wide, acute, carinate; PETALS ca. 3.5 cm long, very dark when dry; OVARY triangular-fusiform.

MATERIAL EXAMINED: Sodiro 171/1a (B, TYPE; US, Nanegal valley, Prov. Pichincha, Oct. 1902; Foster 2609 (US) km 40, Cuenca-Oña, Prov. Azuay, ca. 3660 m, 3 Dec. 1948; Camp E-4704 (US, GH) terrestrial, 4-6 km north of village of Sevilla de Oro, "Pinuela," Prov. Azuay, 2700-3050 m, 14 Aug. 1945; Camp 4575 (US) terrestrial, 1-8 m north of village of Sevilla de Oro, Prov. Azuay, ca. 2400-2700 m, 27 July - 12 Aug. 1945.

2. GREIGIA MULFORDII L. B. Smith, 1949 (Contrib. U.S. Nat. Herb. vol. 29, no. 7) pp. 286-287, fig. 12; Smith, 1957, p. 260.

FIG. 104

PLANT stemmed, stem 30-150 cm long; LEAVES ca. 80 cm long, brown-lepidote throughout, concolorous, blades 3.5-4.0 cm wide, margins conspicuously serrate, usually more so toward sheath and less serrate toward blade apex, sheaths 4.0-7.0 cm long by 4.5-5.0 cm wide, elliptic; INFLORESCENCE lateral, several to many per stem, 6.0-7.0 cm long, many-flowered; OUTER BRACTS 3.5-4.5 cm long, broadly elliptic with narrowly triangular apices, dark castaneous except for transparent margins, not nerved, coriaceous, serrulate toward apices; FLORAL BRACTS ca. 3.0 cm long, lanceolate, slightly lepidote, castaneous except for pale margins; SEPALS ca. 2.1 cm long, subulate-acute, slightly lepidote; PETALS 3.5 cm long, blades lilac, slightly lepidote within.

MATERIAL EXAMINED: Foster 2610 (US) moist cloud forest, dense growth, km 70 Cuenca-Oña, Prov. Azuay, ca. 4100 m, 3 Dec. 1948; Acosta Solís 11189 (US) "Piñuela," between Oya Cachi and Comenia, Prov. Pichincha, ca. 3000 m, 27 Oct. 1945.

COLOMBIA.

TAXONOMIC LITERATURE PERTINENT TO THE BROMELIACEAE OF ECUADOR

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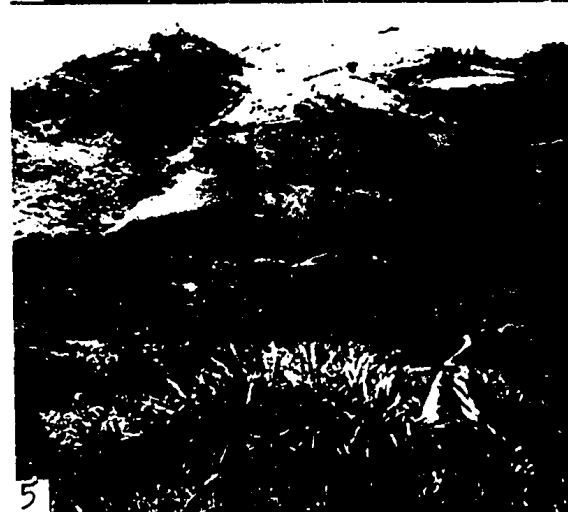
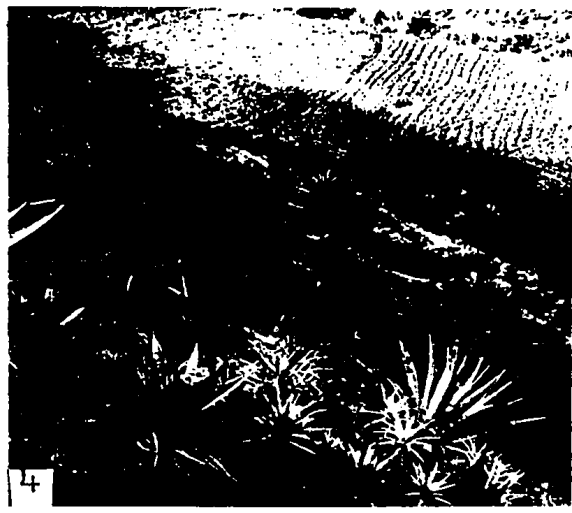
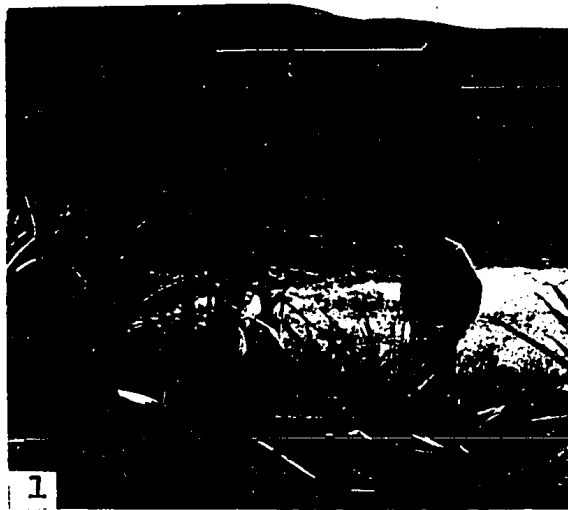
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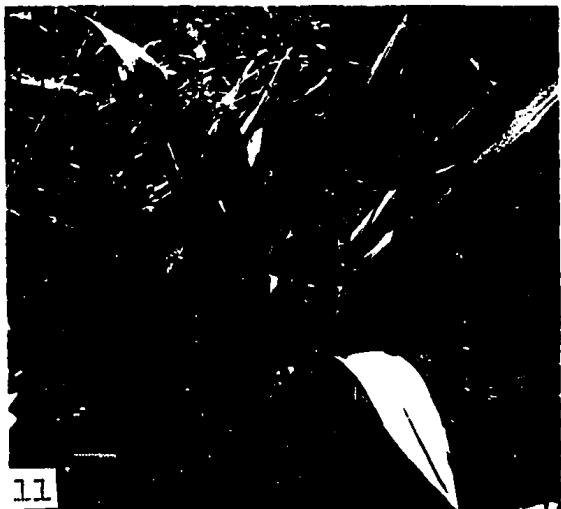
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Figure 1.--Puya fastuosa, AJG 1103; Figure 2.--Puya parviflora, AJG 1134; Figure 3.--Puya clava-herculis; Figure 4.--Puya lanata, AJG 1116; Figure 5.--Puya glomerifera, AJG 1097; Figure 6.--Puya westii, AJG 1108.



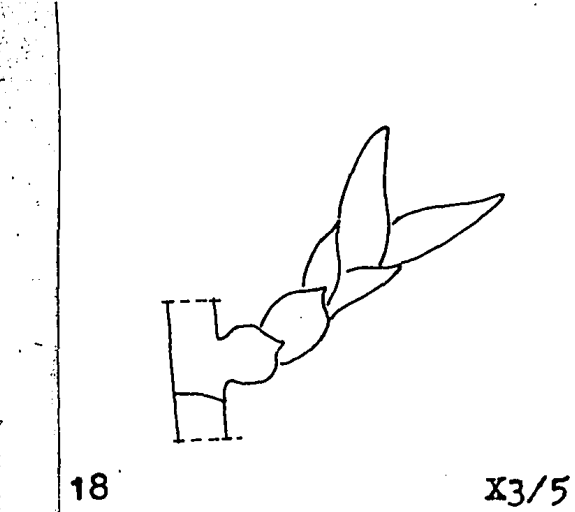
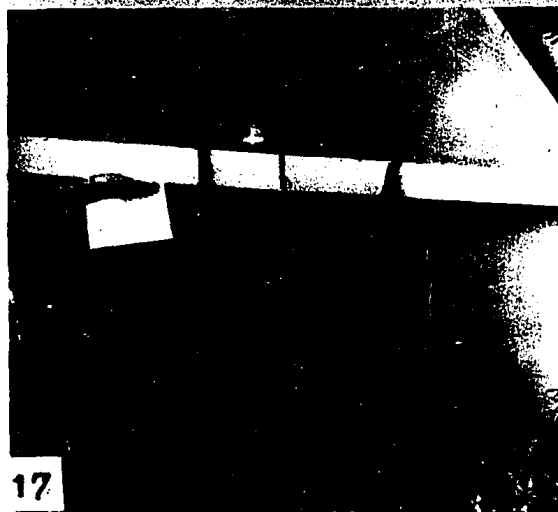
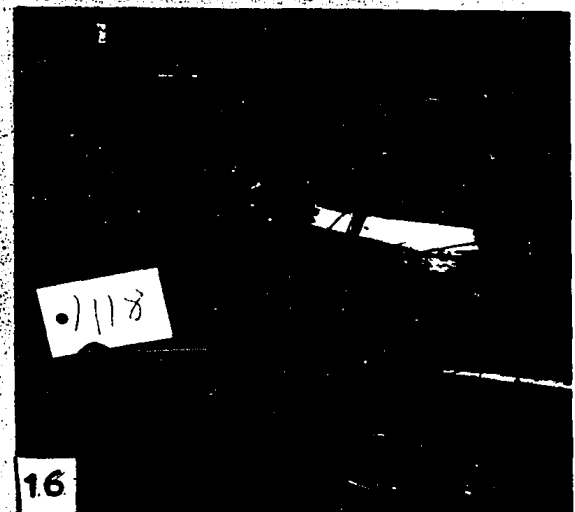
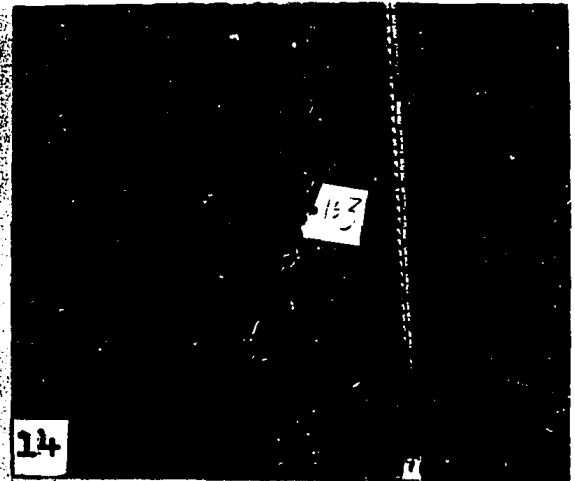
FIGURES 1-6

Figure 7.--Puya thomasiana, AJG 1130; Figure 8.--Puya
aequatorialis, Benoist 3915; Figure 9.--Pitcairnia hetero-
phylla, AJG 1168; Figure 10.--Pitcairnia brevicalycina, AJG
1137; Figure 11.--Pitcairnia sceptrigera, Foster 2646;
Figure 12.--Pitcairnia riparia, AJG 1169.



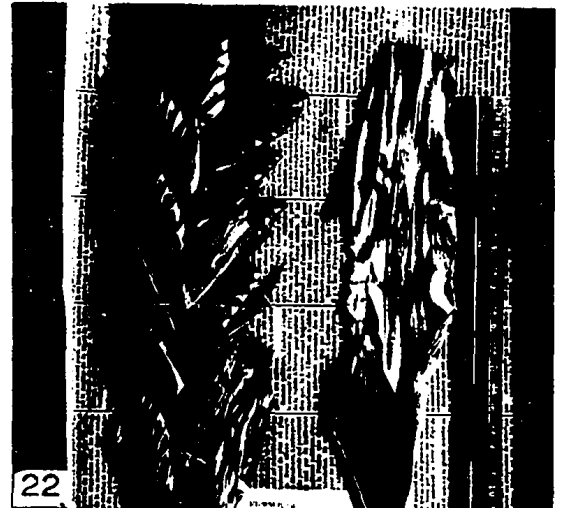
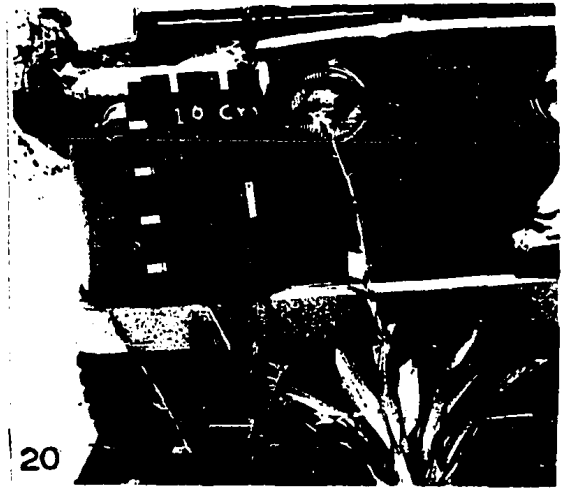
FIGURES 7-12

Figure 13.--Pitcairnia pavonii, AJG 1169; Figure 14.--
Pitcairnia pungens, AJG 1163; Figure 15.--Tillandsia disticha,
AJG 1125; Figure 16.--Tillandsia tectorum, AJG 1118; Figure
17.--Tillandsia stenoura var. stenoura, AJG 841; Figure 18.
--Tillandsia stenoura var. gonzalezii, drawing of spike
base of Espinosa E 342. x 3/5.



FIGURES 13-18

Figure 19.--Tillandsia stenoura var. mauroi, AJG 1112;
Figure 20.--Tillandsia pyramidata, AJG 1151, note vegeta-
tive plantlets on inflorescence; Figure 21.--Tillandsia
fendleri var. reducta, AJG 1109; Figure 22.--Tillandsia
polyantha, photograph of herbarium specimen of Sodiro 38 b.
Figure 23.--Tillandsia demissa, AJG 1154; Figure 24.--
Tillandsia buseri var. nubicola, Foster 2620.



FIGURES 19-24

Figure 25.--Tillandsia fosteri, Foster 2625; Figure 26.
--Tillandsia wurdackii, AJG 1148; Figure 27.--Tillandsia
arcuans, photograph of herbarium specimen of Benoist 3917;
Figure 28.--Tillandsia orbicularis, AJG 1110; Figure 29.--
Tillandsia sceptraformis, AJG 851; Figure 30.--Tillandsia
complanata, AJG 1111.



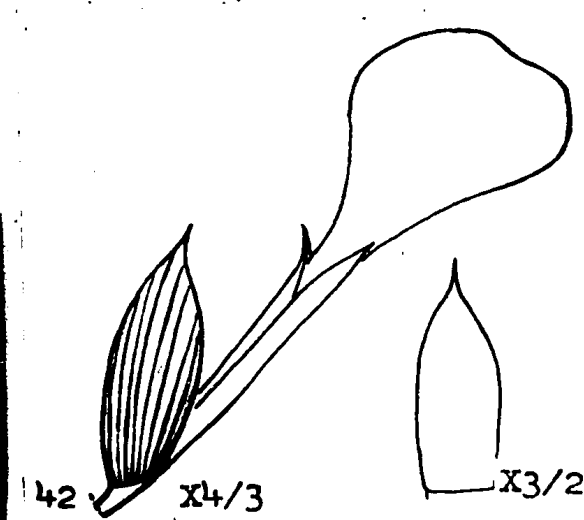
FIGURES 25-30

Figure 31.--Tillandsia zamorensis, AJG 842; Figure 32.
--Tillandsia rubella, AJG 1167; Figure 33.--Tillandsia
barbeyana, AJG 1098; Figure 34.--Tillandsia latifolia var.
divaricata, AJG 1129; Figure 35.--Tillandsia queroensis,
AJG 1102; Figure 36.--Tillandsia incarnata, AJG 1107.



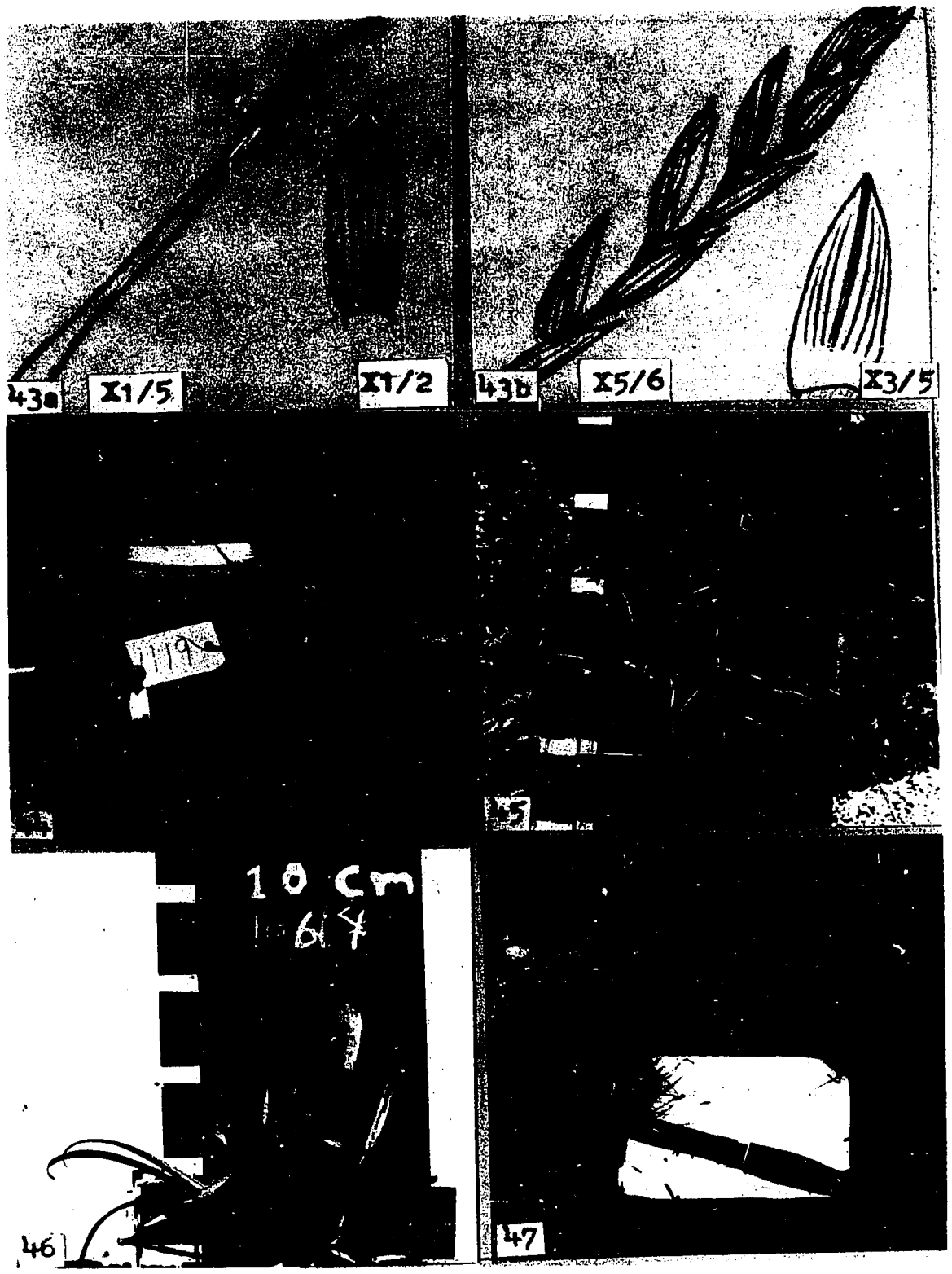
FIGURES 31-36

Figure 37.--Tillandsia cyanea var. cyanea, AJG 703;
Figure 38.--Tillandsia cyanea var. elator, photograph of
herbarium specimen of Sodiro s.n. in (Quito); Figure 39.--
Tillandsia platyrhachis, AJG 1139; Figure 40.--Tillandsia
straminea, AJG 1120; Figure 41.--Tillandsia straminea, AJG
1120; Figure 42.--Tillandsia nubis, drawing of flower, 2
petals removed (x 4/3) and sepal (x 3/2) of Naundorff s.n.



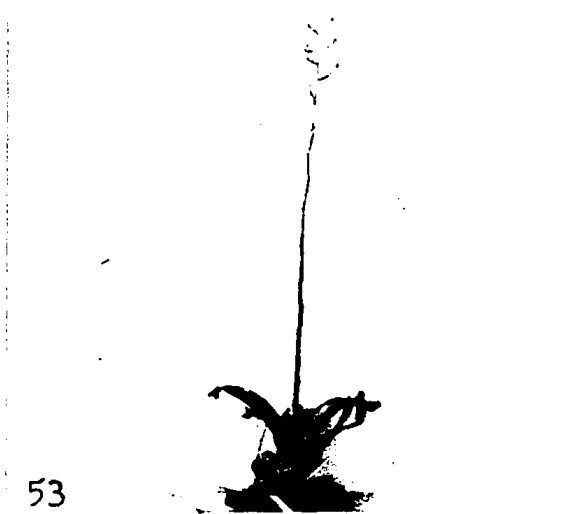
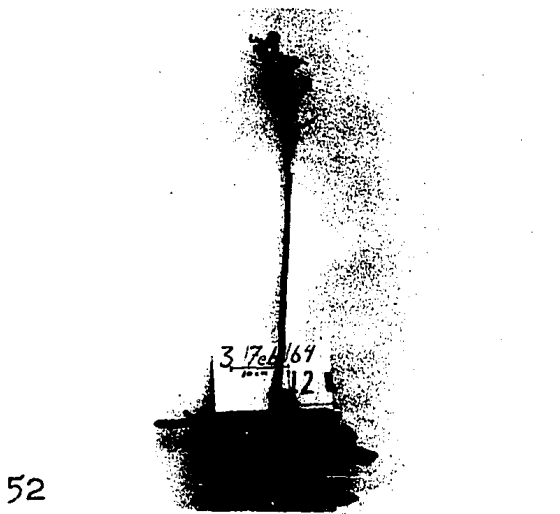
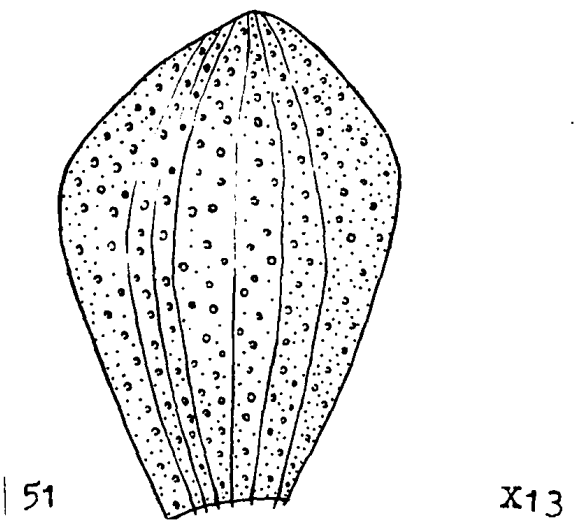
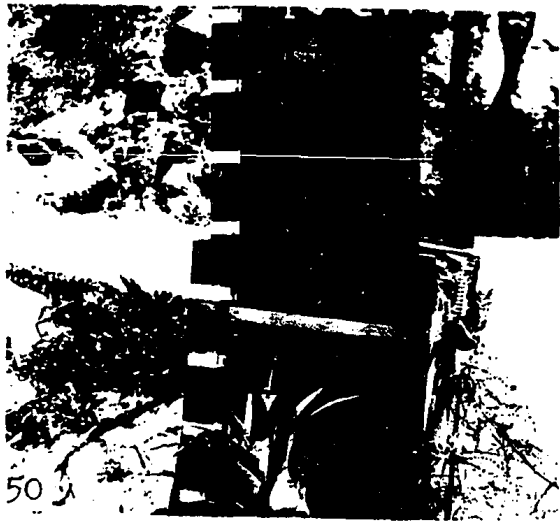
FIGURES 37 - 42

Figure 43 a.--Tillandsia acosta solisii, drawing of leaf (x 1/5) and of sepal (x 1/2) of Teuscher 2275-56; Figure 43 b.--Tillandsia acosta solisii, drawing of spike (x 5/6) and floral bracts (x 3/2) of Teuscher 2275-56; Figure 44.--Tillandsia caerulea, AJG 1119; Figure 45.--Tillandsia triglochinosoides, AJG 1052; Figure 46.--Tillandsia cornuta, AJG 1064; Figure 47.--Tillandsia recurvata, AJG 833.



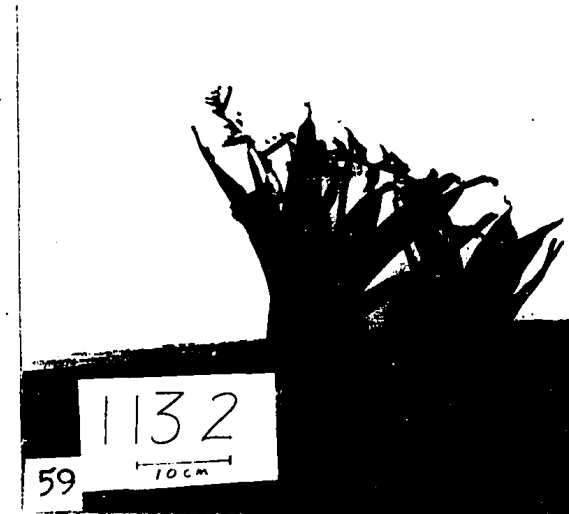
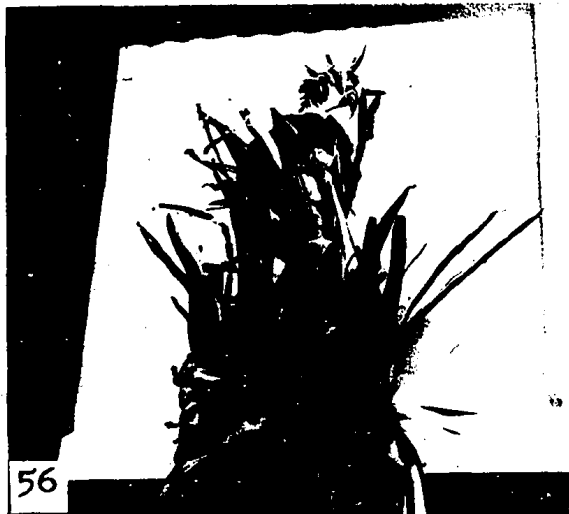
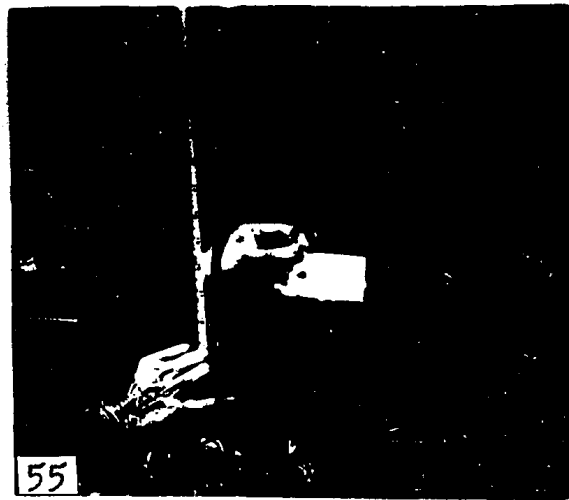
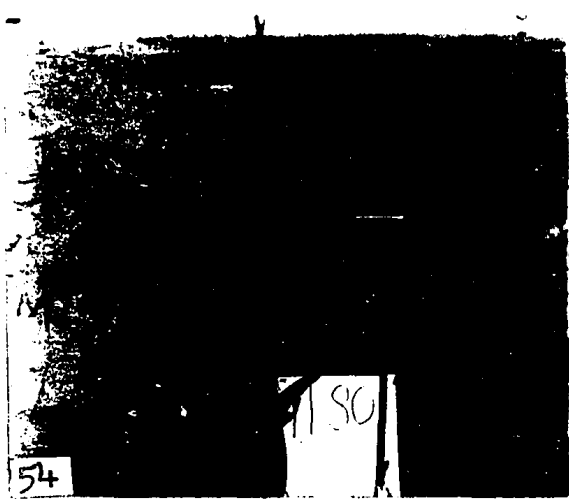
FIGURES 43a - 47

Figure 48.--Tillandsia usnoides; Figure 49.--Tillandsia fraseri, Foster 2596; Figure 50.--Tillandsia pugiformis, photograph of portion of plant of AJG 1152; Figure 51.--Tillandsia sinuosa var. quirozii, drawing of sepal (x 1/3) of AJG 1176; Figure 52.--Tillandsia insularis var. insularis, AJG 883; Figure 53.--Tillandsia insularis var. latilamina, AJG 879.



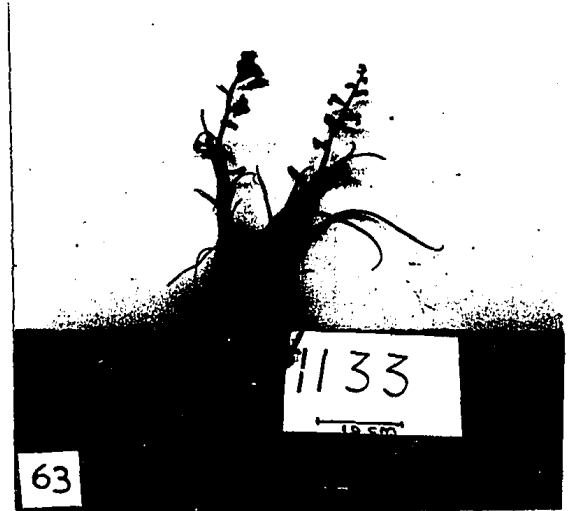
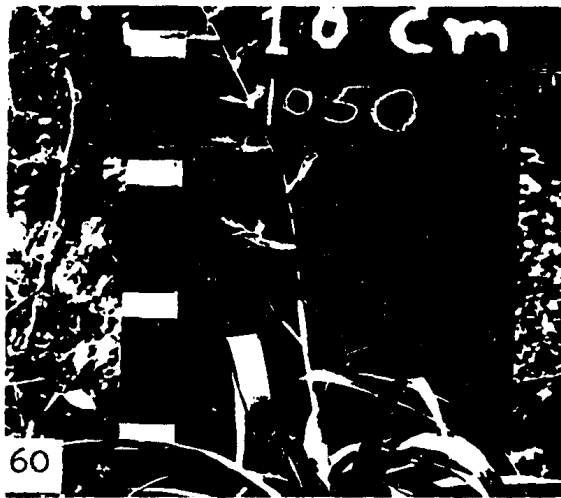
FIGURES 48-53

Figure 54.--Tillandsia quadripinnata, AJG 1180; Figure 55.--Tillandsia micrantha, AJG 1141; Figure 56.--Tillandsia gilmartiniae, AJG 799; Figure 57.--Tillandsia riocruexii, AJG 1138; Figure 58.--Tillandsia tetrantha var. scarlatina, AJG 1150; Figure 69.--Tillandsia tetrantha var. aurantiaca, AJG 1132.



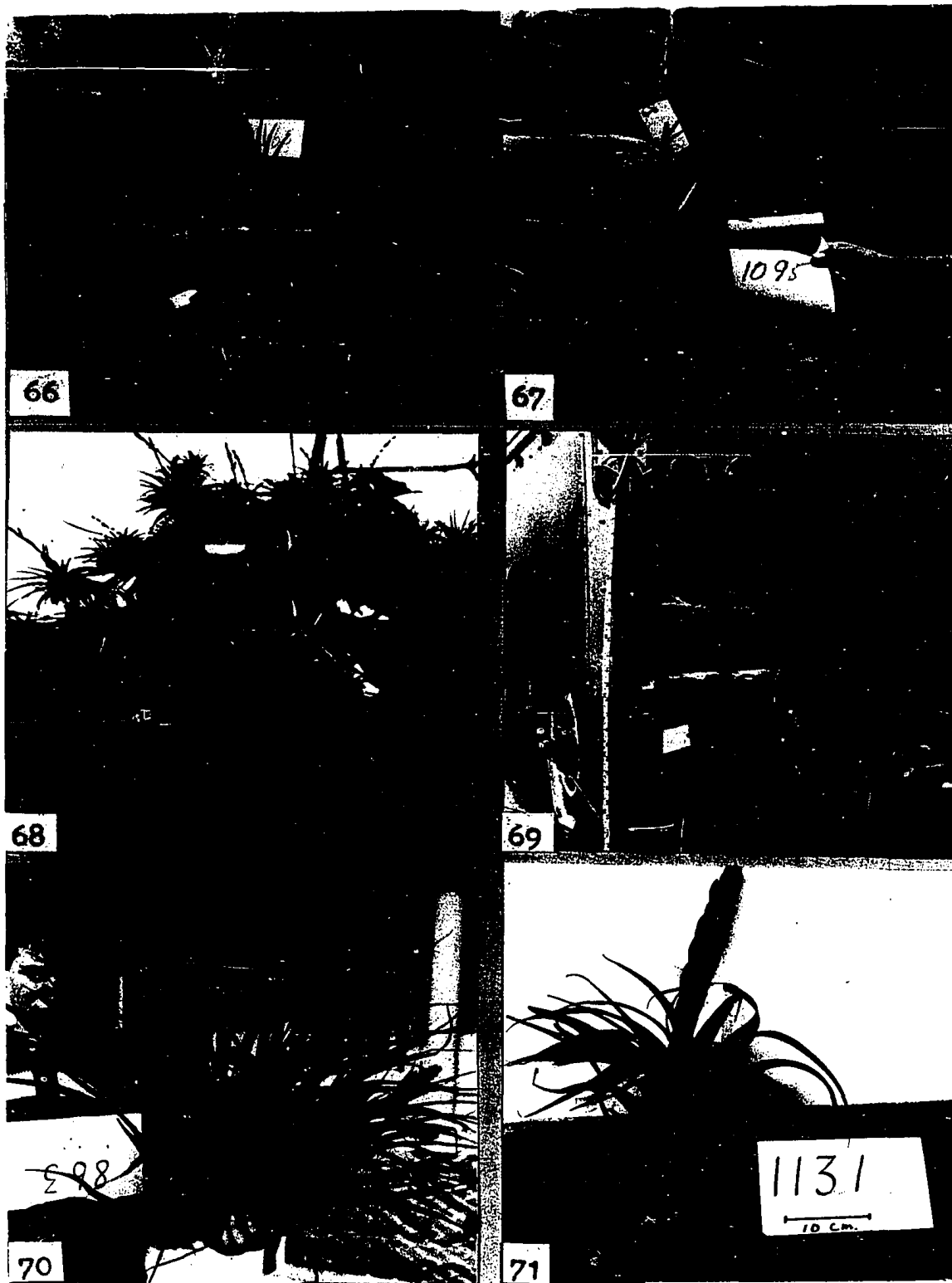
FIGURES 54-59

Figure 60.--Tillandsia multiflora var. decipiens, AJG 1050; Figure 61.--Tillandsia repalocarpa, AJG 1080; Figure 62.--Tillandsia adpressa var. adpressa, AJG 1135; Figure 63.--Tillandsia adpressa var. tonduziana, AJG 1133; Figure 64.--Tillandsia secunda, AJG 1092; Figure 65.--Tillandsia valenzuelana, AJG 802.



FIGURES 60-65

Figure 66.--Tillandsia cygnea, AJG 1165; Figure 67.--
Tillandsia cernua, AJG 1095; Figure 68.--Vriesea espinosae,
AJG 887; Figure 69.--Vriesea hitchcockiana, AJG 1124;
Figure 70.--Vriesea barclayana var. minor, AJG 863; Figure
71.--Vriesea tequendamae, AJG 1131.



FIGURES 66-71

Figure 72.--Vriesea cylindrica, AJG 1147; Figure 73.--
Vriesea sanguinolenta, AJG 867; Figure 74.--Vriesea capituli-
gera, AJG 873; Figure 75.--Guzmania angustifolia, AJG 872;
Figure 76.--Guzmania lingulata, AJG 859; Figure 77.--
Guzmania monostachia, AJG 694.



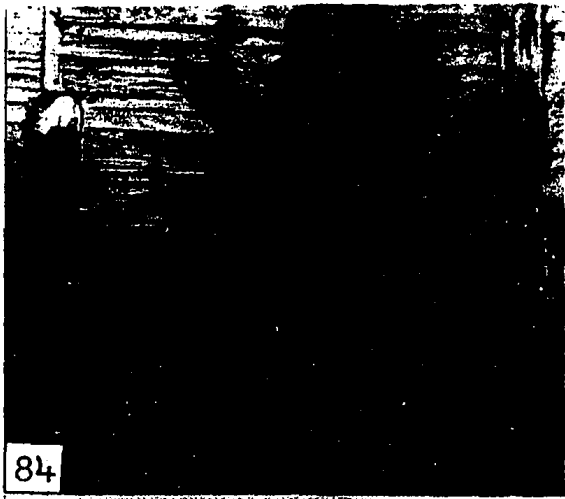
FIGURES 72-77

Figure 78.--Guzmania fusispica, Naundorff s.n.; Figure
79.--Guzmania fuerstenbergiana, AJG 1063; Figure 80.--
Guzmania melinonis, AJG 860; Figure 81.--Guzmania conifera,
AJG 1142; Figure 82.--Guzmania devansayana, AJG 836; Figure
83.--Guzmania sanguinea var. sanguinea, AJG 861.



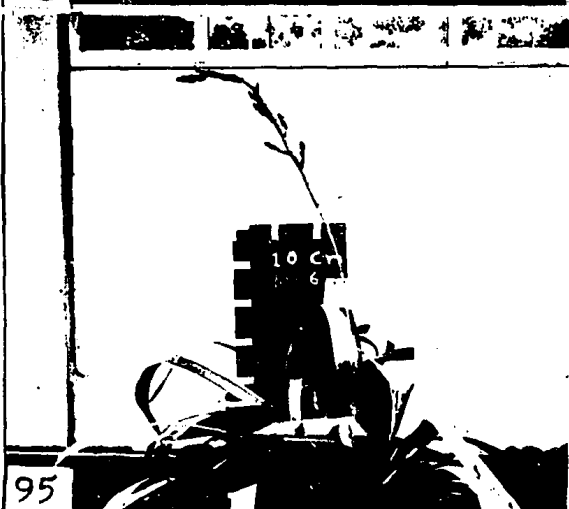
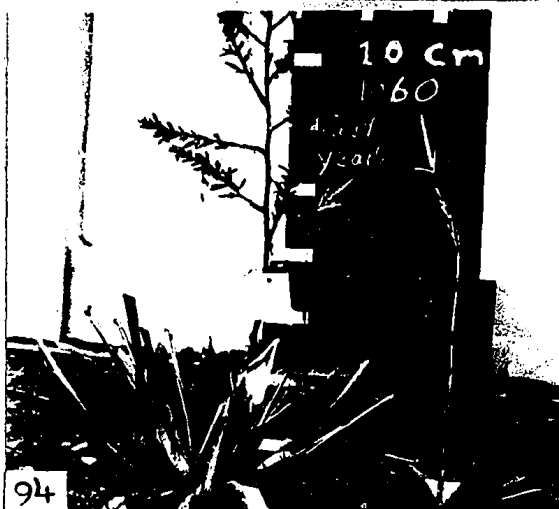
FIGURES 78 - 83

Figure 84.--Guzmania sanguinea var. brevipedicellata,
AJG 739; Figure 85.--Guzmania teuscheri, AJG 1179; Figure
86.--Guzmania wittmackii, photograph of herbarium specimen
of Sodiro 48 (Quito); Figure 87.--Guzmania squarrosa, AJG
852; Figure 88.--Guzmania variegata, AJG 848; Figure 89.--
Guzmania scherzeriana, AJG 1059.



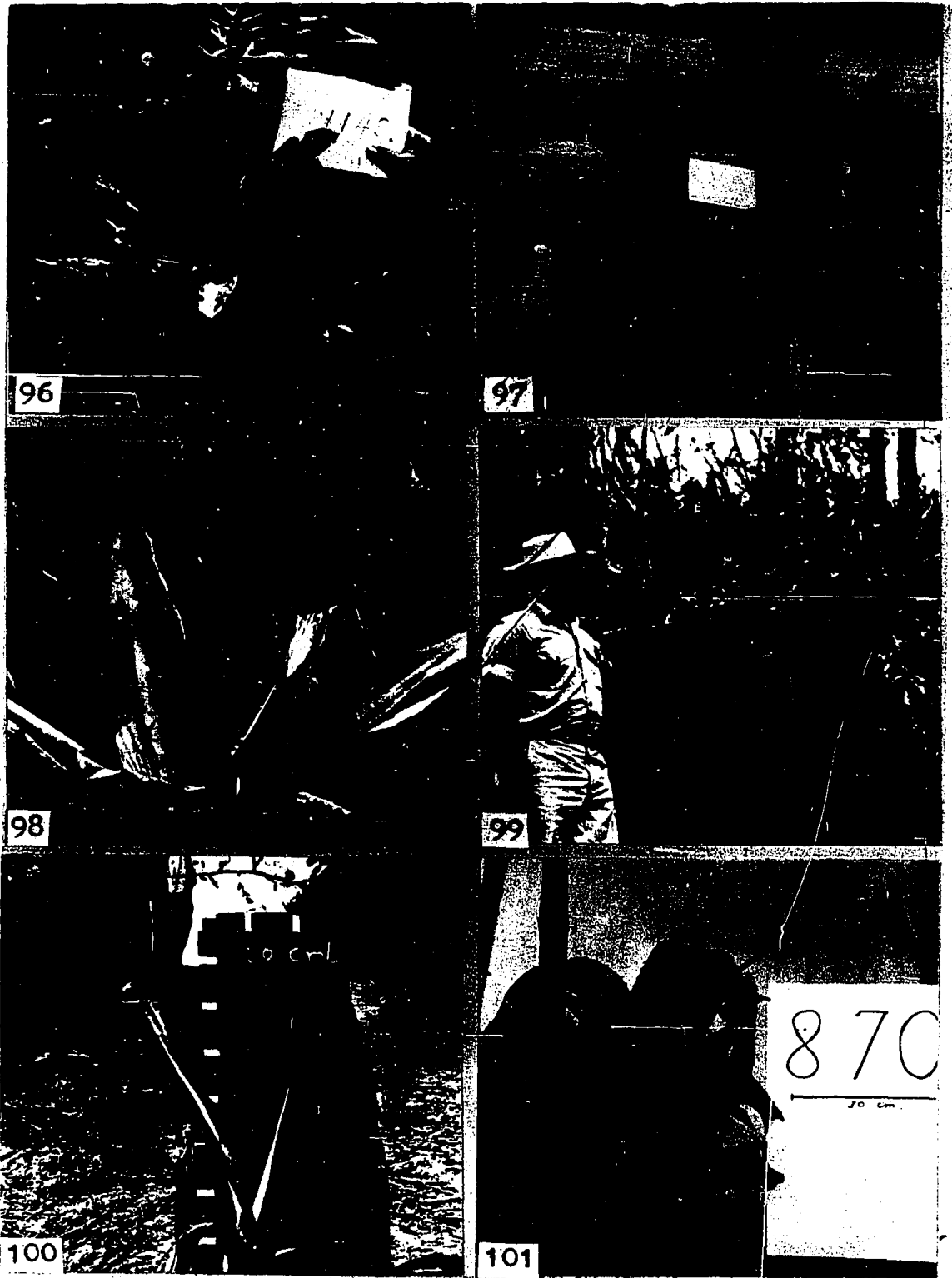
FIGURES 84-89

Figure 90.--Guzmania patula, AJG 766; Figure 91.--
Guzmania merreniana, AJG 1140; Figure 92.--Guzmania
calamifolia, AJG 844; Figure 93.--Guzmania xanthobractea,
AJG 871; Figure 94.--Guzmania rhonhofiana, AJG 1060; Figure
95.--Guzmania hitchcockiana, AJG 1056.



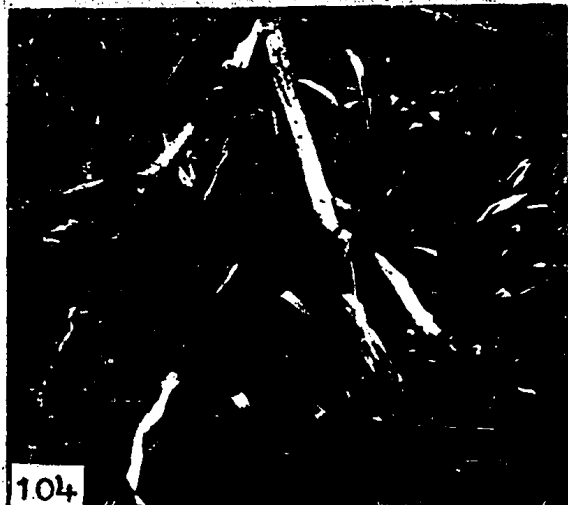
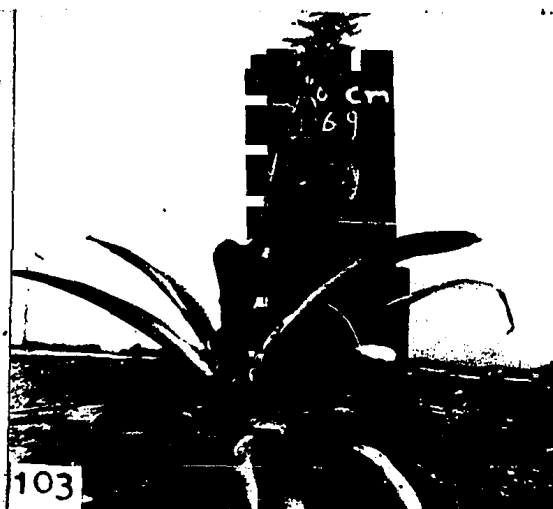
FIGURES 90-95

Figure 96.--Aechmea drakeana, AJG 1143; Figure 97.--
Aechmea nudicaulis, AJG 815; Figure 98.--Aechmea involuocrata,
Foster 2593; Figure 99.--Aechmea mexicana, AJG 832; Figure
100.--Aechmea pyramidalis, AJG 1055; Figure 101.--Aechmea
andradei, AJG 870.



FIGURES 96-101

Figure 102.--Aechmea leucocarpa, AJG 1061; Figure 103.
--Aechmea angustifolia, AJG 1069; Figure 104.--Greigia
mulfordii, Foster 2610.



FIGURES 102-104

LIST OF COMMONLY COLLECTED SITES IN ECUADOR

Location	Altitude (meters)	Latitude	Longitude	Province
Alausi	2356	2° 12' S	78° 50' W	Chimborazo
Ambato	2540	1° 17' S	78° 38' W	Tungurahua
Angel, páramos del	3000	0° 41' N	77° 54' W	Carchi
Antonio de Cumbe	ca. 2000	3° 37' S	80° 13' W	Loja
Archidona	600	0° 55' S	77° 48' W	Napo
Arenillas	15	3° 33' S	80° 05' W	El Oro
Ayabaca	2715	4° 39' S	79° 44' W	Peru
Ayangüe	0	1° 58' S	80° 46' W	Guayas
Azogues	2519	2° 44' S	78° 49' W	Azuay
Baños	1815	1° 24' S	78° 25' W	Tungurahua
Borja	1600	0° 25' S	77° 50' W	Napo
Bucay	300	2° 10' S	79° 8' W	Guayas
Cajanuma	3000	4° 4' S	79° 11' W	Loja
Cañar	3104	2° 33' S	78° 56' W	Cañar
Cariamanga	1933	4° 21' S	79° 34' W	Loja
Catamayo (La Toma)	1238	4° 00' S	79° 21' W	Loja
Cayambe	2812	0° 3' N	78° 9' W	Pichincha
Cerro Azul, summit	420	2° 6' S	79° 57' W	Guayas
Cerro Chillacocha	3592	3° 29' S	79° 39' W	Loja
Cerro Monte Cristi	500	1° 3' S	80° 41' W	Manabí
Chiriboga	1680	0° 16' S	78° 44' W	Pichincha
Chota	1590	0° 3' N	78° 3' W	Imbabura
Chuquiribamba	2704	3° 52' S	79° 27' W	Loja
Colonche	ca. 200	2° 00' S	80° 41' W	Guayas
Cotacollao	2784	0° 7' N	78° 80' W	Pichincha
Cuenca	2342	2° 54' S	78° 58' W	Azuay
Cumbe	2600	3° 6' S	78° 59' W	Azuay
Cumberatza	1930	3° 58' S	78° 52' W	Zamora

LIST OF COMMONLY COLLECTED SITES IN ECUADOR (cont'd)

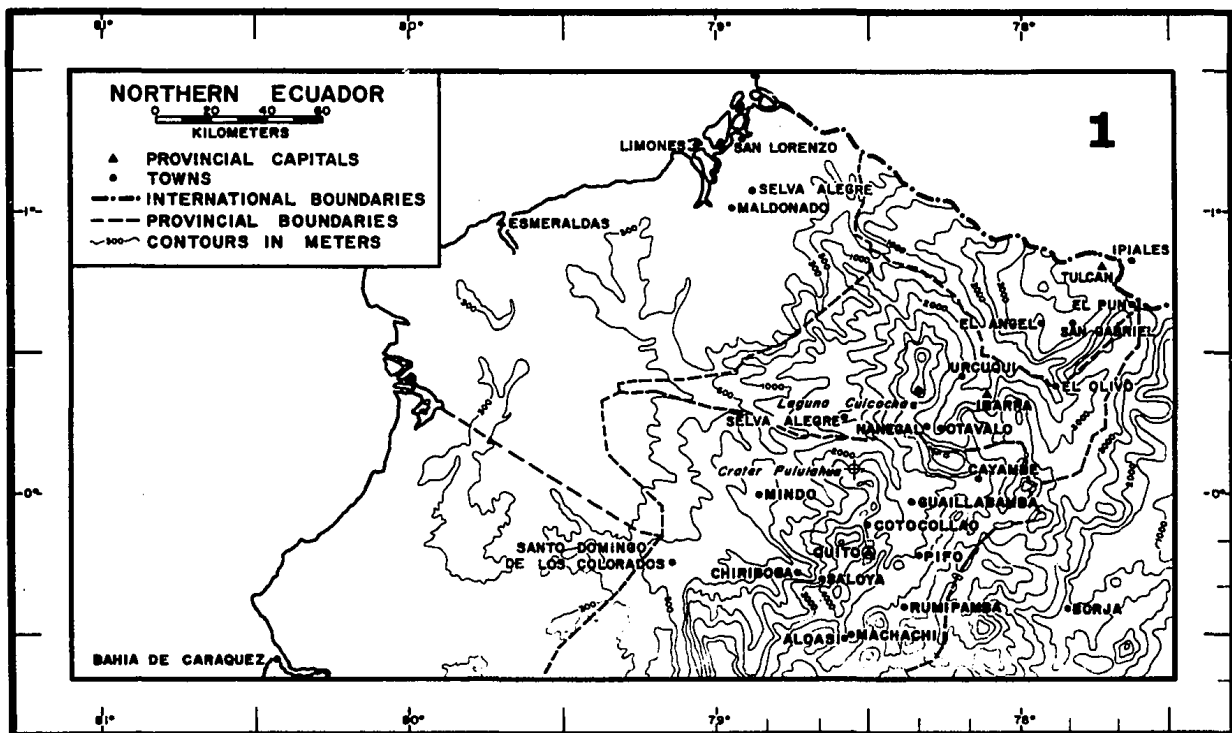
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Daule	20	1° 51' S	74° 58' W	Guayas
Ducur	ca. 1500	2° 29' S	79° 7' W	Chimborazo
El Tambo	2979	2° 30' S	78° 55' W	Cañar
Esmeraldas	6	0° 59' N	79° 39' W	Esmeraldas
García Moreno	1500	0° 16' N	78° 39' W	Imbabura
Gualaceo	2360	2° 54' S	78° 47' W	Azuay
Gualaquiza	971	3° 25' S	78° 35' W	Zamora
Gualyabamba	2260	0° 3' S	78° 20' W	Pichincha
Guaranda	2608	1° 37' S	79° 00' W	Bolívar
Guayaquil	6	2° 10' S	79° 53' W	Guayas
Hacienda Clementina	20	1° 40' S	79° 21' W	Los Ríos
Huigra	900	2° 18' S	79° 59' W	Chimborazo
Ibarra	2228	0° 21' N	78° 8' W	Imbabura
Ipiiales	2921	0° 49' N	77° 38' W	Colombia
Jipijapa	ca. 500	1° 20' S	80° 35' W	Manabí
Lago Cuicocha	1500	0° 19' N	78° 22' W	Imbabura
Las Delicias	600	0° 15' S	79° 15' W	Cañar
Loja	2064	4° 00' S	79° 12' W	Loja
Macará	430	4° 23' S	79° 57' W	Loja
Machala	6	3° 16' S	79° 58' W	El Oro
Malacatus	1600	4° 13' S	79° 14' W	Loja
Manglaralto	3	1° 52' S	80° 44' W	Guayas
Manta	6	0° 57' S	80° 42' W	Manabí

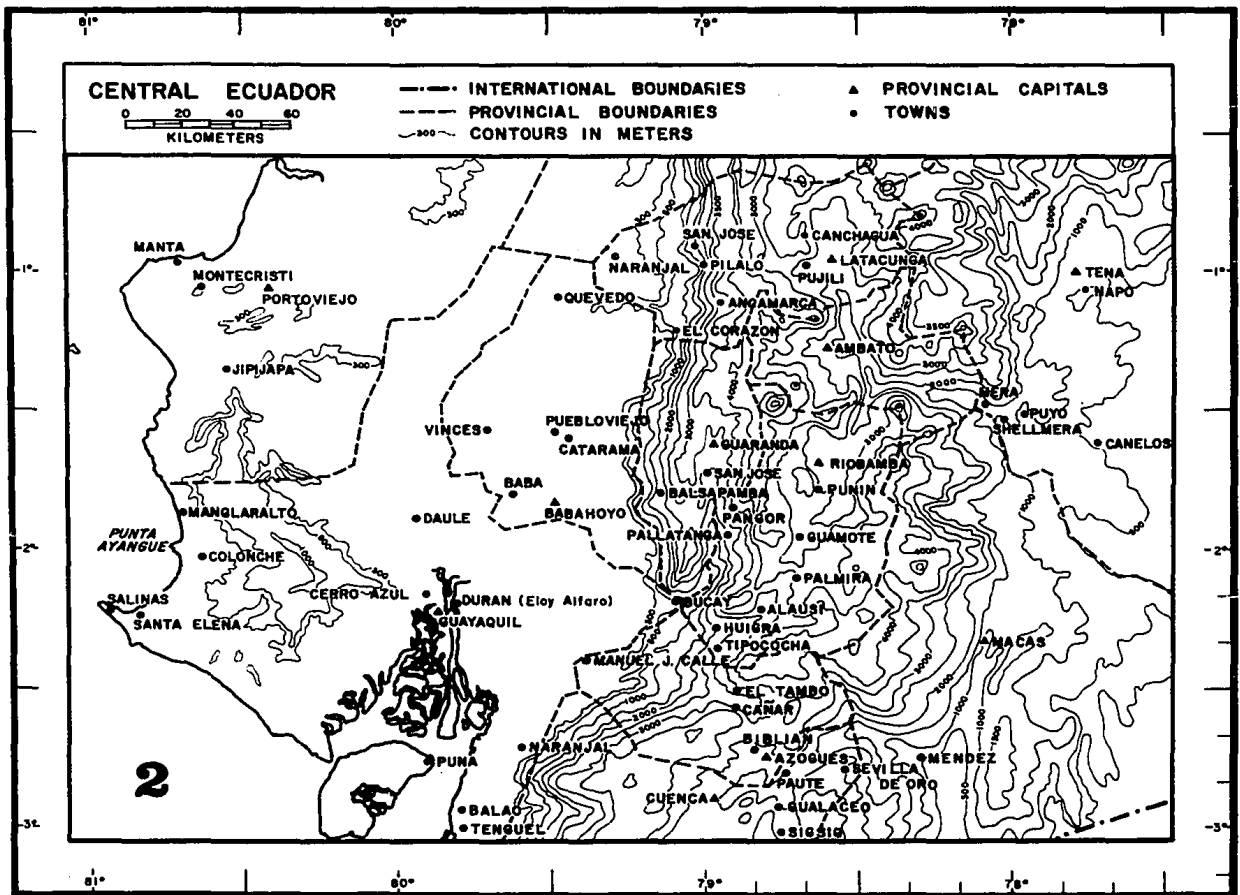
LIST OF COMMONLY COLLECTED SITES IN ECUADOR (cont'd)

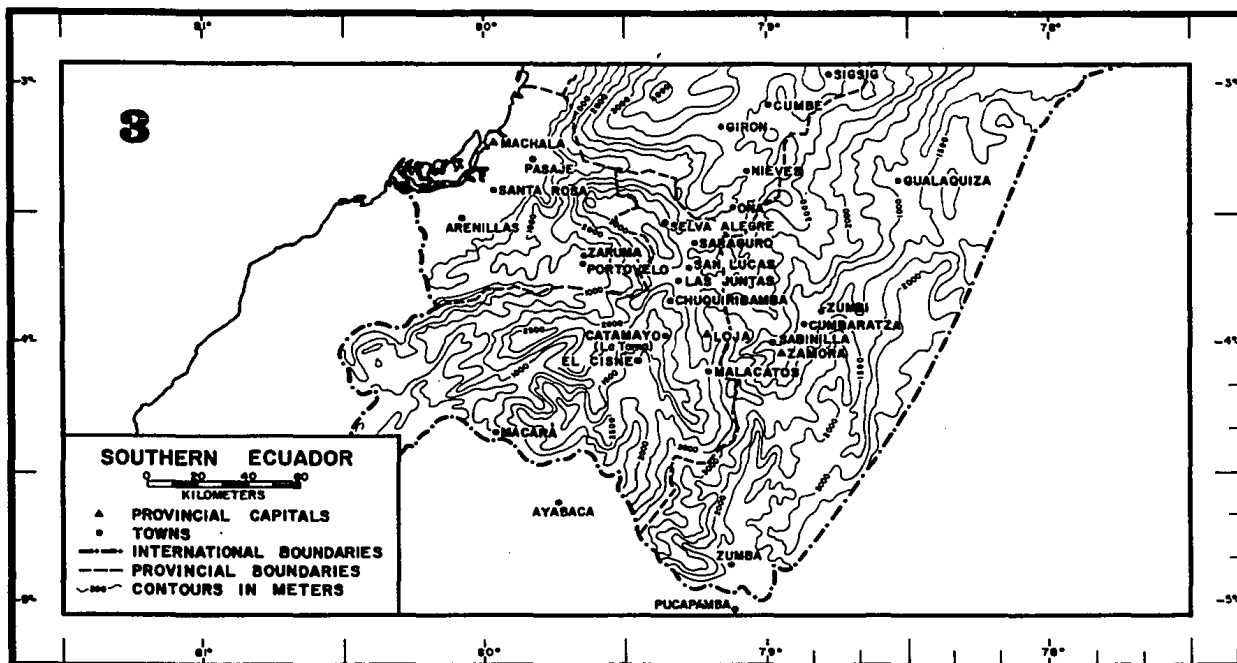
Location	Altitude (meters)	Latitude	Longitude	Province
Mendez	620	2° 43' S	78° 19' W	Zamora
Mera	1140	1° 28' S	78° 6' W	Napo
Montaña Corazon, summit	4786	0° 32' S	78° 40' W	Pichincha
Montaña Pichincha, summit	4784	0° 10' S	78° 36' W	Pichincha
Monte Cristi	ca. 40	1° 2' S	80° 40' W	Manabí
Nanegal	500	0° 9' N	78° 48' W	Pichincha
Naranjal	30	2° 42' S	79° 38' W	Guayas
Niebli	ca. 3000	0° 2' N	78° 30' W	Pichincha
Nieves	2800	3° 21' S	79° 8' W	Azuay
Oña	2373	3° 32' S	79° 10' W	Azuay
Otavalo	2556	0° 14' N	78° 16' W	Imbabura
Paccha	1500	3° 35' S	79° 42' W	El Oro
Palmar	0	2° 2' S	80° 44' W	Guayas
Papallacta	3160	0° 23' S	78° 8' W	Napo
Pasaje	15	3° 21' S	79° 50' W	El Oro
Pastaza	1043	1° 30' S	78° 3' W	Napo
Paute	2280	2° 47' S	78° 43' W	Azuay
Pifo	2600	0° 14' S	78° 20' W	Pichincha
Pilaló	2486	0° 58' S	79° 2' W	Cotopaxi
Porto Velo	640	3° 43' S	79° 39' W	El Oro
Portoviejo	44	1° 4' S	80° 27' W	Manabí
Pucapamba	1200	4° 57' S	79° 6' W	Zamora
Pululahua, crater	3500	0° 4' N	78° 30' W	Pichincha
Puyo	950	1° 35' S	77° 54' W	Napo
Quero	2959	1° 23' S	78° 36' W	Tungurahua
Quevedo	ca. 100	1° 1' S	79° 29' W	Los Ríos
Quinende	ca. 100	0° 15' N	79° 24' W	Esmeraldas
Quito	2870	0° 13' S	78° 30' W	Pichincha

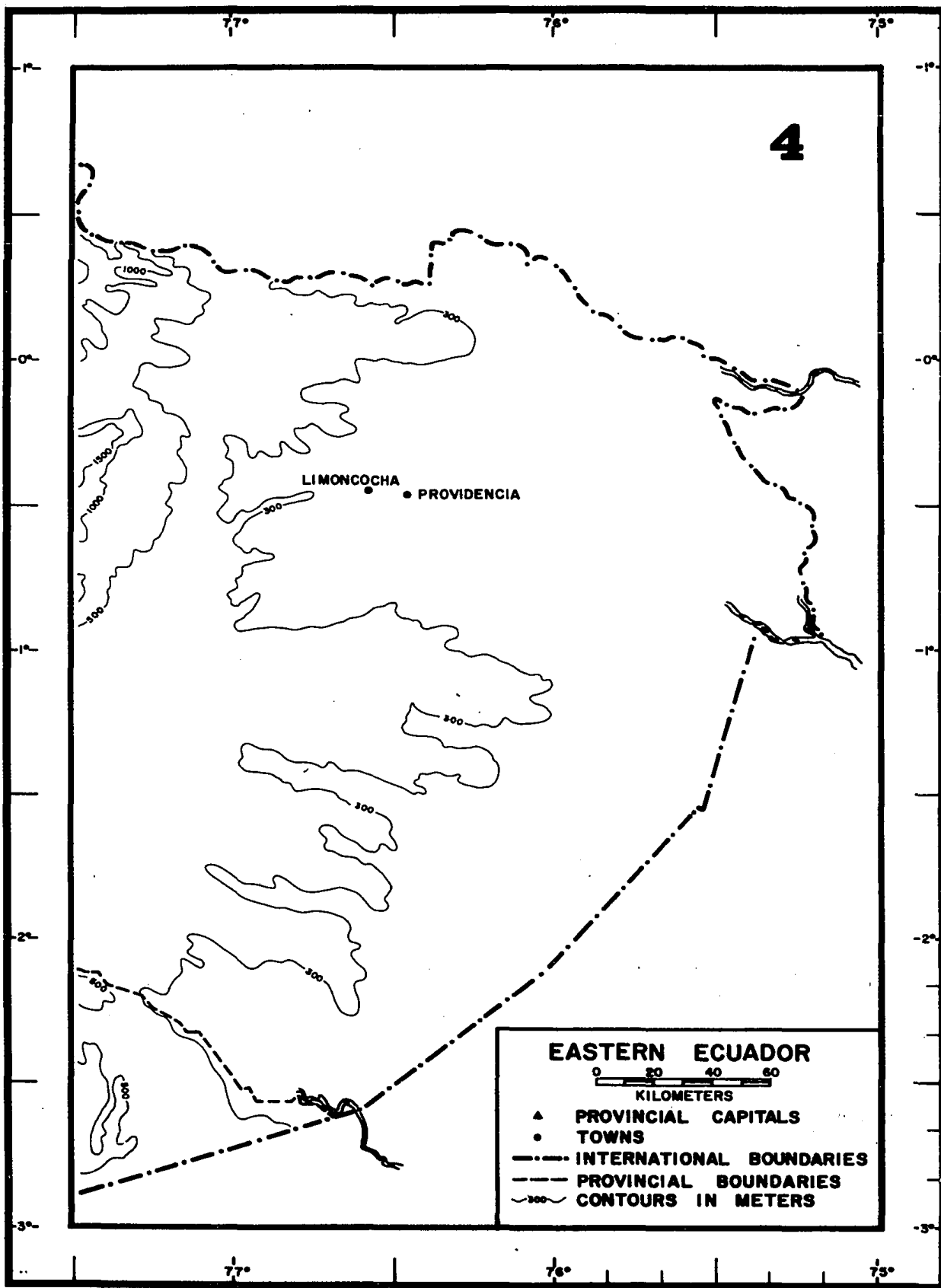
LIST OF COMMONLY COLLECTED SITES IN ECUADOR (cont'd)

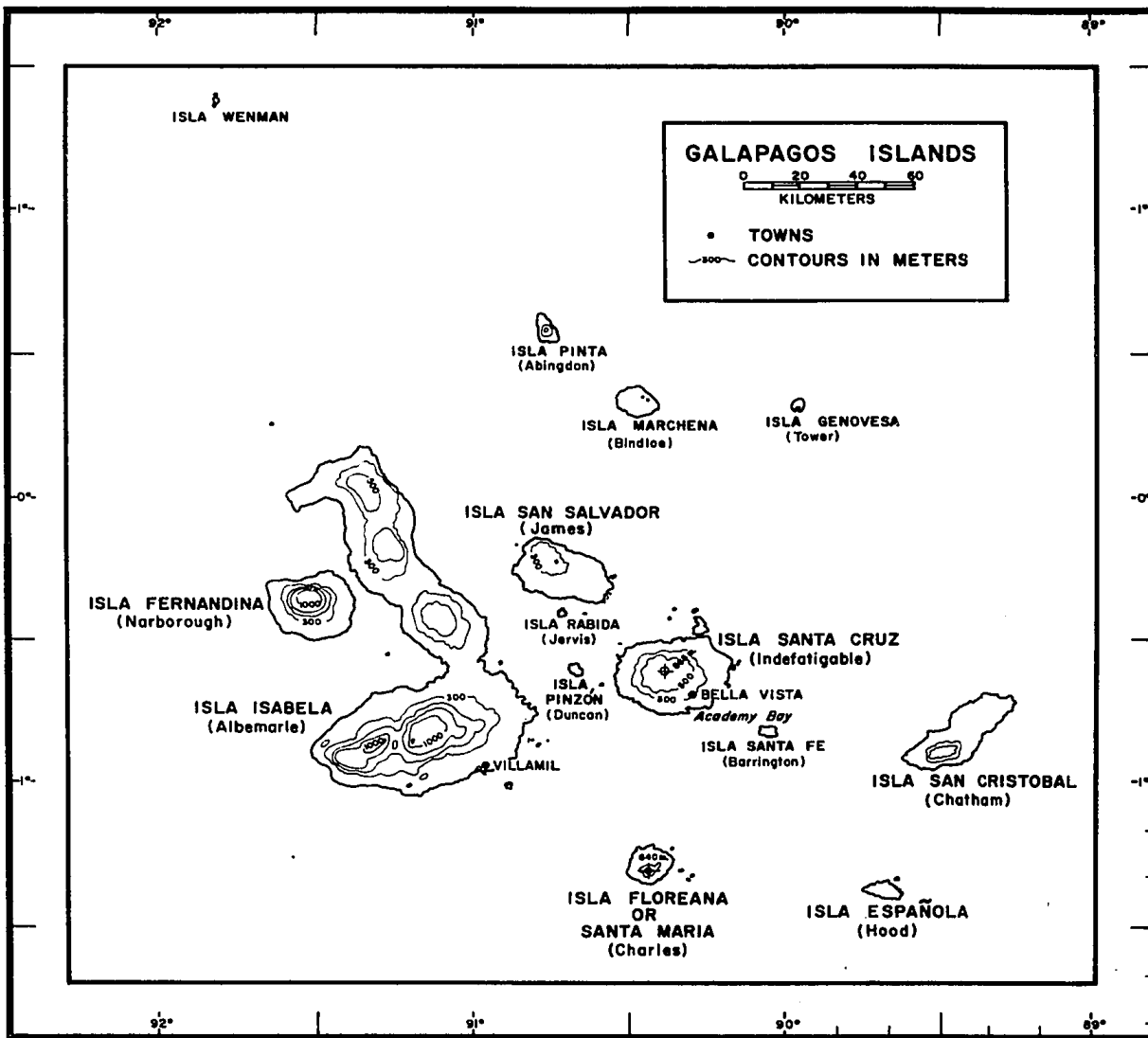
Location	Altitude (meters)	Latitude	Longitude	Province
Riobamba	2754	1° 38' S	78° 40' W	Chimborazo
Rumipamba	2500	0° 25' S	78° 25' W	Pichincha
Sabanilla	1500	4° 2' S	79° 2' W	Zamora
Samborandon	ca. 100	1° 57' S	79° 44' W	Guayas
San Lorenzo	5	1° 17' S	78° 57' W	Esmeraldas
San Lucas	2380	3° 44' S	79° 17' W	Loja
San Pablo de Tenta	2500	3° 37' S	79° 17' W	Loja
Santa Elena	ca. 50	2° 15' S	80° 52' W	Guayas
Santa Rosa	12	3° 26' S	79° 58' W	El Oro
Saraguro	2520	3° 38' S	79° 15' W	Loja
Selva Alegre	2500	3° 25' S	79° 22' W	Loja
Sevilla de Oro	2500	2° 47' S	78° 40' W	Azuay
Shell Mera	ca. 1000	1° 30' S	78° 4' W	Napo
Sibambe	2419	2° 13' S	78° 5' W	Chimborazo
Sigsig	2200	3° 2' S	78° 46' W	Azuay
Tandapi	2000	0° 25' S	78° 49' W	Pichincha
Tena	300	0° 59' S	77° 49' W	Napo
Tipococha	ca. 2000	2° 24' S	78° 49' W	Cañar
Tinajillas, páramo	ca. 3480	3° 12' S	79° 2' W	Azuay
Tulcan	2956	0° 49' N	77° 42' W	Carchi
Tumbez	6	3° 34' S	80° 28' W	El Oro
Villonaco, summit	2946	4° 1' S	79° 16' W	Loja
Yaguarcocha	ca. 2000	0° 22' N	78° 6' W	Imbabura
Zamora	970	4° 5' S	78° 58' W	Zamora
Zaruma	1160	3° 41' S	79° 38' W	El Oro
Zumba	1000	4° 52' S	79° 8' W	Zamora
Zumbi	700	3° 53' S	78° 46' W	Zamora

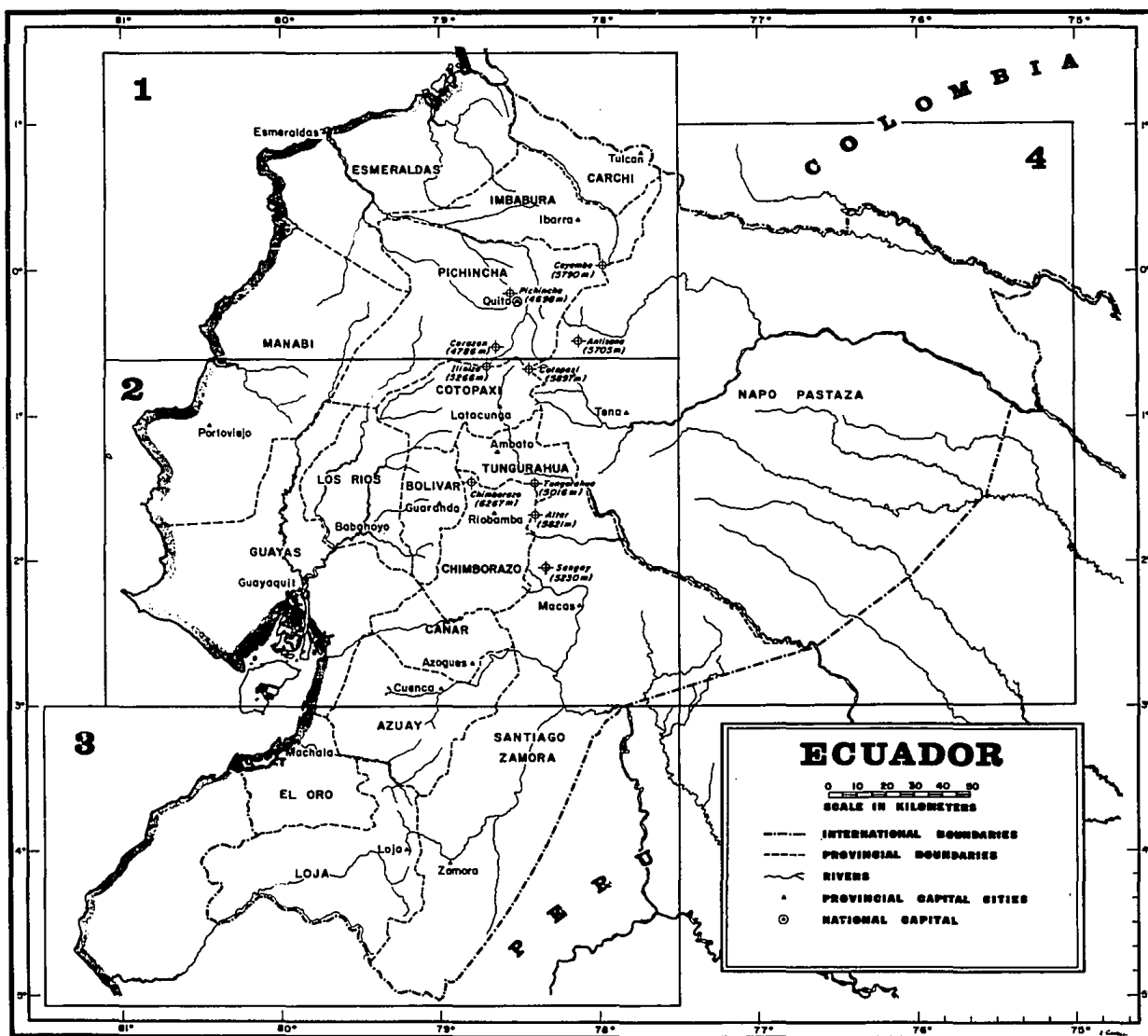












APPENDIX D
NUMERICAL TAXONOMY

DETAILS OF METHODS USED

All analyses in the numerical taxonomy (NT) rest upon comparisons of pairs of objects as to presence or absence of attributes. Although the objects (Operational taxonomic units, or OTUs) may be taxa at any level, in the present work the OTUs are all individual specimens. For comparisons of pairs of OTUs, 104 characters were used with each character having two to six states, though usually three. The characters and character states are listed in TABLE I. An individual specimen is scored for each character, the score being recorded on an IBM scoring sheet. From these scoring sheets, with columns representing character states and rows being OTUs, IBM data cards were punched and verified. The format used for the data cards was; column one through four, OTU code number, column five, card number (for my own record), and three columns for each character starting with column six. For each OTU verified, four punch cards were necessary plus a fifth card with the first 17 columns punched.

The program for obtaining estimates of affinity between OTUs was written by the writer with the help of the program consultants at the University of Hawaii Computer Center, based on the paper by Rogers and Fleming (1964). The similarity ratio between two OTUs can be expressed by the relationship:

$$S_{ij} = M/N \quad (1)$$

where:

S	=	similarity ratio or index
i & j	=	OTUs
ΣM	=	sum of the matches of character states
ΣN	=	sum of the number of character states compared

Let one OTU, a single plant here, be called i and another plant OTU j. The computer will compare OTU i with OTU j for a given character. Within the same character, states are mutually exclusive, that is, if an object has one attribute of a given character it cannot possibly have any of the other states of that character. Let us assume that OTU i happens to have the same state as OTU j for the first character. In this event one is added to M and one is added to N. If OTU i and OTU j have different states for the second character, then nothing is added to M and two is added to N since there has not been a match in character states and we have just compared two different character states. In this way positive matches and negative matches as well are taken into account. When this process has been carried through for OTUs i and j for all the characters the sum of M is divided by the sum of N to yield the similarity ratio between i and j as in equation 1. In turn each possible pair of objects is treated in the same way for all the characters for which comparisons can be made. For example, with 20 OTUs the number of distinct

paired comparisons between OTUs is 190, since number of different pairs = $n(n-1)/2$ where n = number of OTUs.

The computer used for the most part was the IBM 7040, the IBM 360/44 was also used in part.

The similarity ratio, equation (1), is transposed into a distance function by the following relationship:

$$d_{ij} = -\log_2 S_{ij} \quad (2)$$

where: d_{ij} = the distance between objects i and j

S_{ij} = the similarity ratio for objects i and j

Because the 7040 computer worked with natural logarithms, $-\log_2 S_{ij}$ is transformed as:

$$\frac{-\log_e S_{ij}}{\log_e 2} \quad (3)$$

The distance functions for all pairs are stored because the distance between objects are used through the program.

A value designated as the T value by Rogers and Fleming (1964) is then calculated:

$$T_i = \frac{H_i}{R_i} \quad (4)$$

where: H_i = the sum of the distance from object i to all the other objects in the group

R_i = the number of objects which have one or more attributes held in common with object i

T_i = the index of typicality

For example if T_i were less than T_j this would indicate that

object i has more in common with a larger number of other objects than does object j .

Of course, if an OTU in the group were totally unrelated to the other objects, that is, had no matches in character states with any other OTUs, then the T value for such an OTU would be impossible to define since R would equal zero and one would be attempting to divide by zero. By the same token if the sum of the matches in the calculation of the similarity ratio had for any two OTUs been zero, in equation (1), then in the transposition to the distance function, equation (2), one would have been attempting to find the log of zero. The d_{ij} would be infinitely large and thus incapable of being defined. For these reasons, in the present program, a Fortran statement is included which says that if sum of M equals zero then let sum of M equal one. The net result will be that in such a situation the T value would be the same as the H value, but still very high.

In addition to the distance function matrix and the T values described by Rogers and Fleming the following computations were written into the program: number of distance functions, sum of the distance functions, sum of the squared distance functions, mean of the distance functions, sum of squares and the standard deviation. The OTU--OTU relevancy, i.e. the number of comparisons between each OTU was computed and printed out. Additionally were computed and printed out for each of the 104 characters, the number of matches which

each produced and the character relevance, i.e. the ratio of the number of times a character was employed to the total number of times it could have been employed. Finally computed and printed out was the ratio of the number of times any given pair of states of characters did show up in the same OTU to the number of possible times that they might have, i.e. a measure of association of character states. The program print-out is found under Figure 1 and a sample of the print-out with 63 OTUs being used in the input is found under Figure 2.

Theoretical Aspects of Numerical Taxonomy

Numerical taxonomy makes it possible to establish reasonable limits between taxa. It can quantify the affinities between pairs of OTUs and can group like-taxa together on a quantified basis. It also can be used to quantify circumscriptions that are already erected.

Several assumptions are inherent in an application of numerical taxonomy (NT) directed toward quantifying reasonable limits for circumscription. First there is the assumption that the erected groups are valid. Second is the assumption of the correctness of the uniform taxon concept, that is, that the differences between various species, for example, are approximately of the same magnitude. Third is the assumption that the character set which is used to quantify phenetic affinities produces a valid estimate of the actual affinity between OTUs.

These are three assumptions and are not under test themselves. They should be kept in mind however, since one cannot generalize beyond these very assumptions. Phenetic affinity here designates the closeness or difference between OTUs that our evaluation of the phenotype indicates. There is no explicit assumption that this reflects genetic relationship. However, once the phenetic affinities have been estimated then there is no reason why hypotheses may not be made concerning the genetic relationships and phylogeny of the OTUs.

Assumption one, that the erected groups are valid groups, is always known to be only partly correct, for few classifications are not subject to some change as more information becomes available. Assumption two, that of the uniform taxon concept is of course itself rather tenuous and, in fact, we now accept that often it is not correct, especially when comparing taxa from categories high in the hierarchy of classification. As to assumption three, character set validity, no way has yet been found to generalize one's results in numerical taxonomy beyond the character set that is used. If the character set is a valid sample of the enormous information content provided by organisms, then one's results might be generalizable, but to date it has not been possible to ascertain the validity of any character set. Nevertheless with these three assumptions clearly in mind we can go ahead and quantify taxonomic statements such as:

"Taxon a) is much closer to taxon b) than it is to c)." If the statement is based primarily upon taxonomic evaluation of the phenotypes of the three taxa, as is usually the case, and certainly is the case with alpha taxonomy, then the quantification is one of phenetic affinity.

Having applied NT techniques the taxonomist can then say something like the following: "Using this set of characters, I obtain an estimate of the phenetic distance between taxon a) and taxon b) of 0.50 and between taxon a) and taxon c) of 0.75." However, this sort of quantification becomes pertinent only if the taxonomist has at his disposal some estimates of phenetic affinities between other OTUs belonging to the same general taxonomic group.

In order to provide this framework in the context of the Bromeliaceae and particularly in the context of the Bromeliaceae of Ecuador, I have sampled phenetic affinities between OTUs from established taxa. That is, I have randomly-selected phenetic distance values which had been computed from comparisons of individual predetermined specimens. The comparisons were made relative to the array of 104 characters listed in TABLE I. The specimens had been determined by a classical taxonomist. For example, for the sample of the subfamilial circumscription, random selection was made from the OTUs belonging to distinct subfamilies. Five types of circumscriptions were sampled, subfamilial, generic, subgeneric, specific and one subgeneric circumscription of special interest, the subgenus Allardtia.

The generic circumscription, for example, was sampled as the phenetic distance occurring between specimens belonging to the same genus but to different subgenera. In the same way, subgeneric circumscription was sampled as the phenetic distances occurring between specimens belonging to the same subgenus but to different species. The mean distance and the standard deviation for any given circumscription was calculated. Tables IIa-e show these data for the five types of circumscriptions. These samples, therefore, are samples of an orthodox taxonomist's circumscriptions. In most cases the taxonomist whose decisions are being quantified is Dr. Lyman B. Smith. The means and standard deviations for five kinds of phenetic distances are shown diagrammatically in Figure 3. For example, the generic circumscription shows a mean distance of 1.703, and standard error of .518 at the $P = .05$ level. This tells me that phenetic distances which hover between 1.185 and 2.221 are likely to be distances between OTUs belonging to the same genus. For specimens belonging to the same subgenus I can expect the phenetic distances to hover between .980 and 2.166. Now, if I have two OTUs for which I am trying to determine the relative circumscriptions, that is, inquiring as to whether they belong to the same species, to the same subgenus, or to the same genus, then I can compare the phenetic distance between these two with the distances which I have obtained from sampling various circumscriptions. Thus, if I found that

the phenetic distance between OTU a) and OTU b) were 1.19 it would be likely that I would consider these two as belonging to different species but to the same subgenus and certainly to the same genus.

The question arises as to how valid these estimates of circumscriptions are. Might not very different, i.e. larger phenetic distances, be found if the specimens being compared were from various geographic areas and not all from one country? The answer is probably yes, if the evolutionary age of the taxa in the two areas was not similar. By evolutionary age is meant the age which takes into account not just absolute time but also rate of change, i.e. rate of evolution. Thus, the subgenus Allardtia in Ecuador appears to be relatively compact, i.e. the phenetic distances between Ecuadorian specimens belonging to this subgenus yet not conspecific is smaller than that found between Ecuadorian specimens belonging to other subgenera. This could indicate that Ecuadorian Allardtia are evolutionarily younger than say Ecuadorian Pseudo-catopsis or Ecuadorian Tillandsia. However, before the subgenus Allardtia, as a whole, could be rated, phenetic distances between specimens of this subgenus from other geographic areas would have to be determined. The applicability of these samples of phenetic distances for the five types of circumscriptions is justified only for comparisons with phenetic distances between specimens of Ecuadorian Bromeliaceae. This is the application of Figure 3.

The statement was made that pairs of objects were compared for every possible character of the character array, 104 characters here. This brings up the matter of missing data, or as numerical taxonomists say, no comparisons. Certainly not all 104 characters will be available for comparisons of every OTU pair. Especially in alpha taxonomy different characters are often available for different plants. If the characters can be thought of as dimensions, then with 60 characters the taxonomist is dealing with 60 different dimensions. A given 60 characters applied to a pair of OTUs will generate with the present computer program a given phenetic distance. When another pair of specimens is compared, a somewhat different group of characters may be found applicable, that is, some dimensions may be different. The phenetic distance for the second OTU pair will therefore be based upon a character set somewhat different from that of the first.

The question of the practical importance of missing data might be raised. Missing data, though frequently encountered does not seem to bother unduly many taxonomists who work in the classical fashion of recognition of patterns of characters. This is probably true because the good taxonomist actually has at his disposal an extremely large number of characters. He may be conscious of only a few of them. In alpha-numerical taxonomic work, it becomes necessary to test whether or not phenetic distances computed from

somewhat different dimensions (different character sets) differ significantly.

By utilizing numerical taxonomic techniques we can discover just how different combinations of characters do affect phenetic distance. The tests involve the random selection of several sets of 80 characters from the maximum possible here, of 104. The same group of OTUs was subjected to the computer program several times, each time with a different randomly-selected set of characters. The results are several sets of distance values, each set being similar, of course, because they indicate the phenetic distance for the same pairs of OTUs, yet not identical, because of the differences in some of the characters. The question then is, how different are the phenetic distances computed from different sets of characters? Two kinds of tests were made: one with 8 OTUs, specimens, scored for three sets of 62 to 75 characters; another with a single OTU pair scored for 10 sets of 63 to 68 characters. In the first type of test, the analysis of variance was carried out upon the three means and variances of the three sets of 28 distance values ($(8(7)/2=28)$). Figure 4 depicts this analysis of variance. In the second type of test, i.e. 10 distance values for the same OTU, computed from 10 randomly-selected character sets, an estimate of the variance in distance values was calculated and is shown in Figure 5. The F test for significance of difference between means did not call for rejection of the

null hypothesis. A test for homogeneity of variance was made upon these data from the three sets of 28 distance values. Bartlett's test for homogeneity of variance did not indicate any heterogeneity, Figure 6. However, it was thought that perhaps a more realistic test for homogeneity of variance could be made if rather than comparing mean squares of 28 distance values, the mean squares of single pairs could be compared as they varied with different character sets. As a result of discussing this problem with David Goodall, University of California at Irvine, he developed a computer program to do this. Goodall, in order to have at least one degree of freedom, randomly selected 13, 34 and 52 characters from the maximum of 104. As would be expected with these small numbers of attributes, significant differences were found between the sample means. However, more importantly, the variances between pairs were not significant. This means that the nonrejection of the null hypothesis as indicated in the analysis of variance, Figure 4, still seems to stand. In a practical sense, therefore, the differences in the phenetic distances which are produced from slightly different randomly selected character sets are small enough to justify comparing phenetic distance values in this particular work. The point, that, with only 13, or 34, or even 52 characters, the variance in distance values is bound to be significant or nearly so, cannot be minimized. Although statistical sampling techniques

require one or more degrees of freedom, nevertheless in this particular case, taking such small numbers of characters is not called for, I feel. The approach did enable a test for the significance of the residual variances, i.e. the variances of phenetic distance values between pairs.

The results of Goodall's print-out applying Bartlett's chi square test of homogeneity of variance between pairs are summarized in Figure 7. In all cases the chi squared value does not show significant differences of the variances. Therefore, I can still feel justified in assuming homogeneity of variance, i.e. I assume that I am sampling from a single homogeneous population of characters when randomly selecting subsets of characters for these tests.

In addition, I have no indication that my sets of 60 or more characters which I am using to compute phenetic distance are producing distance values that differ significantly because of differences in characters. Stated more positively, I therefore feel confident that any phenetic distance which I find between two OTUs which has been calculated on the basis of ca. 60 or more characters from among the 104 can be compared to any other likewise computed phenetic distance value.

An additional but related problem involves the number of characters used. In the above tests, the character sets differed in kind but not in number. That is, approximately the same number of characters were used in computing the

phenetic distance values. However, occasionally, one may wish to compare a distance value which was computed for example, from 75 characters with another computed from 55 characters, i.e. 20 fewer characters. It is easy to show that the range in distance values which accrues to character sets of 55 characters is larger than the range accruing to character sets of 75 characters. This is obvious because randomly selected sets of 55 out of 104 will have a potential for greater difference in characters than will randomly selected sets of 75 characters.

The greater potential for difference is on two counts. First, the number of different character sets, irregardless of how different any one set is from another set, is greater with 55 out of 104 than with 75 out of 104. This is a reflection of the binomial distribution and is summarized by the equation for calculating the number of different combinations. $C(n,x)$ is $n!/x!(n-x)!$. Thus, exactly 52 characters out of 104 in a random selection exercise produces the maximum possible number of different character sets. The number of different character sets falls off as one goes to either side of 52.

However, this concerns only the number of different sets possible and not the potential degree of difference between sets. For example, if set a) differs from set b) in a single character it is a different character set. Certainly of great importance to the numerical taxonomic analysis is the

amount of difference in character sets, specifically, how many characters are different.

In the random selection technique, two completely different character sets are only possible with one half or less than one half of the total number of characters. Theoretically, a random selection of 52 characters from 104 could produce two totally different sets, though this is unlikely. The fewer the number of characters selected the greater the chances for the sets to differ in more characters. Therefore, it would appear to be inappropriate to compare phenetic distance estimates which are based upon very different numbers of characters. Any point estimate based upon 60 characters, for example is likely to be "wilder" than an estimate from 80 characters. Figure 8 shows the plot of standard deviation against number of characters for 20, 30, 40, 50 and 65 characters of 28 distance values.

There is a way out of this dilemma. By empirically testing the effect upon phenetic distance of different numbers of characters it has been found possible to convert the standard deviations to obtain expected standard deviations. Thus any given point estimate of phenetic distance from say 80 characters will fall somewhere within an appropriate range. By suitable conversions which are explained below, an estimate of the expected variance that would be found were 60 characters used rather than 80 can be calculated.

Interconversion of Standard Deviations of Mean Distance
Values Computed from Sets of Characters with Different
Numbers of Characters

There are two steps involved in the interconversion of standard deviations computed from sets having different numbers of characters. The first step is involved with equilibrating the standard deviation for the different numbers of sets which are possible. The numbers of different sets (without taking into account the degree of difference between sets) can be calculated by applying the binomial distribution, $C_n^x = \frac{n!}{x!(n-x)!}$, where n is the total number of attributes from which random selection is made and x is the sample set number. For example, randomly selecting 50 characters from 100 characters produces the maximum possible number of different character sets. Since this is a binomial distribution, the number of possible different sets with 60 out of 100 is the same as with 40 out of 100; the number of possible different sets with 30 out of 100 is the same as with 70 out of 100, etc. Converting standard deviations computed from 80 characters to 30 and vice versa therefore, in this first step is the same as converting 70 and 80 or 20 and 30.

Recourse to Figure 9, a graph of the binomial distribution plotted on semi-log paper with the abscissa being the number of characters, and the log axis, the distance conversion, enables one to convert standard deviation computed from one number of attributes to the expected standard

deviation for any other number of attributes. For example, one OTU pair and 10 sets of 80 characters, the SD of the mean distance was computed as 0.064, while with 30 characters the SD was 0.304. Now if one had just the 0.304 value, that is SD of the mean distance using 30 characters then the first step of conversion to that for 80 would be to look up on the graph 80 character, Figure 9, and read off 3.5; at 30 characters read off 5.4. The difference between 5.4 and 3.5 is 1.9. This number, 1.9, is the conversion factor the reciprocal of which is multiplied by the SD for 30 characters to obtain an expected value for the standard deviation of distance values for 80 characters. Conversely, actual SD for 80 characters is converted to predicted SD for 30 characters by multiplying the actual SD by 1.9.

The foregoing is just the first step. From the expected values obtained in the first step, one can then obtain a predicted value for SD by applying step two conversion which takes into account the potential number of different characters in different randomly selected sets. Continuing with the above example, to convert the SD observed for 30 characters to that for 80 characters one takes $3/8$ of the observed SD which has been converted by step 1) or conversely to convert from SD observed for 80 characters to that for 30 one takes $8/3$ of the converted observed SD. TABLE III shows a comparison of actual standard deviations and predicted values. There is fairly close agreement. It should be noted that

best agreement is obtained by utilizing in step 2, the actual number of characters applied in the computation of distances rather than the number of characters randomly selected. It is to be remembered that missing data is always possible and not all characters are applicable for every comparison.

To summarize, I have found that it is possible and helpful to quantify concepts of phenetic relationships and taxonomic circumscription. I realize that this can be done only if one is willing to make certain assumptions. In addition, realizing that missing data is a frequent occurrence in alpha taxonomic work I have tried to evaluate its effect upon my estimates of phenetic affinities. I find that in the context of the Bromeliaceae of Ecuador and with my particular 104 characters, its effect is negligible. I have had to recognize that comparisons of phenetic affinities obtained from character sets which differed considerably as to number of characters could be misleading. Therefore I have empirically obtained estimates of how the variance is affected by change in number of characters. Keeping in mind my own assumptions and keeping in mind these results I have utilized point estimates of phenetic affinities in order to aid in difficult taxonomic decisions.

Although it would be nearly impossible to outline completely just how these point estimates of phenetic distance have been helpful in every case, two examples will be given for illustrative purposes.

Numerical Phenetic Results Applied to a Portion of the Genus
Tillandsia subgenus Allardtia, and to T. insularis

Within the somewhat difficult subgenus Allardtia, one group of species has constantly been a source of trouble. Smith (1963, Phytol. 9(4): 255) says, "It becomes increasingly difficult and dangerous to describe novelties from the complicated maze of Tillandsia subgenus Allardtia that centers on the northern and central Andes."

Six specimens of Tillandsia subgenus Allardtia were particularly difficult to place. Using classical methods it seemed to me that two belonged to the typical variety of T. fendleri, one to a new variety, one to a new species and the others to T. stenoura Harms. In fact, this is much the way that the first draft of the keys to the species was written. Nevertheless there was doubt in my mind. Because of this doubt the specimens were scored for NT analysis and submitted along with others to the computer program for obtaining phenetic distance values.

Phenetic distance values were determined between all possible pairs of the six specimens and additionally for two other specimens belonging also in the subgenus Allardtia, but quite distinct from any of the six. Contrary to the original allocation of specimens, the numerical phenetic analysis indicated the following: the six questionable specimens rather than being divided up into different species were all found to be suitably close for circumscription within the

same species, T. stenoura Harms. This was indicated because the mean distance between any of the six was 0.93 based upon numbers of characters varying from 45 to 60. The range in distance values was 0.50. For orientation purposes see Figure 3. These distance values were compared with distance values obtained using specimens which were undoubtedly distinct species. With these values in mind, I felt justified in the interest of consistency within the subgenus to circumscribe all six specimens within one species. Paired comparisons of the six specimens in question with specimens of the two species in the same genus, produced phenetic distance values of 1.05 to 1.60, with a mean of 1.27, based upon 45-60 characters. Had I allocated the six specimens as originally planned, I would not have been consistent with the treatment of the bulk of the subgenus Allardtia.

To reiterate: the six specimens in question were found to be interrelated with a mean distance of 0.93, range of 0.5. However, the mean phenetic distance between these six specimens and the specimens from two other species in the same subgenus was 1.27, range of 0.55. The phenetic distances observed among the six specimens were most similar to phenetic distances that I have observed between specimens classically allocated to the same species.

As a result of these numerical phenetic analyses which showed relatively close phenetic distance within the six, I have circumscribed the six questionable specimens all within

the same species, T. stenoura Harms, and within three distinct varieties of this species.

Another illustration of how quantification of the phenetic affinities has proved helpful is provided by some specimens of Tillandsia insularis subgenus Pseudo-Catopsis, from the Galapagos Islands.

Collections were made from two aggregations of T. insularis from the island of Santa Cruz in the Galapagos Islands. Five specimens were collected from an area known as El Occidente, nine were collected from the area called Bella Vista. From observations of these and observations of many others in the field it seemed to me that these might be distinct varieties. However, I was reluctant to so circumscribe them since collections from some other islands did not seem to be worthy of distinct varietal status. The others seem to be very close to the specimens collected and observed growing near Bella Vista. Therefore specimens of T. insularis were scored for numerical phenetic analysis. In all cases it was possible to score them at least for 63 characters. The Bella Vista group after submission to the program and the generation of the $9(8)/2$, or 36 phenetic distance values showed a mean distance value of 0.635. Comparison of the five specimens from the El Occidente yielded a mean of 0.575. Comparison of Bella Vista specimens with those from El Occidente yielded a mean of 0.836.

These data were tested for homogeneity of variance

and the null hypothesis could not be rejected. The significance of the difference between the two means was then tested. The difference was significant at a probability level of $P = .01$. As a result I described the specimens from El Occidente as a new variety. Following this NT work I reviewed the specimens once more as well as additional specimens collected by others from several islands and was able to find consistently five character differences between populations.

TABLE I
APPENDIX C

TABLE I

List of Characters and Their States Used in an
Alpha-Numerical Taxonomic Study of Ecuadorian Bromeliaceae

Character						
1. plant height (6)	<u>101</u> 1-10cm.	<u>102</u> 11-30cm.	<u>103</u> 31-50cm.	<u>104</u> 51-75cm.	<u>105</u> 76-150cm.	<u>106</u> 151cm. & over
2. plant width (6)	<u>107</u> 1-10cm.	<u>108</u> 11-30cm.	<u>109</u> 31-50cm.	<u>110</u> 51-75cm.	<u>111</u> 76-150cm.	<u>112</u> 151cm. & over
3. rosette shape (4)	<u>113</u> campanu- late erect	<u>114</u> spreading	<u>115</u> bulbous	<u>116</u> long erect		
4. distance from ground (4)	<u>117</u> on ground	<u>118</u> up to 3.9m.	<u>119</u> 4-10m.	<u>120</u> more than 10m.		
5. altitude above sea level (6)	<u>121</u> 0-50m.	<u>122</u> 51-300m.	<u>123</u> 301-500m.	<u>124</u> 501-1500m.	<u>125</u> 1500-2500m.	<u>126</u> 2600-3000m.
6. plant community moisture level (3)	<u>128</u> xero-	<u>129</u> meso-	<u>130</u> hydro-			
7. geographic location (6)	<u>131</u> insular	<u>132</u> moist NW	<u>133</u> dry coast	<u>134</u> moist El Ora	<u>135</u> Andean	<u>136</u> El Oriente
8. leaf length (mature) (6)	<u>138</u> 10.1-30cm.	<u>139</u> 31-50cm.	<u>140</u> 51-75cm.	<u>141</u> 76-100cm.	<u>142</u> 1-1.5m.	<u>143</u> more than 1.5m.

TABLE I (Cont'd)

9. leaf habit (3)	<u>144</u> erect to spread- ing	<u>145</u> spread- to reflexed	<u>146</u> reflexed			
10. leaf blade width (mature) (6)	<u>147</u> to 2mm.	<u>148</u> 3-10mm.	<u>149</u> 11-25mm.	<u>150</u> 2.6-4cm.	<u>151</u> 4.1-10cm.	<u>152</u> over 10cm.
11. leaf texture (3)	<u>153</u> soft (flat)	<u>154</u> hard at apex	<u>155</u> coriaceous and/or involute through much of blade			
12. leaf sheath angle with blade (5)	<u>156</u> 0-5°	<u>157</u> 6-10°	<u>158</u> 11-15°	<u>159</u> 16-25°	<u>160</u> 26° & over	
13. leaf sheath shape (4)	<u>161</u> ovate	<u>162</u> obovate or elliptic	<u>163</u> oblong	<u>164</u> linear		
14. blade shape (4)	<u>165</u> lingulate	<u>166</u> broad triangular	<u>167</u> narrow triangular	<u>168</u> linear (20:1 or more)		
15. rosette's outer leaves (3)	<u>169</u> dis- tinctly shorter, wider	<u>170</u> not distinct	<u>171</u> not evident, die early			
16. leaf color (6)	<u>172</u> same gray gn. throughout	<u>173</u> hori- zontal striped	<u>174</u> partly red	<u>175</u> red throughout	<u>176</u> spotted or striped purple	<u>177</u> same bright or deep gn. throughout
17. leaf blade apex (mature) (5)	<u>178</u> obtuse	<u>179</u> acute	<u>180</u> apiculate	<u>181</u> acuminate- attenuate	<u>081</u> caudate- filiform	

TABLE I (Cont'd)

18. leaf margin (3)	<u>182</u> armed conspicu- ously	<u>183</u> armed, but incon- spicuously	<u>184</u> not at all armed		
19. leaf sheath color (4)	<u>185</u> over- of purple and/or red	<u>186</u> light brown	<u>187</u> dark reddish brown	<u>188</u> concolorous with blade	
20. plant stemmed? (3)	<u>189</u> not stemmed	<u>190</u> short stemmed	<u>191</u> long stemmed		
21. primary bract length in rela- tion to branch length (4)	<u>192</u> much shorter	<u>193</u> $\frac{1}{3}$ to $\frac{1}{2}$ branch length	<u>194</u> more than $\frac{1}{2}$ to same	<u>195</u> much longer	
22. inflorescence compounding (3)	<u>196</u> simple	<u>197</u> bipinnate	<u>198</u> tri- and more pinnate		
23. inflorescence length (5)	<u>199</u> to 10cm.	<u>200</u> 11-30cm.	<u>201</u> 31-50cm.	<u>202</u> 50-100cm.	<u>203</u> <u>101</u> and more
24. inflorescence habit (4)	<u>204</u> erect	<u>205</u> slightly bent	<u>206</u> nodding to reflexed	<u>207</u> completely hanging	
25. inflorescence diameter (5)	<u>208</u> to 2.0cm.	<u>209</u> 2.1-10cm.	<u>210</u> 11-25cm.	<u>211</u> 26-50cm.	<u>212</u> <u>51</u> and over
26. inflorescence surface (3)	<u>502</u> glabrous to sub- glabrous	<u>503</u> lepidote, but moderate	<u>504</u> strongly, obviously lepidote		

TABLE I (Cont'd)

27. disposition of flowers on spikes (3)	<u>213</u> distichous	<u>214</u> polystichous	<u>215</u> secund			
28. inflorescence shape (6)	<u>216</u> cylindrical	<u>217</u> pyramidal	<u>218</u> globose	<u>219</u> ellipsoid	<u>220</u> flabellate	<u>221</u> non descript
29. distance between flowers (6)	<u>222</u> to 2mm.	<u>223</u> 3-5mm.	<u>224</u> 6-10mm.	<u>225</u> 11-15mm.	<u>226</u> 16-25mm.	<u>227</u> 26- more
30. scape length not including inflorescence (5)	<u>228</u> not visible	<u>229</u> to 10cm.	<u>230</u> 10-30cm.	<u>231</u> 31-75cm.	<u>232</u> more than 75cm.	
31. scape diameter (3)	<u>233</u> to 3mm.	<u>234</u> 4-10mm.	<u>235</u> more than 10mm.			
32. scape bract length (6)	<u>236</u> to 1cm.	<u>237</u> 1.1-4cm.	<u>238</u> 4.1-10cm.	<u>239</u> 11-18cm.	<u>240</u> 18.1-32cm.	<u>241</u> more than 32cm.
33. scape bract width (5)	<u>242</u> to 1cm.	<u>243</u> 1.1-1.5cm.	<u>244</u> 1.6-3cm.	<u>245</u> 3.1-9cm.	<u>246</u> more than 9cm.	
34. scape bract habit (4)	<u>247</u> strict throughout	<u>248</u> mostly erect	<u>249</u> spreading at least at apex	<u>250</u> reflexed		
35. scape bract color (4)	<u>251</u> green throughout	<u>252</u> gn. apex, red base	<u>253</u> red apex, gn. base	<u>254</u> red or purple throughout or orange throughout		

TABLE I (Cont'd)

36. degree of overlapping of scape bracts (4)	<u>255</u> imbricate above only	<u>256</u> totally imbricate	<u>257</u> imbricate below only	<u>258</u> remote throughout		
37. spike or branch length (6) if branches present use branch length	<u>259</u> to 2cm.	<u>260</u> 2.1-10cm.	<u>261</u> 10.1-20cm.	<u>262</u> 20.1-50cm.	<u>263</u> 51-100cm.	<u>264</u> more than 100cm.
38. spike width (5) (<u>NOT</u> branch)	<u>265</u> to 5mm.	<u>266</u> 6-10mm.	<u>267</u> 1.1-5cm.	<u>268</u> 5.1-10cm.	<u>269</u> more than 10cm.	
39. spike rhachis, undulate or straight (3)	<u>270</u> straight	<u>271</u> sharply	<u>272</u> sinuous	<u>273</u>		
40. spike habit (5)	<u>274</u> erect (strict)	<u>275</u> ascending	<u>276</u> erect to spreading	<u>277</u> spreading reflexed	<u>278</u> reflexed	
41. length of sterile portion of spike (5)	<u>279</u> minimal	<u>280</u> 4-20mm.	<u>281</u> 2.1-6cm.	<u>282</u> 6.1-20cm.	<u>283</u> more than 20cm.	
42. primary bract length (5)	<u>284</u> to 0.5cm.	<u>285</u> 0.6-2.5cm.	<u>286</u> 2.6-15cm.	<u>287</u> 16-30cm.	<u>288</u> more than 30cm.	
43. primary bract width (5)	<u>289</u> to 0.5cm.	<u>290</u> 0.6-1.5cm.	<u>291</u> 1.6-2.5cm.	<u>292</u> 2.6-4cm.	<u>293</u> 4.1-8cm.	

TABLE I (Cont'd)

44. primary bract, keel (3)	<u>294</u> strongly carinate	<u>295</u> partially keeled	<u>296</u> not at all keeled			
45. primary bract habit (5)	<u>297</u> erect	<u>298</u> ascending	<u>299</u> spreading	<u>300</u> spreading reflexed	<u>301</u> reflexed	
46. distance between primary bracts (3)	<u>302</u> less than 1/2 bract length	<u>303</u> 1/2 to same	<u>304</u> more than 1 bract length			
47. rhachis color (4)	<u>305</u> white, yellow- neutral	<u>306</u> green	<u>307</u> red	<u>308</u> purple overtones	<u>309</u>	
48. spike rhachis outline (4)	<u>310</u> terete	<u>311</u> rec- tangular	<u>312</u> ex- cavated	<u>313</u> strongly flattened		
49. primary bract color (6)	<u>314</u> all green	<u>315</u> green apex, red or yellow base	<u>316</u> red or yellow apex, gn. base	<u>317</u> all red	<u>318</u> yellow	<u>319</u> other
50. primary bract apex (5)	<u>320</u> obtuse	<u>321</u> acute	<u>322</u> apiculate & cuspidate	<u>323</u> acuminate- attenuate	<u>324</u> caudate	
51. floral bract length (5)	<u>325</u> to 5mm.	<u>326</u> 0.6-1.2cm.	<u>327</u> 1.3-2cm.	<u>328</u> 2.1-4cm.	<u>329</u> more than 4cm.	

TABLE I (Cont'd)

52. floral bract width (5)	<u>330</u> to 5mm.	<u>331</u> 0.6-1.2cm.	<u>332</u> 1.3-2cm.	<u>333</u> 2.1-4cm.	<u>334</u> more than 4cm.	
53. floral bract texture (3)	<u>335</u> cori- aceous	<u>336</u> papery	<u>337</u> fleshy, thick			
54. floral bract shape (6)	<u>338</u> ovate	<u>339</u> elliptic	<u>340</u> ovate- elliptic	<u>341</u> tri- angular	<u>342</u> obovate	<u>343</u> other, e.g. sides straight
55. floral bract apex (4)	<u>344</u> obtuse or mucro- nate	<u>345</u> acute	<u>346</u> apiculate & cuspidate	<u>347</u> acuminate- attenuate to caudate		
56. floral bract color (6)	<u>348</u> all green	<u>349</u> green apex, red base	<u>350</u> red apex, gn. base	<u>351</u> all red or all purple	<u>352</u> yellow	<u>353</u> other
57. floral bract nerved? (3)	<u>354</u> obviously nerved	<u>355</u> obscurely nerved	<u>356</u> not nerved at all			
58. floral bract margins (3)	<u>357</u> entire	<u>358</u> obviously serrate	<u>359</u> slightly serrulate			
59. floral bract relation to primary bract (3)	<u>360</u> floral bract shorter	<u>361</u> same length (less than 3mm. diff.)	<u>362</u> floral bract longer			
60. petals (3)	<u>363</u> totally without scales	<u>364</u> scales present, not obvious	<u>365</u> scales very obviously present			

TABLE I (Cont'd)

61. union of petals (3)	<u>366</u> strongly agglutinated	<u>367</u> obviously separate	<u>368</u> ostensibly (nearly) joined but easily separable			
62. petal length (5)	<u>369</u> to 5mm.	<u>370</u> .6-1.5cm.	<u>371</u> 1.6-2.2cm.	<u>372</u> 2.3-3.5cm.	<u>373</u> 3.6cm.	and more
63. petal shape (3)	<u>374</u> lorate or linear	<u>375</u> lobed	<u>376</u> slightly lobed			
64. petal width, widest part (4)	<u>377</u> to 5mm.	<u>378</u> 0.6-1.0cm.	<u>379</u> 1.1-1.5cm.	<u>380</u> more than 1.5cm.		
65. petal lobe (fresh) color (7)	<u>381</u> white	<u>382</u> yellow	<u>383</u> red or orange	<u>384</u> violet	<u>385</u> pink	<u>386</u> green
66. sepal length (5)	<u>388</u> to 5mm.	<u>389</u> .6-1.2cm.	<u>390</u> 1.3-2cm.	<u>391</u> 2.1-3cm.	<u>392</u> 3.1-4cm.	or more
67. union of sepals (3)	<u>393</u> equally free	<u>394</u> equally connate	<u>395</u> connate posteriorly (1/3 or more)			
68. sepals, carinate ? (3)	<u>396</u> strongly carinate	<u>397</u> slightly carinate	<u>398</u> not at all carinate			
69. sepal width (6)	<u>399</u> to 2mm.	<u>400</u> .3-.5cm.	<u>401</u> .6-1.0cm.	<u>402</u> 1.1-1.5cm.	<u>403</u> 1.6-2.5cm.	<u>404</u> more than 2.5cm.
70. sepal apex (4)	<u>405</u> obtuse	<u>406</u> acute	<u>407</u> apiculate or mucronate	<u>408</u> acuminate attenuate		

TABLE I (Cont'd)

71. sepal texture (3)	<u>409</u> papery and/or transparent	<u>410</u> somewhat coriaceous	<u>411</u> thick & fleshy		
72. sepal shape (4)	<u>412</u> ovate	<u>413</u> obo- vate or asymmetric	<u>414</u> elliptic	<u>415</u> other	
73. sepal color (5)	<u>416</u> green- gn. yellow	<u>417</u> green apex, red base	<u>418</u> red apex, gn. base	<u>419</u> red	<u>420</u> other
74. sepal outer surface (4)	<u>421</u> glabrous	<u>422</u> lepidote	<u>423</u> densely, loosely lepidote	<u>424</u> densely appressed lepidote	
75. ovary length (5)	<u>425</u> to 2mm.	<u>426</u> 3-6mm.	<u>427</u> 7-15mm.	<u>428</u> 16-25mm.	<u>429</u> more than 2.5cm.
76. ovary width (5)	<u>430</u> to 2mm.	<u>431</u> 3-5mm.	<u>432</u> 6-9mm.	<u>433</u> 1-1.5cm.	<u>434</u> more than 1.5cm.
77. style, relation to ovary (3)	<u>435</u> 2X or more	<u>436</u> about same	<u>437</u> less than 1 ovary length		
78. stamens, rela- tion to petals (3)	<u>438</u> ex- ceeding petals	<u>505</u> same length	<u>506</u> much shorter		
79. filaments (3)	<u>439</u> straight	<u>440</u> incon- spicuously folded	<u>441</u> much plicate		

TABLE I (Cont'd)

80. fruit type (3)	<u>442</u> capsule	<u>443</u> fleshy	<u>444</u> dry indehiscent		
81. fruit length (3)	<u>445</u> to 10mm.	<u>446</u> 11-20mm.	<u>447</u> 2.1-4.0cm.	<u>599</u> more than 4.0cm.	
82. seeds (4)	<u>448</u> plu- mose, apical attach.	<u>449</u> white plumose, basal attach.	<u>450</u> winged	<u>451</u> caudate	<u>600</u> brown plumose, basal attach.
83. abundancy of other bromel. species at collection site (4)	<u>452</u> very abundant	<u>453</u> moderately common	<u>454</u> occasional	<u>455</u> rare	
84. abundancy of specimens of same species (4)	<u>456</u> very abundant	<u>457</u> moderate	<u>458</u> occasional	<u>459</u> rare	
85. amount of tank water (3)	<u>460</u> none to trace, scarcely pours	<u>461</u> ca. 1/2 full	<u>462</u> more than 1/2 full		
86. distance from humans (3)	<u>463</u> on cultivated fanca	<u>464</u> near humans not in sight of	<u>465</u> very distant		
87. monoecious- dioecious (3)	<u>466</u> monoecious & bisexual	<u>467</u> dioecious	<u>468</u> monoecious & unisexual		

TABLE I (Cont'd)

88. scales, density on leaf (4)	<u>469</u> less than 6 per linear mm.	<u>479</u> 6-9 per linear mm.	<u>471</u> 10 scales or more per linear mm.	<u>472</u> absent
89. scales or leaf, degree of appressedness (3)	<u>473</u> appressed, not obvious to naked eye	<u>474</u> obvious but still appressed	<u>475</u> loose, obvious, eg. flocculous	
90. plants, grouped or no (3)	<u>476</u> individual	<u>477</u> several	<u>478</u> large groups, 10 or more	
91. ovary, superior? (3)	<u>479</u> superior	<u>480</u> inferior	<u>481</u> superior-inferior	
92. ants (3)	<u>482</u> living and conspicuous	<u>483</u> signs of activity only	<u>484</u> no signs of	
93. stomata, leaf surface, blade-sheath transition (3)	<u>485</u> ca. 120 micra apart conspicuous longi. rows	<u>486</u> common, 200-350 micra apart	<u>487</u> uncommon 360 micra or more apart	
94. stomata shape, surface view (3)	<u>488</u> round width-length ratio, .834-1.166	<u>489</u> narrow elliptic, .495-.833 ratio	<u>490</u> other	
95. trichomes, number of layers (5)	<u>491</u> apparently 1,3	<u>492</u> 1,2,& 4	<u>493</u> 1,2,3,& 5 or more	<u>494</u> no trichomes seen <u>495</u> asymmetrical organization

TABLE I (Cont'd)

96. leaf thickness at blade-sheath transition (3)	<u>496</u> ca. .25mm.	<u>497</u> ca. .50mm.	<u>498</u> .75mm. and more	
97. silica bodies per epidermal cell	<u>499</u> 1/cell	<u>500</u> several/cell	<u>501</u> none	
98. sterile bracts on spike or branch (3)	<u>510</u> 0	<u>511</u> 1-4	<u>512</u> 5 or more	
99. floral bracts (2)	<u>513</u> bi- carinate	<u>514</u> not bicarinate		
100. basal sterile floral bract (3)	<u>515</u> single keeled	<u>516</u> not keeled	<u>517</u> wide double keeled	
101. number of flowers/spike (4)	<u>518</u> 6	<u>519</u> 7-15	<u>520</u> 16-24	<u>521</u> 25 and more
102. floral bract inner surface (2)	<u>522</u> glabrous or subglabrous	<u>523</u> lepidote		
103. sterile bracts inner surface (2)	<u>525</u> glabrous	<u>526</u> lepidote		
104. sepals inner surface (3)	<u>528</u> glabrous	<u>529</u> slightly lepidote	<u>530</u> strongly lepidote	

Aechmea and specimens of species belonging to another subfamily.

<u>D_{ij}</u>	<u>x²</u>	
2.733	7.469	
1.988	3.952	
1.904	3.625	
2.363	5.584	
2.136	4.562	
2.459	6.047	(x) ² = 35,787.04
2.322	5.392	
2.445	5.978	c = 35,787.04
2.109	4.448	
2.131	4.541	c = 131.032
2.322	5.392	
2.342	5.485	ss = 132.427-131.032
2.227	4.960	
2.647	7.007	ss = 1.395
2.323	5.397	
1.969	3.877	s ² = 1.395/26.
2.012	4.048	
2.230	4.972	s ² = .054
2.042	4.170	
2.107	4.443	s = .234
2.207	4.871	
1.904	3.626	
2.349	5.518	
2.322	5.392	
2.102	4.418	
1.685	2.839	
2.101	4.414	

$$x = 59.48 \quad x^2 = 132.427$$

$$n = 27 \quad \bar{x} = 2.203 \quad \text{at } P=.05 \quad \pm (.234) 2.056$$

$$\bar{x} = 2.203 \pm .481$$

$$x = 1.722 - 2.684$$

TABLE IIa. Sample of phenetic distance (D_{ij}) within same family circumscription and two different subfamilies, Tillandsioideae and Bromelioideae. One subfamily, Bromelioideae, represented by a single OTU, AJG 1066, Aechmea angustifolia. All phenetic distances obtained with 60 or more characters applied to OTUs which are individual specimens.

TABLE IIb

Vriesea species:

OTU		D _{ij}	x ²
code	no.		
1121	867	1.682	2.829
1121	193	1.379	1.902
1121	2000	1.323	1.750
1121	1131	1.500	2.250
1121	873	1.386	1.921
867	193	1.170	1.369
867	2000	1.898	3.602
867	1124	1.609	2.589
867	1131	1.856	2.444
867	873	1.489	2.217
193	2000	1.766	3.119
193	1124	1.322	1.748
193	1131	1.650	2.723
193	873	1.451	2.105
2000	1124	1.469	2.158
2000	873	1.895	3.591
1124	1131	1.732	2.999
1124	873	1.379	1.902
1131	873	1.489	2.217
1131	2000	1.051	1.105

n = 20 X = 30.496 x² = 46.540

\bar{X} = 1.525

Guzmania species:

OTU		D _{ij}	x ²
code	no.		
1171	862	1.609	2.589
1171	871	1.493	2.229
862	871	1.709	2.921
660	869	1.901	3.614
862	869	1.550	2.403
862	1060	1.471	2.164
859	869	2.039	4.158
859	1060	1.688	2.849
852	869	1.816	3.298
852	1060	1.459	2.129
861	869	2.209	4.880
861	1060	1.731	3.000
1171	869	1.919	3.682
1171	1060	1.848	3.415
862	860	1.263	1.595
859	862	1.531	2.344
852	860	1.791	3.208
852	862	1.644	2.703
861	862	1.704	2.904
1171	860	1.893	3.583
1171	862	1.661	2.759
1056	861	2.046	4.186
1056	862	1.585	2.521
1056	1171	1.900	3.610
860	1060	1.550	2.403

n = 25 X = 43.010 x² = 75.138

\bar{X} = 1.720

TABLE IIb (Cont'd)

Subgenera
Pseudo-Catopsis with Allardtia:

OTU		D_{ij}	X^2
code	no.		
799	64	1.585	2.512
799	65	1.618	2.619
799	69	1.692	2.863
799	1148	1.495	2.235
799	1158	1.525	2.326
799	1167	1.585	2.512
799	2144	1.474	2.173
799	131	1.864	3.474
843	131	2.218	4.919
843	212	2.439	5.949
843	841	1.976	3.905
843	711	2.030	4.121
843	740	2.091	4.372
853	131	1.724	2.972
853	212	2.322	5.392
853	841	1.373	1.885
853	711	1.524	2.323
853	740	1.535	2.357
853	64	1.354	1.833
853	65	1.675	2.806
853	69	1.648	2.716

$$n = 21 \quad \sum X = 36.747 \quad \sum X^2 = 66.264$$

$$\bar{X} = 1.750$$

Subgenera Tillandsia,
Phytarhiza with Pseudo-Catopsis:

OTU		D_{ij}	X^2
code	no.		
37	162	2.420	5.856
37	1165	1.775	3.151
162	1165	1.647	2.713
162	1050	1.766	3.119
162	853	1.829	3.345
37	1050	2.054	4.219
37	853	2.266	5.135
1165	853	1.477	2.182
1165	1050	1.819	3.309
1165	853	2.132	4.545

$$n = 10 \quad \sum X = 19.185 \quad \sum X^2 = 37.574$$

$$\bar{X} = 1.919$$

TABLE IIb (Cont'd)

	30.496		46.540
	36.747		66.264
	43.010		75.138
	<u>19.185</u>		<u>37.574</u>
(X) =	129.438	(X ²) =	225.516
n =	76	(X) ² =	16,754.196
X =	1.703	C =	16,754.196/76
(X) ² =	(129.438) ²	C =	220.450
(X) ² =	16,754.196		

sum of squares = 225.516-220.450

sum of squares = 5.066

s² = 5.066/75

s² = .068

s = .26

At P=.05:

$\bar{X} = 1.703 \pm .26 (1.991)$ $\bar{X} = 1.703 \pm .518$ $\bar{X} = 1.185 - 2.221$

TABLE IIb continued. Summation of sample of phenetic distances for within same genus but with different subgeneric circumscription. Represented are Vriesea, Guzmania, Pseudo Catopsis X Allardtia (subgenera of Tillandsia) and Tillandsia and Pseudo Catopsis (subgenera of Tillandsia). All phenetic distances obtained with 60 or more characters applied to OTUs which are individual specimens.

TABLE IIc

Subgenus Psuedo-Catopsis species:

OTU			
code	no.	D _{ij}	x ²
1180	1050	1.541	2.375
1180	853	1.631	2.660
1180	1141	0.924	0.854
1180	101	1.505	2.265
1180	102	1.406	1.977
1180	877	1.420	2.016
1180	930	1.801	3.244
1180	880	1.368	1.871
1050	853	1.779	3.165
1050	1141	1.724	2.972
1050	101	1.350	1.823
1050	102	1.308	1.711
1050	877	1.309	1.713
1050	930	1.533	2.350
1050	880	1.373	1.885
853	1141	1.639	2.686
853	101	1.474	2.173
853	102	1.584	2.509
853	877	1.437	2.065
853	930	2.227	4.960
809	799	1.453	2.111
809	843	1.437	2.065
809	853	1.585	2.512
809	883	1.609	2.589
809	1080	1.795	3.222

$$n = 25 \quad \bar{x} = 38.211 \quad x^2 = 59.773$$

$$\bar{x} = 1.528$$

Subgenus Tillandsia

OTU			
code	no.	D _{ij}	x ²
37	162	2.420	5.856
37	1165	1.775	3.151
162	1165	1.647	2.713

$$n = 3 \quad \bar{x} = 5.842 \quad x^2 = 11.720$$

$$\begin{aligned} (\bar{x}) &= 44.053 & (\bar{x})^2 &= 1,940.667 \\ (\sum x^2) &= 71.493 & C &= 1,940.667/28 \\ &= 28 & C &= 69.309 \end{aligned}$$

$$ss = 71.493 - 69.309$$

$$ss = 2.184$$

$$s^2 = 2.184/27 = .081$$

$$s = .289$$

at P=.05

$$\bar{x} = 1.573 \pm .289(2.052) = 1.573 \pm .593$$

$$\bar{x} = .980 - 2.166$$

TABLE IIc. Summation of sample of phenetic distances for within the same subgenus but with different species. All phenetic distances obtained with 60 or more characters applied to OTUs which are individual specimens.

TABLE 11d

Tillandsia subgenus Allardtia species:

OTU		D _{ij}	x ²
code	no.		
64	65	0.816	0.665
64	69	0.782	0.612
64	72	0.748	0.560
64	1148	0.953	0.908
64	1158	1.232	1.518
64	1167	1.126	1.268
64	2144	0.883	0.780
64	131	0.985	0.970
65	131	0.984	0.968
65	69	0.828	0.686
65	72	1.015	1.030
65	1148	0.955	0.912
65	1158	1.415	2.002
65	1167	1.203	1.447
65	2144	1.124	1.263
69	72	0.911	0.830
69	1148	0.811	0.658
69	1158	1.292	1.669
69	1167	1.280	1.638
69	2144	1.233	1.520
72	131	1.192	1.421
69	131	0.911	0.830
72	1148	0.716	0.513
72	1158	0.726	0.527
72	1167	0.791	0.626
72	2144	0.841	0.707
131	212	0.986	0.972
131	213	0.930	0.865
131	1167	1.170	1.369

$$(\sum x)^2 = 831.688$$

$$c = 831.688/29$$

$$c = 28.679$$

$$\text{sum of squares} = 29.734 - 28.679$$

$$ss = 1.055$$

$$s^2 = 1.055/28$$

$$s^2 = 0.037$$

$$s = 0.193$$

TABLE IIId (Cont'd)

$$n = 29 \quad \Sigma X = 28.839 \quad \Sigma X^2 = 29.734$$

$$\bar{X} = 0.994$$

$$\begin{aligned} \text{at } P=.05 \quad \bar{X} &= .994 \begin{matrix} + \\ - \end{matrix} (2.04) .061 \\ \bar{X} &= .994 \begin{matrix} + \\ - \end{matrix} .124 \\ \bar{X} &= .870 - 1.118 \end{aligned}$$

TABLE IIId. Summation of sample of phenetic distances for different species within the subgenus *Allardtia* circumscription. All phenetic distances obtained with 60 or more characters applied to OTUs which are individual specimens.

TABLE IIe

Individuals of same species:

OTU		D _{ij}	x ²
code	no.		
1167	1158	0.889	0.790
1158	2144	1.049	1.100
1167	2144	0.968	0.937
71	70	0.434	0.188
1111	61	0.606	0.367
1111	62	0.617	0.381
1111	181	0.775	0.601
1111	769	1.174	1.378
1111	644	1.019	1.038
1111	12	0.620	0.384
1111	798	0.674	0.454
32	61	0.431	0.186
32	181	0.617	0.381
32	769	0.922	0.850
32	644	0.751	0.564
32	12	0.334	0.112
32	798	0.617	0.381
6003	228	0.752	0.566
1121	1124	0.767	0.588
875	190	0.542	0.294
932	930	0.908	0.824
212	6001	0.773	0.598
1133	1173	0.652	0.425
869	1060	0.848	0.719
859	767	0.981	0.962
866	1060	0.856	0.733
1071	1060	0.667	0.445
1071	869	0.792	0.627

$$(\sum x)^2 = 442.345$$

$$C = 442.345/28$$

$$C = 15.798$$

$$\text{sum of squares} = 16.873 - 15.798$$

$$SS = 1.075$$

$$s^2 = 1.075/27$$

$$s^2 = .039$$

$$s = .198$$

$$\frac{.198}{r} = .245 \text{ (Snedecor TABLE 2.2.2)}$$

$$r = .808$$

$$1/2 r = .404$$

TABLE IIe (Cont'd)

$$n = 28 \quad \bar{x} = 21.032 \quad s^2 = 16.873$$

$$\bar{X} = 0.751$$

$$\text{at } P=.05 \quad \bar{X} = .751 \pm 2.05 (.198)$$

$$\bar{X} = .751 \pm .406$$

$$\bar{X} = .345 - 1.157$$

TABLE IIe. Summation of sample of phenetic distances for within the same species circumscription. All phenetic distances obtained with 60 or more characters applied to OTUs which are individual specimens.

TABLE III

Actual standard deviation	Predicted standard deviation	Actual number of characters	Number of characters for predicted SD
.304	.279	30	80
.064	.066	80	30
.245	.292	30	80
.067	.051	80	30

TABLE III. Comparison of the predicted standard deviations using the two-step conversion with the actually-computed standard deviations. The distance values were those between OTU 1124 and 1110 submitted with 10 different randomly selected character sets.


```
0 $IBFTC
1   DIMENSION IA(100,110),NAT(100), D(100,100),T(100),IR(100)
   C MM(110), NN(110),IEXCAR(110), A (13, 13)
2   READ (5,201) IEXC
4   201 FORMAT (I3)
5   IF (IEXC) 21, 21, 22
6   22 READ (5,200) (IEXCAR (I),I=1,IEXC)
13  200 FORMAT (26I3)
14  21 READ(5,1111)L1,L2
17  1111 FORMAT(2I3)
20  DO 1112 I=1,L1
21  IF (L2-25) 10, 10, 12
22  10 READ(5,100)NAT(I),(IA(I,ICAR),ICAR=1,L2)
27  100 FORMAT(I4,1X,25I3)
30  GO TO 1112
31  12 READ(5,100) NAT (I),(IA(I,J),J=1,25)
36  READ (5,110) (IA(I,J),J=26,L2)
43  110 FORMAT (5X,25I3)
44  1112 CONTINUE
   C
   C DISTANCE FUNCTION FOR EACH POSSIBLE DIFFERENT OTU PAIR
   C
46  SUM = 0
47  SUMSQ = 0
50  DO 54 KATT=1,L2
51  MM(KATT)=0
52  54 NN(KATT)=0
54  LL=L1-1
55  500 FORMAT (1H1)
56  301 FORMAT (41H OTU PAIRS WITH LESS THAN 100 COMPARISONS//
   C34H OTU1 OTU2 NUMBER OF COMPARISONS)
57  ZN = 0
60  LINES=0
61  DO 4I=1,LL
62  K=I+1
63  DO 4J=K,LI
64  M=1
65  N=1
66  ZN = ZN +1.
67  DO 3 KATT=1,L2
   C
   C CALL FOR THE SUBROUTINE TO EXCLUDE DESIGNATED CHARACTERS
   C
70  CALL XCLUDE (KATT,IEXC, IEXCAR,INDIC)
71  IF (INDIC) 23, 23, 3
72  23 IF (IA(I,KATT).EQ.0.OR. IA(J,KATT).EQ.0) GO TO 3
75  IF (IA(I,KATT) - IA(J,KATT)) 1,2,1
76  2 M=M+1
77  N = N+1
100 MM(KATT) =MM(KATT)+ 1
101 GO TO 3
102 1. N = N+2
103 NN(KATT)=NN(KATT) +1
104 3 CONTINUE
106 XM=M
```

```

107      XN=N
110      D(I,J)= -(ALOG(XM/XN)/ALOG(2.0))
111      SUM = SUM + D(I,J)
112      SUMSQ = SUMSQ + D(I,J) **2
      C
      C      NUMBER OF COMPARISONS FOR OTU PAIRS, PRINTOUT WHEN
      C      LESS THAN 100
113      NUMCOM=(N+M)/2 - 1
114      IF (NUMCOM.GT. 99) GO TO 4
117      LINES=LINES+1
120      IF(MOD(LINES-1, 50)) 703,704,703
121      704 PRINT 500
122      PRINT 301
123      703 PRINT 300, NAT(I), NAT (J), NUMCOM
124      300 FORMAT (I5, 1X, I5, I-10)
125      4 D(J,I) = D(I,J)
      C
      C      ESTIMATION OF PARAMETERS OF DISTANCE FUNCTIONS ARRAY
      C
130      XBAR = SUM/ZN
131      SS = SUMSQ - SUM**2/ZN
132      STDEV = SQRT (SS/(ZN-1.))
133      NJ=L1+5
134      MJ=1
135      DO 52 JJ=5,NJ,5
136      IF (JJ.GT.L1) JJ=L1
141      LINES=0
142      DO 51 I=1,L1
143      LINES=LINES+1
144      IF(MOD(LINES-1, 25)) 51,702,51
145      702 WRITE (6,101) (NAT(J),J=MJ,JJ)
152      101 FORMAT (1H1,5X,17HDISTANCE FUNCTION//5I15//)
153      51 WRITE (6,102) NAT(I), (D(J,I),J=MJ,JJ)
161      102 FORMAT(3X,I4, F12.8, 4F15.8,/)
162      IF (JJ-L1) 52,53,52
163      52 MJ=MJ+5
      C
      C      R ROUTINE
      C
165      53 DO 6 I=1,L1
166      DO 6 J=1,L1
167      IF (I.EQ.J) GO TO 6
172      DO 70 K=1,L2
173      CALL XCLUDE (KATT,IEXC, IEXCAR,INDIC)
174      IF (INDIC) 24, 24, 70
175      24 IF(IA(I,K).NE.IA(J,K)) GO TO 70
200      IR(I)=IR(I)+1
201      GO TO 6
202      70 CONTINUE
204      6 CONTINUE
      C
      C      H-T-ROUTINE
      C
207      DO 80 I=1,L1
210      SIH=0.0
  
```

DISTANCE FUNCTION

	1124	1131	862	871
1124	0.0	1.73230362	1.76081085	1.779230
1131	1.73230362	0.0	1.64571476	2.270852
862	1.76081085	1.64571476	0.0	1.709408
871	1.77923012	2.27085209	1.70940876	0.0
1171	1.85244179	1.77578354	1.60941410	1.492596
1051	1.48278141	1.64385509	1.42884254	2.099534
1104	1.71620560	1.61470890	1.71989059	1.874467
1106	1.47130394	1.55639267	1.58496094	1.845828
1155	1.12199020	1.52724648	1.30932808	1.779230
1802	1.50901222	1.55359650	1.58496094	1.795178
1120	1.34577465	1.80109501	2.30116844	1.999999
1118	1.49476337	1.88348389	2.21089554	2.130702
1066	2.73382378	1.98750782	1.90413857	2.362568
37	1.78135777	1.94753170	1.90332317	1.986577
162	1.49749851	1.88452148	2.24100685	2.217904
63	1.61470890	1.62015152	1.79141140	1.716205
131	1.22239208	1.55359650	1.66985035	1.405991
212	1.76004791	1.48542595	1.74723244	2.042642
213	1.58496094	1.80735397	1.61565781	1.390459
8411	1.56130981	1.34395409	1.37345791	1.657111
652	1.49749851	1.48186779	1.42084217	1.649811
711	1.21230316	1.37851143	1.28950596	1.645714
740	1.37851143	1.58496094	1.63603592	1.662963
6001	1.46339989	1.50249863	1.37851143	1.720845

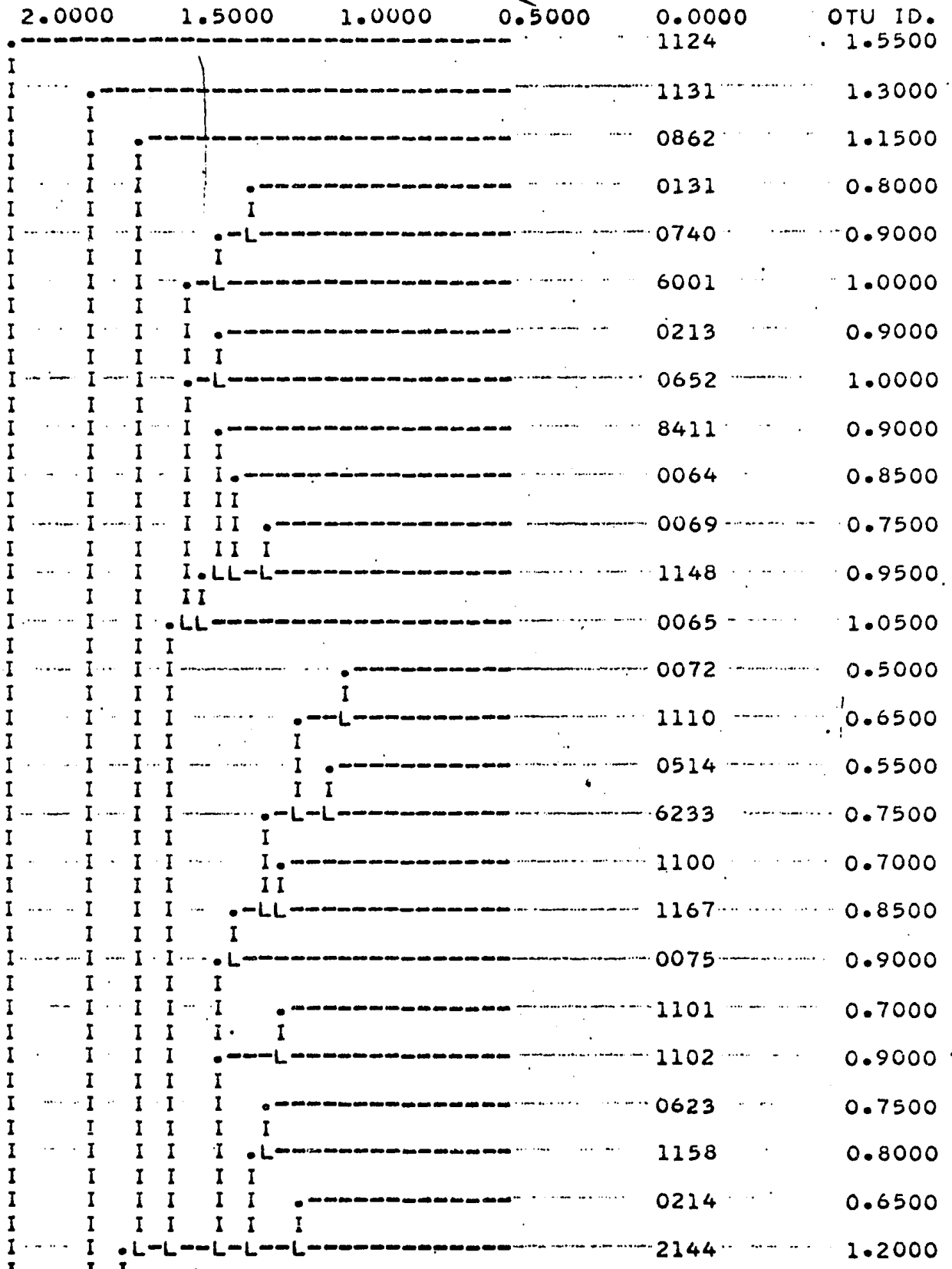
DISTANCE FUNCTION

	1124	1131	862	871
799	1.66742325	1.23446465	1.44875717	1.697072
843	1.45606327	2.08091927	1.81398678	2.471303
853	1.46262646	1.31451035	1.68536282	2.321927
854	1.63471508	1.73696423	1.92138958	2.459430
883	1.96466541	1.98657703	1.91616631	2.210895
1050	1.63113213	1.78135777	1.88981628	2.342390
1080	1.95108891	2.71271706	1.99999905	2.226507
1132	1.70626831	1.58496094	1.58496094	2.197299
1133	2.14684010	1.79354858	1.99999905	3.010567
1135	1.97862530	2.02553368	2.10108471	2.584960
1138	1.80735397	1.88348389	1.37851143	2.573464
1150	1.66985035	1.49476337	1.85626316	2.106914
1164	1.53201199	1.97198391	1.86598015	1.925998
1173	1.97400379	2.52025604	2.09760952	2.321927
1176	1.75632954	1.80022907	2.10780144	2.197299
1180	1.98902798	1.87446785	1.70626831	2.301168
14	2.02974606	2.32192707	2.20163250	1.952170
1130	1.98657703	2.08341503	2.21299171	1.643855
64	1.50479126	1.28540134	1.46712494	1.793548
65	1.58496094	1.61890888	1.83650017	1.643855
69	1.47999287	1.65207577	1.32192802	1.415037
228	1.30256271	1.42626381	1.58496094	1.534774
72	1.32894802	1.28010750	1.49749851	1.556392
75	1.37280846	1.05444717	1.64571476	1.959356

ESTIMATION OF PARAMETERS OF DISTANCE FUNCTION ARRAY
EACH DISTANCE FUNCTION AS THE VARIABLE

NUMBER OF DISTANCE FUNCTIONS = 1953
SUM OF DISTANCE FUNCTIONS = 3222.402
SUM OF SQUARED DIST. FUNCTS. = 5668.375
MEAN OF DISTANCE FUNCTIONS = 1.650
SUM OF SQUARES = 351.492
STANDARD DEVIATION = 0.424

CLUSTER BSM EX STAND BDM USING UPGA METHOD.



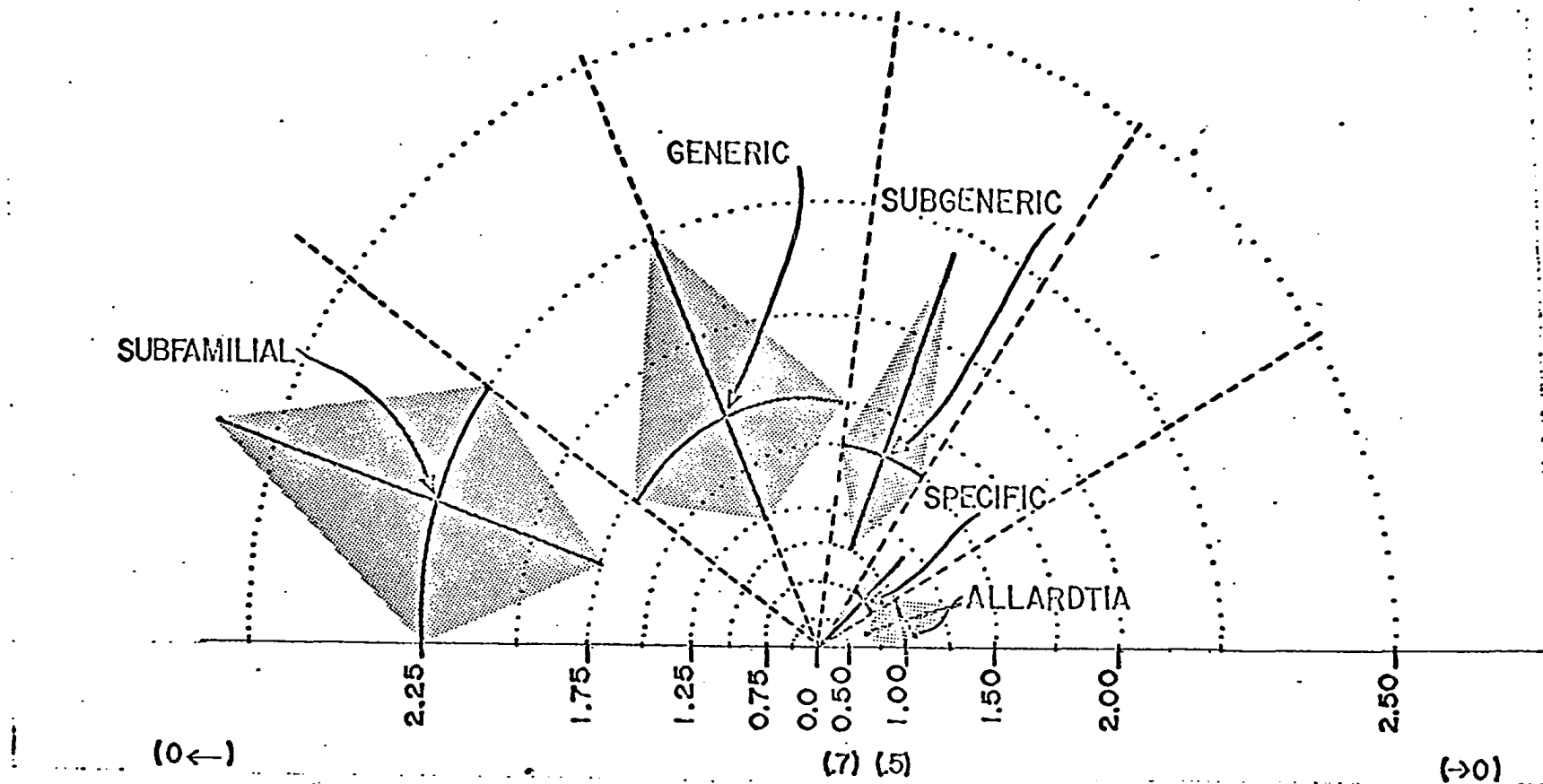


FIGURE 3. CIRCUMSCRIPTION OF SOME TAXONOMIC CATEGORIES WITH ECUADORIAN BROMELIACEAE

Radii are indicated in distance values from 0 to 2.50 where distance is the negative logarithm of the similarity index of Rogers and Fleming. Equivalent similarity indices in parentheses subtend some distance values. Mean phenetic distances are indicated by the distances between the origin and the bold-face arcs. The arc-bisectors show the confidence intervals at the $p=0.05$ level.

Character set	$\sum X$	\bar{x}	$\sum X^2$	$\sum X^2$ (sum of squares)
1	33.799	1.207	44.483	3.685
2	34.870	1.245	46.778	3.354
3	30.762	1.099	36.539	2.743
TOTAL	99.431		127.800	

Source of variance	degrees of freedom	sum of squares	mean square
Sets	2	.325	.1625
Total	83	10.104	
Individual (error term)	81	9.779	.1207

$$F = .1625/.1207 = .1346$$

NOT SIGNIFICANT.

Figure 4. Analysis of variance of distance values calculated from three randomly selected sets of characters of 55-72 characters each applied to eight OTUs, specimens. The mean distance for any one set does not differ significantly from the mean distance for any other set.

X
Distance value

1.36040
1.36678
1.41990
1.50250
1.31451
1.47062
1.36678
1.30666
1.44745
1.46712

$$\Sigma X = 14.0228 \quad \bar{x} = 1.4023$$

$$\Sigma x^2 = .0421$$

$$s^2 = .0047$$

$$s_{\bar{x}} = .0218 \text{ (standard error of the mean)}$$

Coefficient of variation \approx 5%

Figure 5. Coefficient of variation of distance values for one pair of OTUs, AJG 1110 and AJG 1124, submitted with 10 different randomly selected sets of characters of 63-68 characters each.

Character set	Sum of squares	Mean square, s^2
1	3.685	0.1384
2	3.354	0.1242
3	2.743	0.1016
		<hr/>
		$\sum s^2 = .3622$

$$\text{Mean variance } (\bar{s}^2) = \sum s^2 / a = .1207$$

$$a \log \bar{s}^2 \quad .2457 \quad -3$$

$$\sum \log s^2 \quad (-) \quad .2357 \quad -3$$

$$.0100$$

$$\text{Chi square} = 2.3026 \quad (n-1) \quad (a \log \bar{s}^2) - \sum \log s^2$$

$$\text{Chi square} = \text{ca. } .6$$

Figure 6. Bartlett's Test for Homogeneity of Variance of Distance Values. Eight OTUs were submitted to three randomly selected sets of characters of 55 to 72 characters each. The test on the three sets of 28 distance values indicate that the mean squares show less than average sampling variation. There is no indication of heterogeneity of variance.

OTUs	Characters	Chi square	Degrees of Freedom
17	52	110	135
17	52	151	135
17	52	114	135
8	52	19	27
8	34	22	27
8	13	29	27

All the above chi square values are not significant.

FIGURE 7. Bartlett's chi square test of homogeneity of variance between pairs.

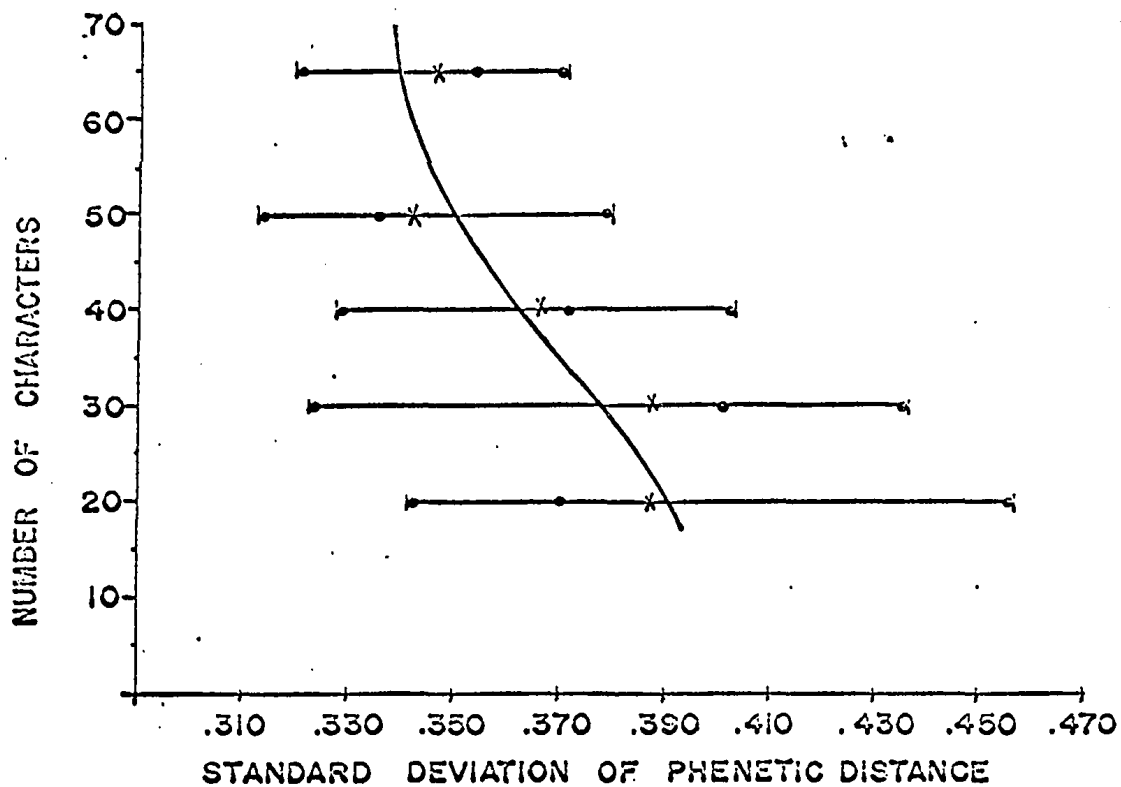


Figure 8. Standard Deviation Plotted Against Number of Characters. Three sets each of 20, 30, 40, 50 and 65 randomly selected characters. Phenetic distance of 28 OTUs.

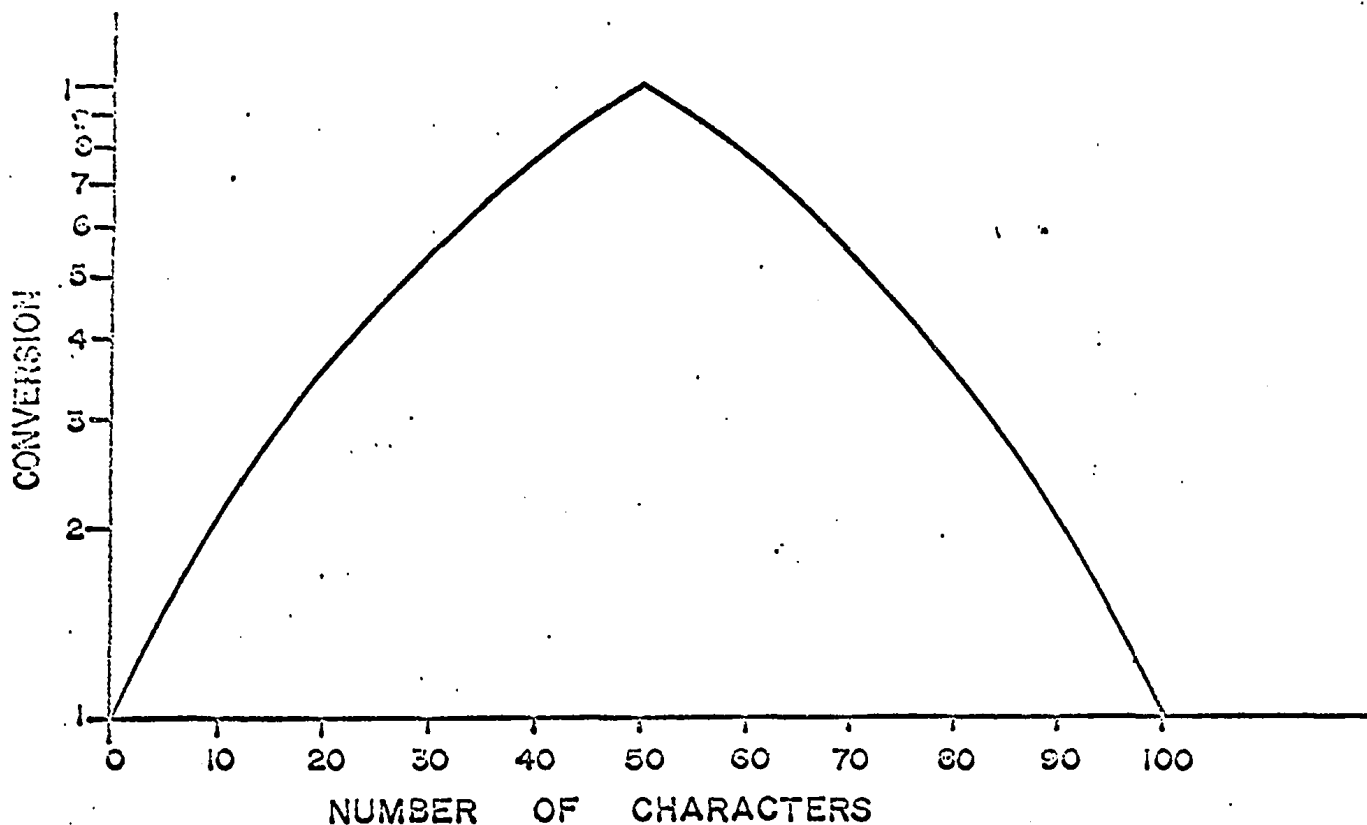


Figure 9. Conversion of Standard Deviations Computed with Different Sizes of Sets of Characters. The ordinate provides the conversion factor by taking the difference between 2 points on the curve for two different numbers of characters.

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