REVISTA DE LA
ACADEMIA COLOMBIANA
de Ciencias Exactas, Físicas y Naturales

LA ACADEMIA ES ORGANO CONSULTIVO DEL GOBIERNO NACIONAL

VOLUMEN XVI — JULIO DE 1988 — NUMERO 63

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SEDE DE LA ACADEMIA: CARRERA 3a. A No. 17-34
APARTADO AEREO 44763 — BOGOTA 1. D.E., COLOMBIA

Nota del Director

Este número de la Revista recoge aportes de una escuela de botánicos que, de una u otra manera, han estado relacionados con el Dr. Richard Evans Schultes en su larga carrera profesional.

Este homenaje al Dr. Schultes se justifica ampliamente por la extensa labor que él ha desarrollado en Colombia no sólo como científico sino como promotor de ideas fundamentales para una política de desarrollo fundamentado en el uso racional del patrimonio biológico.

En efecto, ha sido el Dr. Schultes divulgador infatigable de la riqueza de los ecosistemas colombianos y como científico ha profundizado en temas de botánica económica que antes se habían tocado sólo superficialmente. A él le debemos conceptos fundamentales sobre la variedad florística del territorio colombiano que hablan claramente sobre la necesidad de un cambio en la política estatal de desarrollo científico. La posible existencia en nuestro país de más de 50.000 especies vegetales lo define como un banco genético de importancia mundial, banco que desgraciadamente desaparece en la medida en que se destruyen los bosques y cuya importancia disminuye conforme otros países extraen material genético para utilización en sus procesos industriales.

Ojalá que la publicación de este material ayude a conformar en quienes deciden una visión más clara sobre el potencial económico de la flora colombiana.

JULIO CARRIZOSA UMAÑA

Prof. Dr. Richard Evans Schultes

RICHARD EVANS SCHULTES

Por *Luis Eduardo Mora-Osejo* 1

Es ya una tradición de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales rendir homenaje a sus miembros con motivo de celebrar un onomástico singular o para destacar realizaciones notables en el campo de la actividad científica. En esta oportunidad la Academia rinde homenaje mediante la edición de un número especial de su Revista, al Miembro Correspondiente Profesor Dr. Richard Evans Schultes, vinculado a la Entidad desde 1956, en ocasión de su 75o. cumpleaños y en reconocimiento a la encomiable labor cumplida en el estudio de la Flora de Colombia, en particular, de la región amazónica y, en general, en el desarrollo de las ciencias botánicas en nuestro medio.

Varios de sus antiguos discípulos y colegas han querido asociarse a este homenaje, enviando las contribuciones científicas que conforman este número especial de la Revista de la Academia y expresar así su gratitud imperecedera hacia el Maestro o su aprecio y reconocimiento al colega y amigo. Por este mismo motivo asumí la preparación y edición de este número de la Revista de la Academia, de acuerdo con el doctor Julio Carrizosa Umaña, su actual director.

Poco tiempo después de culminar sus estudios universitarios y optar al título Philosophiae Doctoris (Ph. D.), en la Universidad de Harvard, donde tuvo como maestros, entre otros ilustres y conocidos botánicos, a Oakes Ames y Paul C. Mangelsdorf, siendo todavía muy joven, se vinculó a Colombia, en calidad de "Explorador Botánico", del Consejo Nacional de Investigaciones Científicas de los Estados Unidos. Esta actividad que se iniciara en 1941, se prolongó hasta 1944 y tuvo por objetivo principal el estudio de las especies del género *Hevea* en la Amazonia Colombiana. Posteriormente, 1944-1953, como investigador adscrito al Departamento de Agricultura de los Estados Unidos, Oficina de Industrias Vegetales e Investigador Asociado del Museo Botánico de la Universidad de Harvard, amplió el ámbito de sus studios a toda la Amazonia y se ocupó preferentemente de su Flora económica. Desde entonces, su actividad científica en Colombia no ha tenido interrupciones; si bien su interés científico principal ha girado en torno al estudio de la Flora Amazónica, ello no le ha impedido prestar otros distinguidos servicios al país, ya sea como asesor en emprendimientos científicos relacionados con su especialidad o en la docencia de la Botánica Económica y de la Etnobotánica.

En reconocimiento a esta labor ya en 1953, la Universidad Nacional lo exaltó al rango de Profesor Honorario y en 1983, el Gobierno Nacional le confirió la Cruz de Boyacá en el grado de Oficial.

La Carrera Académica de Richard Evans Schultes en la Universidad de Harvard ha sido asimismo brillante. Primero como Investigador Asociado (1941-1953), luego como Curador del Herbario de Orquídeas de Oakes Ames, adscrito al Museo Botánico (1953-1958), Curador de Botánica Económica (1958-85), Director Ejecutivo del Museo Botánico (1967-1970), Director del Museo Botánico (1970-1985). Además desde 1970 a 1972 desempeñó varias cátedras en el campo de la Botánica Económica, como "Profesor de Biología", (1970-1972), "Profesor Paul C. Mangelsdorf de Ciencias Naturales" (1973-80) y "Profesor Edward C. Jeffrey" (1970-1985) de la Universidad de Harvard.

Su obra sintetizada en siete libros y 378 artículos científicos, de los cuales 183 se refieren a la Flora de Colombia, ha merecido amplio reconocimiento por la comunidad de botánicos de la América Latina, de Europa y de su país natal. Es miembro de la Sociedad "Antonio Alzate" de México, Miembro Honorario de la Asociación Argentina de Antropología Médica, y de la Sociedad Mexicana de Micología; Investigador colaborador del Instituto Agronómico do Norte, Belen do Pará,

1 Presidente Academia Colombiana de Ciencias Exactas, Físicas y Naturales.

Brasil, Profesor Visitante del Instituto de Recursos Bióticos Renovables de Jalapa, México; Miembro de las Academias de Ciencias de Colombia, de la Argentina y de la Sociedad Cubana de Botánica. Ya en 1950 fue designado Miembro de la Sociedad Linneana de Londres. En 1984 recibió la Medalla de Oro del Fondo de Vida Silvestre, presentada por el Príncipe Felipe de Inglaterra. En el año pasado, le fue conferido el premio "John and Alice Tyler" en Ecología y Energética.

En su país, los Estados Unidos, es Miembro de la Academia de Artes y Ciencias, del Colegio Americano de Neurosicofarmacología, de la Academia Nacional de Ciencias, de la Sociedad Americana para el Avance de la Ciencia, de la Sociedad de Botánica Económica, de la Sociedad Americana de Farmacognosia, de la Sociedad Fitoquímica de Norteamérica, entre otras. Desde 1964 hasta 1986 formó parte, entre otros, del Comité de Selección de candidatos oriundos de América Latina a optar becas de la Fundación John Simon Guggenheim Memorial Foundation. Ha formado parte de los comités editoriales de las siguientes revistas y publicaciones científicas: Chronica Botánica (1947-49), Botanical Museum Leaflets, Harvard University (Editor: 1957-85), Economic Botany (Editor: 1962-1979), Llodya (Miembro del Comité Editorial: 1965-1976), Journal of Latin American Folklore (Miembro del Comité Editorial: 1975--), Flora del Ecuador (Miembro del Comité Editorial 1976--), Organización de la Flora Neotrópica (Miembro del Comité, 1978--), Social Pharmacology (Miembro del Comité Editorial: 1986--), Journal of Psichoactive Drugs (Miembro del Comité Editorial: 1974--).

Como profesor visitante ha ocupado cátedras de reconocido prestigio, en diversos centros de Educación Superior, entre otras: Cátedra Kaufman de la Escuela de Farmacia, de la Universidad de Ohio, Columbus, Ohio (1968), Cátedra Laura L. Barnes, Morris Arboretum, Filadelfia (1969); Cátedra J. A. Koch, Universidad de Pittsburg (1971); Cátedra Rho Chi, Chicago (1974), Cátedra Cecil e Ida Green, Universidad de British Columbia, Vancouver (1974); Cátedra Hubert Humphrey, del Macalaster College, Minneapolis (1979); Cátedra Conmemorativa Frederich Henry Sikes Connecticut College, New London (1982).

Ha participado en más de 40 Congresos y Reuniones Científicas internacionales sobre temas relacionados con la Botánica Sistemática, la Botánica Económica, las plantas medicinales, la Farmacognosia, la Etnofarmacología, las Drogas Psicoactivas, la Farmacia, la Antropología y la Etnología y el Conservacionismo, entre otras disciplinas de la Botánica y conexas. En desarrollo de sus actividades científicas o profesionales ha viajado en repetidas ocasiones por Colombia, Venezuela, Perú, Ecuador, Brasil, Argentina, México, Costa Rica, Cuba, Trinidad, Canadá, Inglaterra, Holanda, Bélgica, Francia, España, Suiza, Alemania, Dinamarca, Suecia, Afganistán, Sri Lanka, Malaya y Sabah.

Conocí a Richard Evans Schultes en el año de 1950, cuando iniciaba estudios universitarios de Ciencias Naturales en la Universidad Nacional, desde entonces me llamó la atención, aparte de su sólida preparación académica y científica, el gran entusiasmo, energía, seriedad y disciplina que sabía imprimir a sus empresas científicas, todo ello bajo el aliento de una gran admiración a nuestro país y de un profundo respeto a sus gentes todas, sus pobladores indígenas, sus campesinos o sus colegas. Con ellos su trato siempre ha sido cordial, y se ha desenvuelto dentro de estrecha camaradería, salpicada con el gracejo oportuno, expresión de su sentido del humor fino y penetrante. Lo ha animado siempre el profundo interés por el conocimiento de nuestra flora, ya se trate de las selvas amazónicas, o de las llanuras de la Orinoquia, de los bosques andinos o de los Páramos. Desde luego, su mayor interés científico se centró, desde cuando visitó por primera vez nuestro país, en nuestras selvas amazónicas y en sus pobladores aborígenes. Unas y otros, los ha concebido siempre como una unidad, como un todo indivisible a manera de una simbiosis. Por la misma razón, pronto comprendió que acercarse y compenetrarse de la sabiduría botánica de los indígenas, obtenida a través de la interacción multimilenaria con el mundo vegetal amazónico, sería fuente inagotable de conocimientos, susceptibles de generar nuevos e imprevistos desarrollos, en términos de la Ciencia y la Técnica modernas.

En mi opinión, fue esta visión, profundamente humana, y esta manera de aproximarse a nuestra realidad las que lo han llevado al éxito en sus pesquisas científicas y gozar del aprecio y reconocimiento por parte de sus colegas, a lo ancho y largo de la comunidad botánica mundial y de quienes en Colombia le hemos brindado nuestra colaboración y amistad.

Siendo todavía estudiante de la Universidad Nacional, tuve la fortuna de encontrarme con él en las selvas del Apaporis y la oportunidad de percatarme de cerca de las calidades humanas y científicas de su personalidad singular; en especial, su solidaridad con las gentes nuestras, su firmeza ante las dificultades, su genuina entrega al estudio sistemático de la Flora Amazónica, su actividad infatigable, su sensillez y su gran capacidad de organizador. Allá mismo, en la propia selva, aprendí de él cuán alejada de la realidad era aquella imagen de "infierno verde" que por aquellos tiempos se tenía del bosque amazónico, cristalizada en mitos y leyendas. Comencé a observarlo todo bajo otra óptica, la del Bioma exuberante donde no solamente ocurre la convivencia de la más grande diversidad de especies de plantas y animales, que ocupan los no menos diversos nichos, sino también donde ocurre el encuentro armónico y el interactuar equilibrado de sus pobladores originales con la naturaleza, merced a la puesta en práctica de las enseñanzas derivadas de una sabiduría consolidada a lo largo de milenios.

Varios años más tarde, tuve el privilegio de ser su huésped en el Botanical Museum de la Universidad de Harvard, cuando ejercía el cargo de Director y tenía bajo su cuidado la Cátedra sobre "Las plantas y el desarrollo de la Medicina Moderna". Fue una nueva y formidable experiencia escuchar sus exposiciones y compartir la estimulante atmósfera generada a través de su Cátedra y del diálogo creador con el grupo de sus alumnos de tesis.

Se justifica, pues, que la Academia Colombiana de Ciencias Exactas, Físicas y Naturales, le ofrezca este homenaje y señale ante las nuevas y futuras generaciones el ejemplo de la vida y trayectoria científica de Richard Evans Schultes, de lo que puede ser capaz del hombre cuando está animado por recia voluntad, firme vocación científica y claridad de propósitos.

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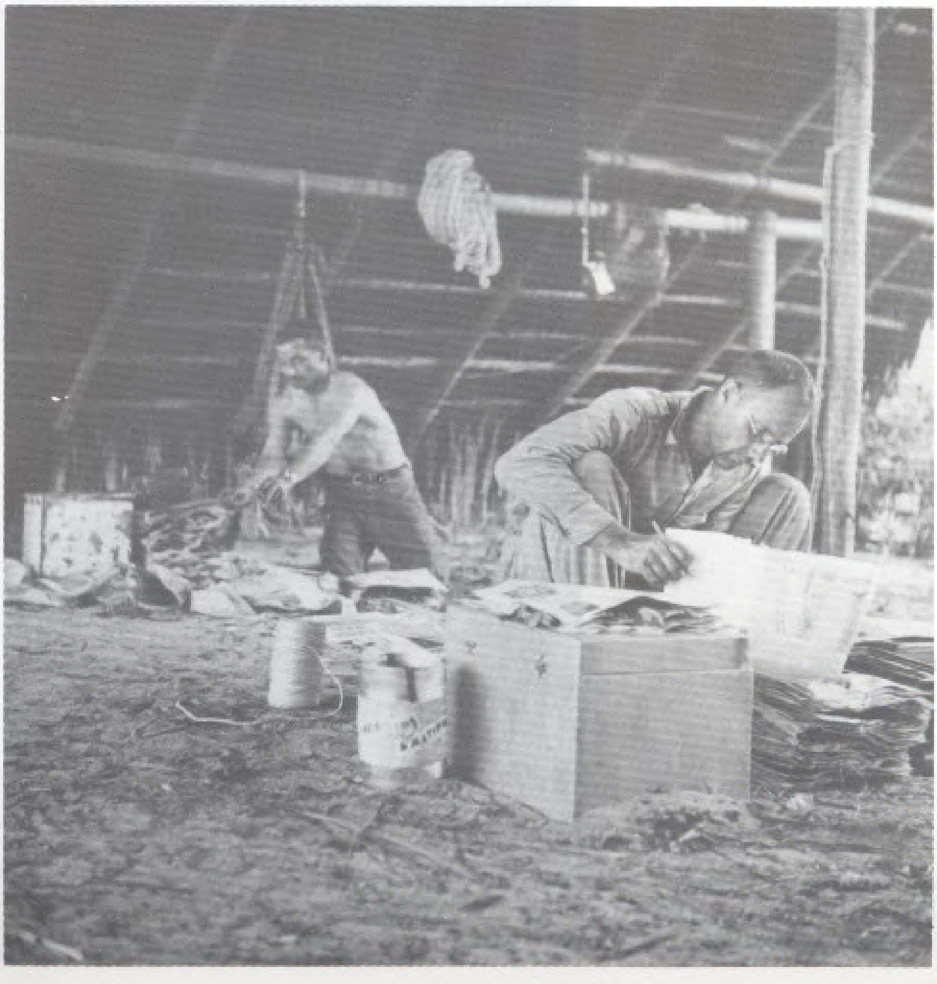
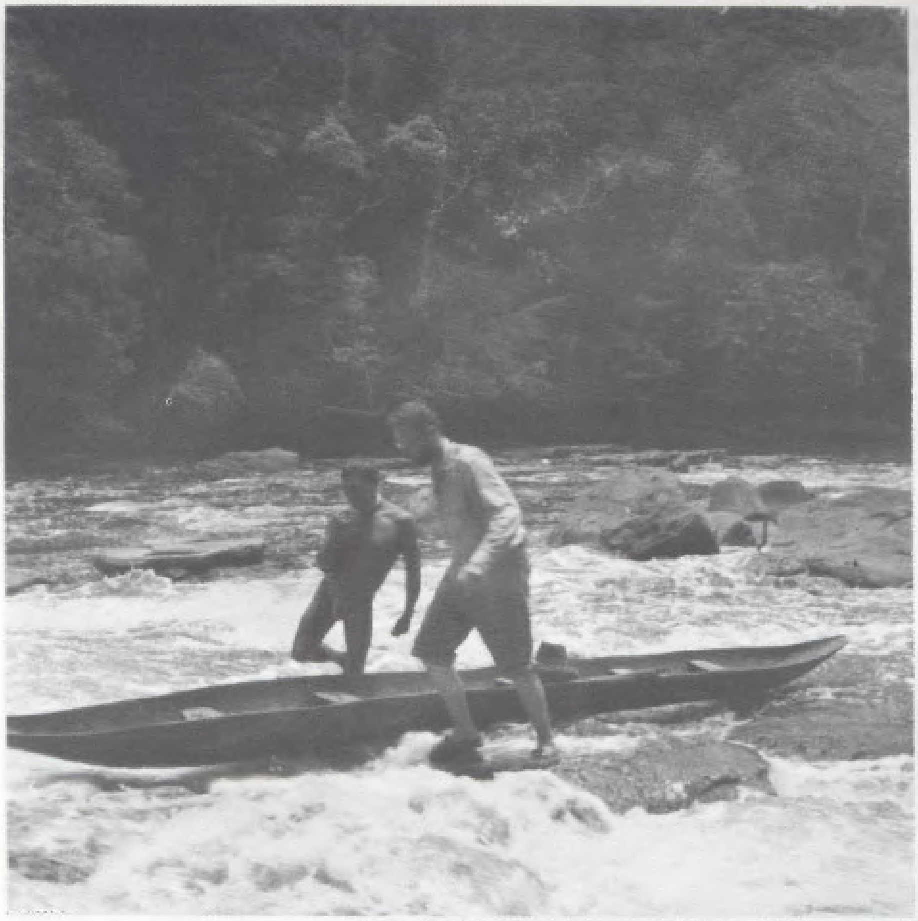
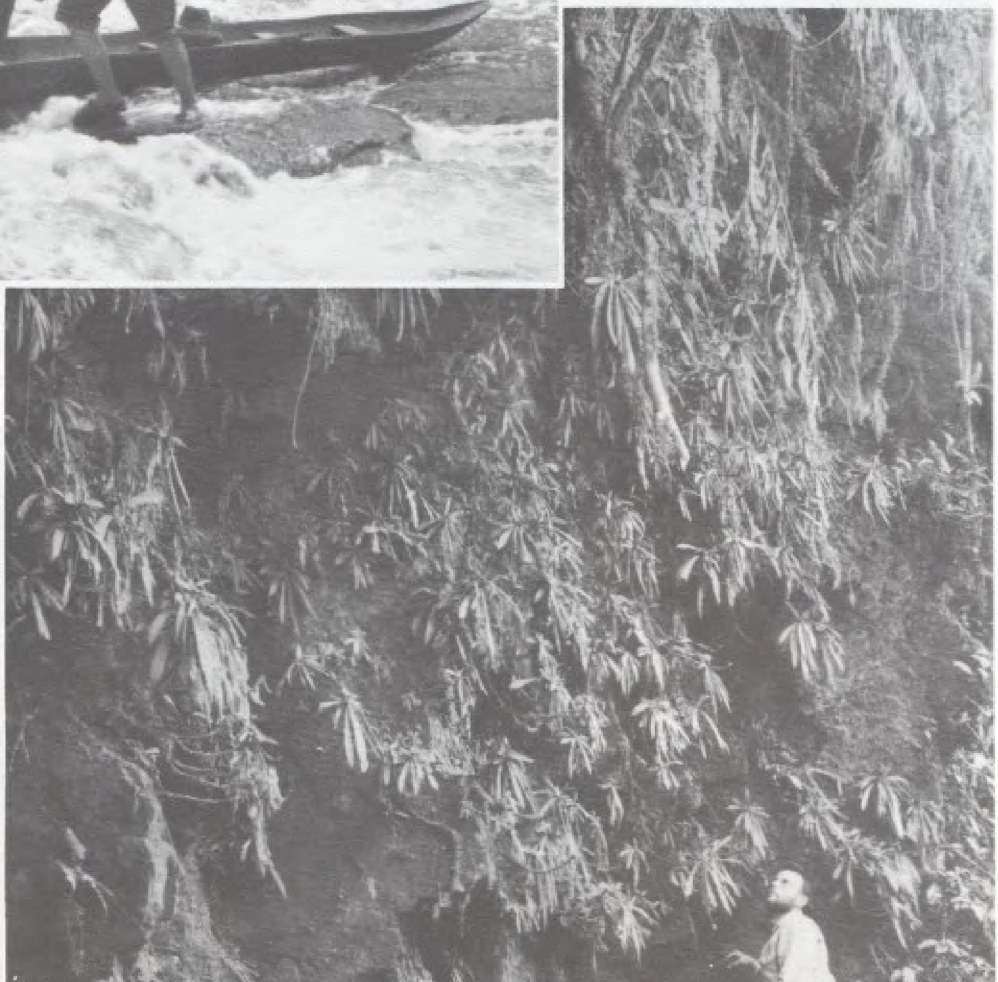
EN LA AMAZONIA Y EN EL VALLE DE SIBUNDOY, PUTUMAYO (1951 - 1953).



Haciendo notas de las colecciones de plantas con su asistente, Isidoro Cabrera.

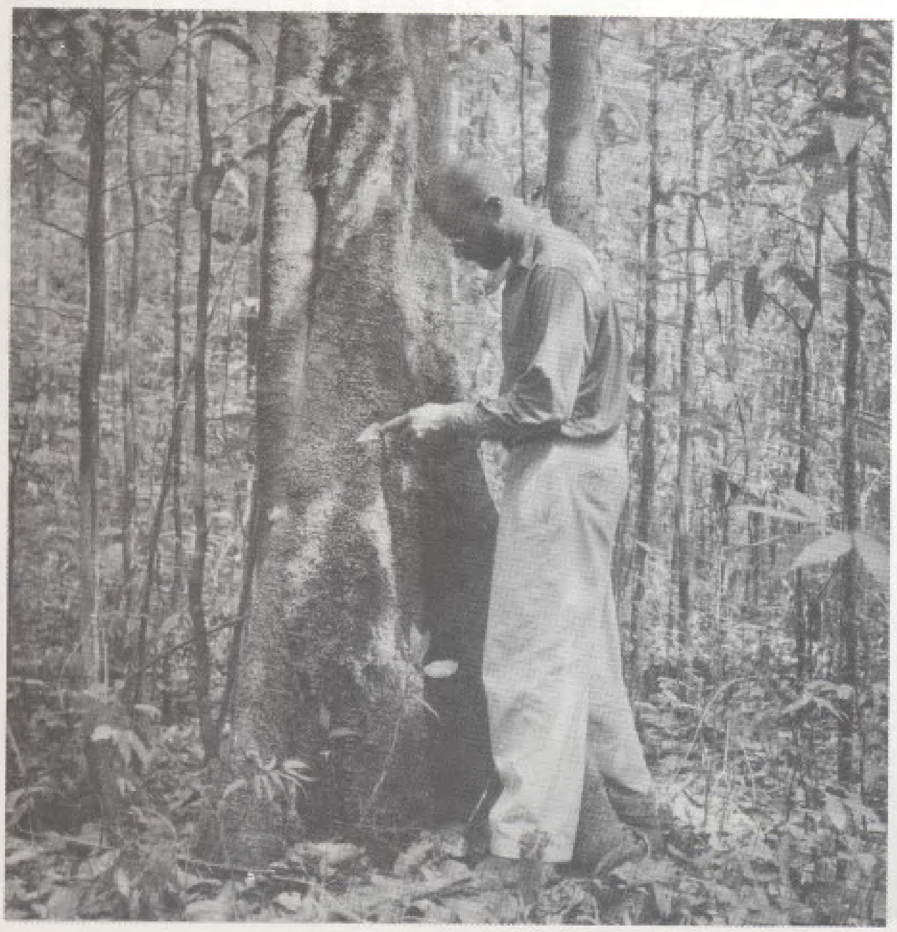


El profesor R. E. Schultes subiendo por el río Papurí, Vaupés.



Coleccionando material del género nuevo *Resia* en la Sierra de la Macarena.

Estudiando la especie muy rara *Hevea rigidifolia,* cerca a Javareté, Vaupés.



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Con un grupo de Waikas en el río Tototobí, territorio de Roraima, Brasil.

R. E. Schultes en estudios sobre plantas psicotrópicas en Sibundoy, Putumayo, con el brujo Chindoy.

SCHULTES ECOLOGO Y ETNOBOTANICO

Por *Plutarco Naranjo**

LA AMAZONIA Y SCHULTES

De la Amazonia sabemos algo e ignoramos mucho. ¿Quién es Richard Evans Schultes? En el mundo de las ciencias su nombre es tan conocido casi como el de Linneo o el de Darwin. Actualmente es profesor emérito de la universidad de Harvard y por muchos años ha sido director del Museo Botánico de la misma universidad.

Cuando joven egresado ganó una beca para preparar una tesis doctoral sobre el veneno de las flechas utilizadas por los aborígenes de la hoya amazónica. Vino en 1943; entró en las selvas amazónicas con el proyecto de investigar las plantas venenosas durante un año ¡y se quedó 13! Se enamoró del bosque tropical y de sus habitantes y se convirtió en uno de los etnobotánicos y ecólogos más famosos del mundo. Cuando regresó a Harvard llevó consigo no sólo el curare, el veneno de las flechas, sino más de 25.000 especímenes de la flora amazónica, la mayor parte de la cual resultó desconocida para la ciencia; llevó sobre todo un vasto e inigualable conocimiento sobre el bosque tropical y sus criaturas vivientes, incluidas las numerosas tribus con las que convivió durante tantos años. Sufrió las enfermedades y más penalidades propias de un extranjero que entra en ese gigantesco y desconocido mundo de la selva y gozó con cada descubrimiento, con cada nueva especie vegetal.

Richard Evans Schultes fue quizás el primero en llamar la atención pública sobre la urgente necesidad de preservar las selvas amazónicas, en razón de que es el más grande ecosistema que contribuye a mantener la vida sobre la superficie terrestre. Bastaría mencionar el hecho de que las selvas amazónicas producen diariamente millones de toneladas de oxígeno que es indispensable para la vida humana y de muchos otros seres vivientes. El equilibrio climático, el equilibrio de las lluvias, depende, asimismo, de la subsistencia de ese gigantesco mundo vegetal.

El bosque amazónico, además, es uno de los ecosistemas más ricos en especies tanto vegetales como animales. El propio botánico Schultes calcula que en las selvas amazónicas hay por lo menos 80.000 especies diferentes de plantas superiores. El estado de Nueva Inglaterra, del cual es originario el científico, apenas tiene 1.900 especies, dato que, por comparación, permite reconocer la riqueza vegetal de la Amazonia. Pero en estos últimos años, varios miles de aquellas plantas han desaparecido ya, en forma definitiva, gracias a la obra depredadora del hombre. La tala del bosque tropical, a un ritmo de miles de hectáreas por año, constituye uno de los más grandes riesgos ecológicos del siglo.

Entre las 25.000 especies recolectadas por Schultes figuran más de 2.000 plantas utilizadas por los aborígenes como alimenticias, medicinales, sicotrópicas y venenosas. El conocimiento empírico de los aborígenes, acumulado a lo largo de varios miles de años, está en esas 2.000 plantas, de las cuales muy pocas hasta hoy han podido ser estudiadas científicamente. A la velocidad de la destrucción de la selva es posible que cuando algunas de tales plantas merezcan ser estudiadas química, farmacológica y clínicamente, hayan desaparecido para siempre.

La mayor parte del trabajo de Schultes se llevó a cabo en la Amazonia colombiana; pero el científico norteamericano ha recorrido todos los países amazónicos y periódicamente ha regresado a la selva, a continuar o completar muchos otros trabajos. Ha efectuado varios recorridos prospectivos por Venezuela, Brasil, Ecuador y Perú.

El profesor Schultes ha asesorado en varias oportunidades al gobierno de Colombia y bajo su iniciativa el gobierno ha reservado extensas áreas de más de 10 millones de hectáreas cuadradas, en su Amazonia, para preservarla como bosque primario y evitar así su destrucción. Parte de este parque

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ecológico lleva el nombre del doctor Schultes. Asimismo el gobierno de Colombia le honró, hace pocos años, con la más alta condecoración que concede ese país, la Gran Cruz de Boyacá.

EL PREMIO TYLER

Hace algunos meses Schultes recibió un nuevo galardón, el premio Tyler, que es el más importante que la institución respectiva otorga a los científicos que han realizado obras de especial mérito y trascendencia en el campo de la preservación del medio ambiente.

El premio Tyler fue fundado en 1973. A pedido de instituciones científicas de cualquier parte del mundo es otorgado a conservacionistas de elevados méritos. El del año 1987 consistió en 150.000 dólares y medalla de oro. Fue compartido entre Schultes y Gilbert White, éste último uno de los pioneros en la lucha contra la destrucción ecológica del mundo que se produciría por una posible contienda nuclear.

LA ETNOBOTANICA

La etnobotánica es una ciencia relativamente nueva. No figura en el diccionario de la Real Academia Española. Uno de los fundadores de la nueva disciplina es, precisamente, Richard Evans Schultes.

Ha sido preciso que la arqueología se haya desarrollado tanto, como ha sucedido en los últimos 50 años; que se hayan excavado restos vegetales o piezas cerámicas o de otros materiales relacionados con el uso de plantas útiles y ha sido también indispensable que la investigación antropológica haya abarcado la mayor parte del mundo y se haya estudiado con gran profundidad la evolución de los pueblos, para que sobre esas bases haya surgido la etnobotánica.

Cada planta alimenticia, cada especie medicinal, cada droga vegetal, en fin, cada planta útil tiene una historia que, en muchos casos, se remonta a miles de años.

Numerosas plantas han viajado con el hombre o a pesar de él por varios continentes y se han convertido en base de la vida humana. Algunas son originarias de América, como el maíz, la papa, el tomate, el ají, el maní, el cacao, el tabaco, la quina o cascarilla, el curare; otras son originarias del Asia, como el arroz, la soya, el té; otras del Cercano Oriente o Europa, como el trigo, la cebada, la arveja; mientras otras lo son del Africa, como el café y el banano.

Los distintos pueblos del mundo han domesticado, cultivado y convivido con muchas plantas. Plantas y hombre forman una sola unidad ecológica.

Gracias a Schultes sabemos hoy muchos aspectos de esa historia, de ese equilibrio biodinámico entre hombre, planta y animal y gracias a su convivencia con grupos étnicos en estado de primitividad sabemos también qué valor, qué utilidad, qué significado práctico o ceremonial tuvieron o tienen las plantas en esos grupos étnicos.

Aunque no hay área de la botánica y la etnobotánica por la cual no haya deambulado Schultes, su campo favorito de estudio ha sido el de las plantas psicoactivas o psicotrópicas, en el cual, sin hipérbole, el profesor bostoniano es la mayor autoridad en el mundo.

Según demuestra la arqueología entre las plantas que muy tempranamente utilizó el hombre, a más de las alimenticias, se encuentran las psicoactivas, en especial aquellas que provocan estados de trance y a mayor dosis, estados alucinógenos, delusivos y finalmente alucinaciones.

En torno a estas plantas surgieron incontables mitos. Alcanzaron el valor de plantas sagradas, y su uso, por lo mismo, se restringió a ciertos ritos y ceremonias, al igual que a ciertas curaciones "mágicas", que fue una forma inicial de psicoterapia.

En las últimas décadas surgió un interés inusitado por las plantas psiquedélicas. Se las ha encontrado en todo el mundo. Suman centenares. De muchas de ellas hay una historia de hasta 10.000 años. Algunas plantas tienen varias sinonimias. A lo largo de los años se las ha ubicado en distintos géneros y hasta en diferentes familias, finalmente vino Schultes y puso orden en este caos. El ha determinado, con precisión, la correcta ubicación taxonómica de centenares de plantas; en pos de algunas de ellas, el científico ha recorrido miles de kilómetros y todos los continentes. Ha querido encontrarlas en su propio hábitat y estudiarlas desde su origen, pasando por los usos actuales de los pueblos para luego proyectar el conocimiento hacia épocas pasadas.

Su genio científico, su capacidad y disciplina de trabajo y su inagotable energía física han permitido que Schultes haya dado forma y contenido a la nueva ciencia, la etnobotánica.

Su producción bibliográfica es asombrosa. Más de 400 publicaciones de trabajos originales y alrededor de una docena de libros, varios de los cuales, a pesar de su contenido estrictamente científico, se han convertido en verdaderos best-sellers.

Schultes, con todo merecimiento, figura ya entre los más grandes científicos del mundo y, en el campo de la botánica y la etnobotánica, entre las mayores autoridades de todos los tiempos.

EL USO POPULAR DE PLANTAS A LA LUZ DE LOS DOCUMENTOS DE LA EXPEDICION BOTANICA

Por *Santiago Díaz - Piedrahíta**

En el Real Jardín Botánico de Madrid (MA), se conservan numerosos documentos relativos tanto a la actividad de Don JOSE CELESTINO MUTIS (1732-1808), como a las labores de la Real Expedición Botánica del Nuevo Reino de Granada (1783-1816). Estos archivos contienen escritos diversos, cartas, notas de viaje, observaciones, apuntes, diagnosis de plantas, descripciones preliminares y definitivas de algunas especies, dibujos anatómicos, esquemas en borrador y láminas ilustrativas de diversas plantas. En muchos de estos documentos se encuentran interesantes anotaciones sobre la utilización de especies vegetales. En este trabajo se presentan algunas referencias relativas al uso popular de unas cuantas especies, la mayoría de ellas pertenecientes a la familia de las Compuestas o Asteráceas.

La mayor parte de la información que se transcribe a continuación está contenida en varios paquetes distinguidos con el número trece (legajos 13(1) y 13(2)) y que figuran bajo el título de "Singenesia" en alusión a la presencia de anteras singenésicas, propias de las campanulales, aclarando que MUTIS distinguía a las compuestas con el nombre de "singenesistas o florones".

MUTIS arribó al Virreinato de la Nueva Granada en 1760; no obstante, la primera alusión a las compuestas como grupo, aparece en los diarios de observaciones el 19 de noviembre de 1766 cuando residía en las Minas del Real del Sapo en la Provincia de Mariquita. A partir de ese momento se da inicio al uso de una terminología muy particular que se empleará para referirse a las compuestas hasta el final de la Expedición. Debe tenerse en cuenta el hecho de que muchas plantas fueron descritas varias veces en distintas épocas y bajo diferentes fitónimos. La mayoría de nombres vulgares han perdido vigencia al igual que los usos registrados hace cerca de doscientos años.

Antes de reseñar los diferentes usos, vale la pena destacar cómo para cada descripción se señalan las características propias de la raíz, el tronco, la ramificación, las hojas, las "orejas" o estípulas, la pubescencia, las "hojas florales" o brácteas del eje de la inflorescencia, los "cabos y cabillos" o pedúnculos y pedicelos, las "chapas" o Brácteas florales, las "chapetas" o bractéolas, el "Cáliz" o involucro, las "rosetas" o capítulos, los estambres, el pistilo, el pericarpio, la semilla, el receptáculo, las condiciones del suelo donde se propagaba la especie, observaciones sobre otras características tales como olores, presencia de látex, etc. y finalmente las "calidades". Es en este último punto, donde se registran los usos.

Hemos podido determinar un buen número de descripciones; de algunas de ellas se ha extraído la parte pertinente para esta presentación.

ESPECIES UTILES EMPLEADAS A FINALES DEL SIGLO XVIII Y COMIENZOS DEL XIX.

1. *Bidens rubifolia* H.B.K. (Santa Fé, mayo 4 de 1792) N.V. "Pacunga".

   "Las flores majadas y puestas a hervir dan tinte amarillo que se emplea en las lanas".

2. *Tagetes subulata* Cerv. (Santa Fé, abril 26 de 1792) N.V. "Asnayuyo"

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"La usan vulgarmente como condimento de las papillas que hacen del maiz a que llaman masamorra".

3. *Spilanthes americana* Mutis ex L.f. (Santa Fé, noviembre 5 de 1791)

N.V. "Chisacá"

"Toda la planta es picante y acre al gusto poi lo que la aplican vulgarmente para mundificar, deterger, y consolidar las encías quando por infección escorbútica, o por otra causa se forman escoriaciones en ellas. El modo de usarla es traerla a la boca mascándola continuamente hasta destruir el daño = Tienese igualmente como remedio certísimo contra los dolores de estómago, quando provienen de un humor acre q[e] lanza y punza en alguno de los intestinos como en la disentería y tenesmos; y entonces llama el vulgo curar el vicho".

4. *Bidens laevis* (L.) B.S.P. (Santa Fé, noviembre 2 de 1791)

N.V. "Guaca negra"

"Aplican vulgarmente esta planta contra el dolor de costado dando a beber el zumo de ella clarificado. Aseguran ser específico quando lo toma el enfermo en los primeros días del insulto, o antes de que se forme vomica".

N.V. "Guaca de laguna" (diagnosis)

"Los indios la nombran Guaca de laguna. La usan en sus alimentos".

5. *Galinsoga quadriradiata* R. & P. (Santa Fé, octubre 29 de 1791)

N.V. "Guasca"

"Usa la gente pobre de las hojas de esta planta en sus comidas en lugar de especia".

6. *Smallanthus pyramidalis* (Triana) H. Rob. (Santa Fé, octubre 19 de 1791)

N.V. "Arboloco"

"Los curiosos haciendo algunas incisiones en el tronco de este árbol, logran de una goma muy transparente, la qual entra en la composición de algunos barnizes".

7. *Baccharis tricuneata* (L.f.) Pers. (Santa Fé, febrero 28 de 1791)

N.V. "Sanalotodo"

"El vulgo hace uso de esta yerva en muchas enfermedades las que se apuntarán luego que se tenga una relación fundada en algunas experiencias = Su mucho amargor denota ser vermífuga".

8. *Siegesbeckia jorullensis* H.B.K. (Santa Fé, noviembre 30 de 1791)

N.V. "Trompetilla"

"Atribuye el vulgo a esta planta singular virtud contra el dolor de costado, pero no siempre se experimentan los felices efectos que de ella se prometen, lo que sin duda proviene de que las personas poco instruidas no pudiendo distinguir los diversos períodos de esta enfermedad, la aplican indistintamente en todos tiempos y contra todas las especies de dolor de costado = Parece que la indicación principal de aplicar esta planta, se halla en lo que se llama pleuresia falsa, o vulgarmente dolor ventoso.
El modo con que aplican este remedio, es dando á beber al enfermo el zumo de toda la planta clarificado; y poniendo sobre la parte afecta su orújo lo más caliente que pueda tolerar el pasiente".

9. *Bidens rubifolia* H.B.K. (Santa Fé, noviembre 19 de 1791)

N.V. "Chipaca"

"Usa el vulgo de ella para los mismos efectos que quedan apuntados en la espcie antecedente (N. . . . . .)* - *Sigesbeckia jorullensis* N. del A. - La Experiencia demostrará a qual de sus especies se debe dar preferencia".

10 *Smallanthus cf. sonchifolius* (Poepp. & Endl.) H. Rob. (Santa Fé, noviembre 6 de 1791)

N.V. "Giquimilla"

"Su raíz es un específico diluyente y enmenagoga".

11. *Bidens cf. pilosa L.* (Santa Fé, noviembre 12 de 1791)

N.V. "Chipáca"

"Atribuye el vulgo á esta planta propiedades dignas de mayor elogio, afianzando en ella la curación de muchas enfermedades, principalmente de las agudas. Ynstimulado con las aclaraciones, q[e] de esta planta se hacen, no he despreciado ocasión, que se me haya presentado, en la qual pudiese confirmar con propia experiencia estas noticias; y en efecto: ella facilita la circulación de la sangre, atenuándola, y haciendo arrojar por la cámara alguna porción de ella ya corrompida; por lo que se puede tener como depurante, enmenagoga, y útil en todas aquellas enfermedades que provienen del lentor o espesura de la sangre, como la hepatitide, ó inflamación del hígado".

12. *Bidens pilosa* L. (Santa Fé, diciembre 10 de 1791)

N.V. "Chipaca"

"De esta especie usan las gentes de esta ciudad para los mismos fines que aplican las otras dos descriptas en el N...... y ...."* - Posiblemente *Bidens* cf. pilosa y *Bidens rubifolia* (N. de A.) -

* Sin números en los documentos originales.

13. *Stevia lucida* Lag. (Santa Fé, febrero 23 1791)

N.V. "Xarilla"

"Elogia el vulgo esta planta como singular remedio contra las luxaciones, dislocaciones. Vg. El modo conque la aplican es: rescoldadas sus hojas y puestas en la parte afecta".

14. *Gamochaeta purpurea* (L.) Cabrera (Santa Fé, febrero 3 de 1792)

N.V. "Lechuguilla"

"Hace el vulgo uso de esta planta, aplicando las hojas sobre las heridas, y otras lastimaduras externas; y en caso de que se haya formado pus, aseguran lo extrae, y mundificando la parte conduce á la perfecta curación = Lavan la parte, antes de aplicar las hojas, con el cocimiento de toda la yerva".

15. Compositae indet, Posiblemente *Eupatorium origanoides*

N.V. "Manzanilla del monte" (Santa Fé, febrero 15 de 1792)

"Los alfareros la usan para cocer la texa, y además material; y este es el único uso que tiene; pero para este la prefieren á las demas yervas, como singular".

16. *Noticastrum marginatum* (H.B.K.) Cuatr. (Santa Fé, febrero 10 de 1792)

N.V. "Tabera"

"Aplica el vulgo esta planta, atribuyéndola la qualidad fresca, contra las fiebres agudas y en los resfriados como suave diaforetico = Yo la he visto producir feliz efecto en un dolor de estómago procedido de humór colerico alli estagnado, tomando la paciente (ya como desesperada) una cantidad regular del cocimiento de toda la yerva, arroxó un humor verdoso, con lo que quedó perfectamente buena".

17. *Espeletia grandiflora* H. & B. (Santa Fé, febrero 15 de 1763)

N.V. "Frailejon mayor"

"Como sean tantas las celebradas virtudes de la liria del Frailejón no creo sea este el único lugar de mi diario en que se hable de dicha liria. Oí decir que era eficacísima para los dolores de hijada en las mujeres, pero aplicándola de suerte que si el dolor está en lado derecho, la liria deberá ponerse en la rodilla izquierda, y en la derecha cuando el dolor ocupa el lado izquierdo. Esta medicina y su aplicación no merece más recomendación que todas las antecedentes.

18. *Porophyllum ruderale* (Jacq.) Cass.

N.V. "Yerva del gallizago" (Icón 1092, colección iconográfica)

"Herva de gallizado por lo edionda. Contra tuco tuco esperimentada por D^{n}. Jorge Lozano. Matis".

19. *Mikania guaco* H. & B.

N.V. "Guaco" (Icón 987; Icón 987d colección iconográfica)

"Obra contra las culebras"
"Contra veneno de culebra"

20 *Gnaphalium pellitum* H.B.K.

N.V. "Benadillo" (Icón 1110, colección iconográfica)

"Esta especie da un aceite para pintar"

21. *Durante mutisii* L.f.

N.V. "Espino" (Santa Fé, Mayo 10 de 1791)

"Por ser muy espinosa, la emplean los labradores para formar cercas, con las que resguardan sus sembrados".

22. *Citharexylum Karstenii* Mold.

N.V. "Agrasejo" (Anatomia M 334)

"Agrasejo de Chioachi sirbe para alimentos de gallinas a falta de mais".
- esta nota está en caligrafía de Francisco Javier Matis (N. de A.). -

23. *Calophyllum mariae* Pl. & Triana

M.V. "Aceite de Maria" (Mariquita)

"Algunas personas lo usan para curar heridas aplicándolo caliente en hilas. Lo extienden en parches para aplicar a las sienes, a la nuca y algunas otras partes del cuerpo, para sacar el que llaman frio.
Tambien se aplica para las mujeres que padecen mal de madre, puesto sobre el ombligo".

24. *Sapium* sp.

N.V. "Cativo de Mangle" (Prov. de Mompos)
Nota de Juan de Casamayor

"Sus virtudes para curar lepra de todo el cuerpo y llagas envegecidas, siempre proferidas en general, la apoyan en la tradición de la historia de un esclavo abandonado al campo y curado milagrosamente con esta resina".

25. *Amarilidácea indeterminada*

Al margen del esquema anatómico marcado actualmente con el número M 512 se halla esta nota escrita aparentemente por FRANCISCO JAVIER MATIS y de evidente utilidad para los diferentes pintores de la iconografía mutisiana:

"Pancracio o esterillo Luguma. La compañera de 6 estambres sirve para teñir de musgo la fruta sobre la tintura de M1.t.m.".

26. *Especie indeterminada*

En la anatomía distinguida actualmente con el número M 316 se encuentra la siguiente leyenda aparentemente escrita por MATIS:

"2 Morcatico amarillo del que dicen da tintura amarilla de las ojas para teñir balletas. Una especie de este género en Pauna cosinan la cortesa y hacen buena tinta".

27. *Especie indeterminada*

Con letra de MATIS también encontramos esta nota al respaldo de otro esquema anatómico:

"Zapote de monte o corrocloco. Disen es de buen gusto la fruta para comerla".

Debe señalarse que los datos presentados constituyen tan sólo una muestra de los usos populares de plantas durante la época en que se desarrolló la Expedición. Falta indagar más en los archivos donde se conserva abundante información. Tan sólo deseo destacar cómo MUTIS tuvo un especial interés por las plantas útiles. Muestra de ello son sus escritos sobre el "Almendrón" *Caryocar amygdaliferum*, el "Té de Bogotá" *Symplocos theiformis*, las quinas *Cinchona* spp., el "Aceite de Canime" *Copaifera* sp. y el "Bálsamo Rubio" *Myroxylon toluiferum*.

LA BOTANICA ECONOMICA: UNA DISCIPLINA NECESARIA PARA EL DESARROLLO

Por *Alvaro Fernández Pérez*[1]

La Botánica Económica, como curso universitario, actualiza los conocimientos sobre la historia, el uso, abuso y comercio de las plantas. No solamente toma en cuenta las plantas utilizadas por determinados grupos étnicos de un país, sino también aquellas sin historia y que constituyen la gran mayoría. Y su meta principal es la búsqueda de nuevas especies vegetales y la mejor utilización de las subutilizadas.

Tratándose aquí de un escrito preparado especialmente para la revista de la Academia Colombiana de Ciencias, que con este número rinde homenaje al doctor Richard Evans Schultes, he considerado oportuno destacar el mérito del homenajeado como el iniciador del primer curso de Botánica Económica que se dictó en Colombia en el año de 1963, con un programa acorde con las conveniencias del país. Al final de este artículo se transcribe el programa del curso, el cual tuvo una asistencia de 140 estudiantes, varios de ellos provenientes de países aledaños a Colombia. Un segundo curso se dictará a finales del presente año, en la Fundación Universitaria de Popayán.

Todo curso o disciplina se apoya en otras: es íntima y necesaria la relación de la botánica económica con la taxonomía vegetal que ordena las especies por sus nombres científicos universales, y nos permite utilizar un lenguaje único para el entendimiento de todas las personas que se ocupan de la botánica, fitoquímica, farmacia, medicina, ecología, biología, veterinaria, ingeniería forestal, agronomía y administración agropecuaria. Estas y otras áreas "no podrían progresar sin la información básica que se encuentra en los herbarios", G. Prance, 1986.

Las plantas medicinales constituyen un capítulo muy especial del curso. Se inicia con la historia de numerosas plantas usadas 5000 ó más años antes de Cristo; se repasan las obras de Aristóteles, Hipócrates, Teofrasto, Dioscórides, etc., hasta llegar a las civilizaciones contemporáneas que aún utilizan esas plantas milenarias. Naturalmente que no se detalla como en un curso de Farmacognosia o de Farmacología, pero se actualizan los conocimientos y se comparan los usos dados a numerosas drogas vegetales como la mariguana, opio, coca, borracheros que hoy son problema para el mundo, posiblemente por deficiencia en el conocimiento sobre su uso y abuso.

Como falsos profetas quedaron quienes por la década de los años cincuenta puntualizaban que las drogas vegetales quedarían con simple valor histórico al ser sustituidas por los productos de la síntesis orgánica. De una publicación del Foro de Comercio Internacional de Plantas (L. Burbage & J. Wells, 1983) tomamos lo siguiente: El comercio mundial de plantas medicinales pasó de 355 millones de dólares en 1976 a más de 550 millones en 1980 y se prevé que va a mantenerse tal tendencia, a pesar de los sucedáneos sintéticos de algunas plantas. Y los países en desarrollo tienen las mayores posibilidades de intensificar sus exportaciones gracias a las siguientes condiciones favorables: diversidad de climas, superficie cultivable y disponibilidad de mano de obra agrícola más barata. Y deben proceder a una cuidadosa labor de estudio de los mercados para determinar los sectores viables para una mayor comercialización. Será también indispensable suministrar productos de gran calidad que satisfagan las exigencias de los usuarios especializados.

1. **Fundación Universitaria de Popayán - Apartado Aéreo 742. Popayán, Colombia.**

Teniendo en cuenta la anterior información, dirijo principalmente a Colombia y a los países aledaños la siguiente lista de plantas medicinales con sus respectivos precios comerciales según un catálogo de 1985. Pues considero poco o casi nulo, el conocimiento en nuestros medios sobre el comercio de numerosas plantas, muchas de ellas nativas y silvestres. En parte se debe a que los catálogos registran sus requerimientos por los nombres científicos de las plantas, lo cual es razonable por cuanto los nombres vulgares son diferentes en cada país, inclusive en diversas regiones del mismo.

El catálogo, procedente de Hamburgo, registra en sus listas de compra 1995 productos del reino vegetal, siendo numerosos los que se encuentran en los países neotropicales. Los nombres del catálogo son los usados en Farmacopeas, libros de Farmacognosia, o nombres científicos dados correctamente. A continuación relacionamos unas que se encuentran en Colombia y que tienen nombres vulgares relativamente constantes en diversas regiones. El precio de compra es por kilo de peso, valor que damos en pesos colombianos estimando que $160,00 equivalen a un marco. El catálogo no da precios para todas las ofertas de compra, y son muchos los casos en que éste debe concretarse previamente. Al final de la lista con precios damos los nombres de las plantas sin precios establecidos.

Vanillae (Vainilla, frutos) $44.000,oo

Es una orquídea que trepa como bejuco en árboles. En Colombia hay ocho especies distribuidas en los pisos térmicos cálido y templado. Es decir de nivel del mar hasta 2000 m de altura. Las especies más aromáticas las encontré en la región de Quilcacé, municipio de Timbío en el departamento del Cauca, también entre cafetales cerca a Armenia. Es un cultivo muy recomendable para alternar en regiones cafeteras. Información sobre especies colombianas suministré en el tomo VII (Primero de Orquídeas) de la Flora de la Real Expedición Botánica del Nuevo Reino de Granada, 1964. En el mismo libro hay un dibujo

Cascarillae (corteza de quina seca) $6.920,oo

Durante la Primera Guerra Mundial la corteza de quina constituyó una importante fuente de divisas para Colombia; hoy, que su precio es elevado, no tenemos suficiente cantidad de árboles para hacer una mediana oferta. Y lo más lamentable es que los árboles de quina, que aún subsisten entre la vegetación nativa, son indiscriminadas víctimas de las empresas que requieren pulpa para cartones y papeles.

Ananas comosus (piña, frutos desecados) $1.400,oo

La piña se cultiva extensamente en Colombia. Sus precios fluctúan mucho, y su demanda depende de si es o no dulce. Esta firma no discrimina calidad por cuanto la utiliza para preparados farmacéuticos, o derivados como la bromelina.

Caricae papaya (papaya, hojas cortadas en porciones pequeñas) $776,oo

Caricae papaya (frutos, cortados y secos) $1.360,oo

La industria farmacéutica utiliza las hojas y frutos de papaya para la elaboración de papaína, que tiene entre otros usos el de ablandar carnes.

Caryophylli (claveles, flores enteras) $2.064,oo

Caryophylli (claveles, flores cortadas) $2.384,oo

Los departamentos de Cundinamarca, Cauca, principalmente, han desarrollado importantes industrias florísticas de claveles. Muchas veces las flores son rechazadas por ligeros desperfectos como caída de pétalos o pequeñas manchas. Este material puede ofrecerse a la industria farmacéutica.

Chamomillae o *Matricariae* (flores de manzanilla) $5.600,oo

Aunque la manzanilla no se cultiva en forma comercial, solamente se encuentra en algunos mercados; el precio ofrecido induce a cultivarla en forma extensa. Las mejores calidades provienen de los pisos térmicos fríos y templados.

Chrysanthemi parteni (flores de crisantemo) $1.920,oo

Los crisantemos que se cultivan en Colombia no están bien estudiados desde el punto de vista taxonómico pero es posible que haya interés para comprar flores, si se envían las muestras.

Cucurbitae cum testa (semillas de zapallo) $400,oo

En algunos lugares de Colombia se comen las semillas de zapallo después de tostar. Si se les quita la cutícula que cubre la semilla, el precio por kilo es de $1.840,oo.

Digitalis purpureae (digital, hojas) $816,00

La digital llegó a Colombia, posiblemente por medio de semillas mezcladas con trigo o cebada importada. Hoy se ha expandido por todos los pisos térmicos fríos del país. Es una planta invasora en Colombia y que constituye peste o plaga en algunos cultivos. Parece que algunos ensayos del pasado indicaron que era muy bajo el contenido de digitalina, en el material colombiano. Se pueden enviar materiales para que se verifique su contenido de digitalina. Es posible que requiera días largos como los de verano en Europa y Norteamérica pero el problema se obvia mediante el uso de luz artificial. Las semillas de digital tienen un precio de $2.880,oo.

Eichorniae (lirio de agua o buchón) $2.880,oo

En los herbarios colombianos se registran las especies *Eichhornia azurea* y *E. crassipes.* Ambas son abundantes principalmente en lagunas con aguas estancadas. Como su base es bulbosa y las hojas relativamente grandes, hay suficiente material para ofrecerlo. Su distribución es muy amplia en

Colombia, más abundante y exuberante en el piso térmico cálido. Es frecuente en pequeñas lagunas del Valle del Patía. A veces la planta cubre toda la laguna constituyéndose en plaga. Existen trabajos sobre los usos de estas plantas en la purificación de aguas negras o estancadas.

Eucalypti globuli (eucalipto, hojas) $280,oo

A Colombia se han introducido diversidad de especies de eucaliptos pero no existe un trabajo taxonómico que indique cuáles son las más abundantes en determinadas regiones. El mismo catálogo ofrece un precio de compra de $528,oo el kilo de hojas molidas.

Euphorbiae (Lecheros herbáceos, toda la planta) $464,oo

En Colombia hay numerosas especies del género Euphorbia, muchas de ellas son llamadas "malezas".

Fragariae vescae (Fresa, toda la planta) $752,oo

La raíz sola tiene un precio de $832,oo

Gaultheria procumbentis (hojas) $4.480,oo

Se trata de una especie de la familia *Ericaceae* con numerosos géneros y especies en Colombia. No estoy seguro si existe la especie *procumbens,* pero sí el género *Gaultheria.*

Mentha piperitae (Menta, hojas) $3.120,oo

Parece que en Colombia se han introducido varias especies de mentas. La piperita es la de hoja glabra y lisa y la *M. crispa* de hoja rugosa y pubescente, esta última tiene un precio inferior.

Ruta graveolens (Ruda, toda la planta cortada en trozos) $896,oo

La ruda se encuentra cultivada y semisilvestre en Colombia, y se le dan varios usos medicinales, también como abortiva.

Stevia rebaudiana (Hojas secas) $1.680,oo

Las hojas de esta planta se están usando mucho para obtener una sustancia edulcorante que comienza a sustituir con ventajas al azúcar de caña. Es herbácea hasta 1.50 m. de alto, con hojas abundantes similares a las de la coca. En Popayán (1700 m. de altura) se está desarrollando muy bien a partir de semillas traídas de Uruguay.

Thevetia neriifolia (Semillas, Cabalonga, Cojón de mico) $784,oo

Frecuente en Colombia en parques y avenidas. Los frutos son venenosos.

Tropaeoli **(Cachaco de muladar, toda la planta) $1.040,oo**

Urticae (Ortiga, hojas molidas) $416,oo

En Colombia hay varias especies de ortiga, algunas se encuentran formando colonias grandes o matorrales.

Vinca (Catharanthus) roseus (Cortejo, hojas) $520,oo

Es una planta herbácea frecuente en jardines de todo el país. De sus ramas con hojas se extraen las drogas oncolíticas (anticáncer) patentadas con los nombres de Viblastin, Leucoviblastin y Oncovin. Es más frecuente en los pisos térmicos cálido y templado.

A continuación damos los nombres de las plantas o productos de ellas cuyos precios deben acordarse previamente: Allii sativi (bulbos de cebolla); Apii graveolentis (apio, toda la planta); Banistariae (Yajé, corteza); Cannabis (Mariguana, frutos); Cardamomi (Cardamomo. Se comienza a cultivar con éxito en Colombia, sus semillas tienen un precio alto en el comercio mundial); Chenopodii ambrosioides (Quenopodio, toda la planta); Cocae (Coca, hojas, abundantísima en Colombia); Crotalaria (Cascabelitos, frutos); Daturae Sanguineae (Borrachero de flor roja, hojas y tallos); Drymis winteri (Canelo de páramo, corteza); Eriobotryae japonicae (níspero del Japón, hojas. Bastante cultivado en Colombia); Erythrinae (Sachapuruto o Sachafruto, corteza); Hevea brasiliensis (Caucho, semillas); Ipecacuanhae (raicilla o Raíz de ipeca); Luffa operculata (Estropajo pequeño y redondo); Mimosae pudicae (Dormidera, hojas y ramillas); Pata de vacca (Pata de vaca, hojas. Son especies del género *Bauhinia,* hojas y raíces); Perseae americanae (aguacate, tanto pulpa como semillas desecadas); Phyllanthi niruri (Tripa de pollo, toda la planta. Es una hierba rastrera con abundante látex blanco); Rauwolfia canescens y R. tetraphylla (Piñique-piñique o venenito, raíces. Son fuente de obtención del alcaloide reserpina, una de las mejores drogas hipotensoras. Las especies son frecuentes en el departamento del Magdalena, regiones aledañas a Santa Marta. Véase Fernández-Pérez en revista Universidad Nacional de Colombia No. 25); Rhizophorae (Mangle,corteza); Ryaniae speciosae (Curare y barbasco, hojas y leño). Son varias las especies colombianas del género *Ryania.* Contienen un alcaloide muy venenoso para animales de sangre fría o caliente. Es fuente de insecticidas. Véase H. Sleumer, Flora Neotropica, Monogr. No. 22 de 1980); Tecoma stans (Floramarillo, hojas. Es un arbusto o hasta pequeño árbol de 5 metros, muy abundante en los alrededores de la ciudad de Popayán); Viciae fabae (Habas, semillas. Se cultiva mucho en el departamento de Nariño donde constituye un alimento básico. Lamentablemente circula un rumor, por cierto muy perjudicial, que la planta es engendradora de cáncer. No figura como tal en una obra publicada por el Instituto Nacional de Investigaciones en Cáncer de los Estados Unidos, la cual da copiosas listas de plantas con actividad oncolítica y oncogénica).

El número de plantas alimenticias que utilizamos es ínfimo si lo comparamos con lo divulgado en la bibliografía botánica: Edward L. Sturtevant agricultor, botánico y médico de Boston, registró en su obra "Edible Plants" (edición póstuma, (1919) 2.897 especies comestibles; 1.920 especies en plantas útiles en Colombia por Enrique Pérez Arbeláez (1956); L.H. Bailey en su Manual de Plantas Cultivadas en los Estados Unidos y Canadá describe 5.347, la mayoría alimenticias; The Standar Cyclopedia of Horticulture (Hortus Second, 1941) registra 31.905 plantas. Y si hacemos un inventario de los alimentos que entran semanalmente en la despensa casera, verificamos que difícilmente pasamos de la docena entre granos, verduras y frutas. ¿Por qué? La respuesta no es simple, pues requiere el análisis de cada una de las especies: tanto de las que han alcanzado mayor nivel hasta constituir monocultivos perjudiciales, como aquellas que no han ido más allá de los registros botánicos. Hay plantas con historia que se remonta a más de 10.000 años y sus semillas viajan por todo el mundo, como las relacionadas en la Biblia. Otras, sin historia, están comenzando a surgir en la medida que aumenta el hambre y la desnutrición.

Además de los cursos de Botánica Económica, es muy conveniente la divulgación bien sustentada y dirigida a otros niveles. Al menos así lo consideró la Academia Nacional de Ciencia de los Estados Unidos, cuando en el año 1975 resolvió reunir en Washington un grupo de 20 botánicos provenientes de diversos países con el fin de someter a consideración un número de plantas que mostraran la posibilidad para mejorar la calidad de vida en áreas tropicales. El grupo tuvo los siguientes objetivos: identificar plantas tropicales subutilizadas pero aparentemente útiles, tanto silvestres como domesticadas, que tuvieran potencial económico; seleccionar las que mostraran la mayor promisión para una extensa explotación en los trópicos; e indicar los requerimientos y rutas de investigación que aseguren que las plantas seleccionadas alcancen su completo potencial. Otros criterios para la selección de plantas, fueron: ¿Pueden crecer en los trópicos?; ¿tienen suficiente potencial como fuente de alimentación, forraje o materia prima para industrias?; ¿pueden ayudar a los países, o áreas de estos, a incrementar la productividad?; ¿pueden contribuir a la nutrición mundial?; ¿tienen propiedades múltiples que permitan la obtención de varios productos útiles?

De 400 plantas sometidas a consideración se seleccionaron 36. Y como tuve la oportunidad y la honrante distinción de hacer parte del grupo convocado por la Academia Americana de Ciencias, he continuado acopiando nuevos datos sobre las especies seleccionadas y de otras no incluidas y que hoy, gracias a las investigaciones químicas, agronómicas, económicas son dignas de consideración.

Los resultados de la reunión aludida se publicaron en 1975 en un pequeño libro titulado "Underexploited Tropical Plants with Promising Economic Value". La publicación tuvo muy buena acogida: pronto se recibieron más de 20.000 solicitudes de ejemplares; en 1976, año siguiente a la primera edición, fue necesario una segunda; otra en 1977; y la cuarta, con algunas revisiones de la bibliografía recomendada y de las entidades para obtener germoplasma, se publicó en 1978.

Damos a continuación los nombres de las 36 plantas seleccionadas con el fin de enterar mejor a los lectores en este artículo. Y si algunos desean datos adicionales sobre una o varias especies, tendré mucho gusto en suministrarlos. Parece que el libro está hoy agotado. En algunos casos, a continuación del paréntesis (familia botánica y nombre vernáculo), siguen notas tomadas del libro, otras propias, otras de otros y otras modificadas.

CEREALES

Echinochloa turnerana (Gramineae). Es un pasto nativo de Australia, de buena palatabilidad para animales, pero con poca información. Puede ser de importancia en regiones áridas y semiáridas.

Amaranthus (Amaranthaceae, seudocereal). El libro indica cinco especies y las recomienda por su alto contenido de proteínas, licina y aminoácidos nutricionales.

Chenopodium quinoa (Chenopodiaceae). La quinua es recomendada como una de las mayores fuentes de proteína. Se cultiva en regiones andinas, especialmente en Perú. El libro da como limitación el espacio que ocupa cada planta, el cual es mayor que el de otros cereales herbáceos.

Zostera marina (Potomagetonaceae, seudocereal). Recomendado principalmente por desarrollarse bien en aguas marinas bajas. Indígenas de la tribu Seri de la costa occidental de México utilizan sus granos como alimento.

RAICES Y TUBERCULOS

Arracacia xanthorriza (Umbelífera, arracacha). Esta raíz es bastante conocida por agricultores colombianos. Posiblemente la poca demanda no ha permitido su cultivo en forma extensiva. El contenido de almidón oscila entre 10 y 25%, es rica en calcio y fósforo.

Xanthoxoma sagittifolium, X. violaceum, y otras tres (3) especies (Araceae). Son tubérculos (cormos) que se preparan en forma similar a la papa. Aunque son nativos de América, su mayor consumo está en el oeste de Africa. Estas dos especies se conocen en Colombia con los nombres de Mafafa y Malangay. Algunos las distinguen por el color de los peciolos: Mafafa, si es violáceo; Malangay cuando blancos o verdosos. Contienen 2-3% de proteína, pero deficientes en licina.

Colocasia esculenta (Araceae). Del grupo de la anterior y a veces se le confunde con ellas. Esta es más ampliamente cultivada principalmente en Filipinas, Hawai y Egipto en donde ha alcanzado renglón importante como comestible. Se le conoce con el nombre de Taro. Sus raíces tuberosas constituyen fundamentalmente una fuente de carbohidrato; también son ricas en calcio, fósforo, potasio y vitaminas A y B.

En la bibliografía sobre plantas colombianas a veces se registra el nombre de "Rascadera" para especies de *Xanthosoma* y de *Colocasia.* Pero en algunas regiones de los departamentos del Cauca y Tolima, el nombre se aplica a especies del género *Dioscorea* (grupo de los ñames). Y evidentemente en varias personas observé sensibilización o alergia por contacto con tubérculos de algunas especies. La acción alérgica se manifiesta por priurito, y seguramente de aquí deriva el nombre de "rascadera" para las dioscoreas. La observación la hice cuando recolectaba material para investigar materia prima en un programa para síntesis de hormonas (diosgenina) y anticonceptivos. México había comenzado a desarrollar una gran industria a partir de la *Dioscorea elata.* Estimo que Colombia tiene unas 70 especies, algunas de ellas con tubérculos con peso de 25 kilos. Es curioso que nuestros campesinos no las distinguen o han pasado desapercibidas. Varias las comí bien, después de cocinarlas como el ñame. En una sola localidad, región de Munchique, encontré 10 especies del sotobosque en selva densa, hoy extinguidas al haberse sustituido la selva por plantaciones de coníferas. Cabe aquí recordar el alto endemismo que presenta la flora de Colombia y que "la extinción es para siempre".

VEGETALES

Cnidoscolus chayamansa, C. aconitifolius (Euphorbiaceae). Son arbustos de 3-5 m, cuyas hojas se consumen en algunas regiones de México y Centroamérica en forma similar a la espinaca, pero deben cocinarse para eliminar la toxicidad que presentan cuando frescas. Su nombre vernáculo es "chaya".

Euterpe, Guilielma, Iriartea, Acronomia, Cocus. Son géneros de palmas, de sus tallos jóvenes o porción medular se elabora el alimento delicado y exótico conocido como "palmitos". Su valor alimenticio es similar al del repollo *(Brasica).* Su demanda crece día a día pero deben tenerse en cuenta las limitaciones indicadas en el libro. Principalmente, por tratarse de palmas de dispendioso cultivo que conlleva a la utilización de plantas silvestres.

Creo que una posible fuente para la industria de palmitos sean los retoños o tallos jóvenes de *Gynerium sagittatum,* (caña brava) que se consumen en el departamento del Cauca con el nombre indígena de "Chulquín". Se le rebana, se macera o mantiene varias horas en agua, para consumirlo en encurtidos o guisado mezclado generalmente con papa. En la forma de encurtido es similar a los palmitos. Solamente le falta mejor posición social.

Benicasa hispida y *B. cerifera* (Cucurbitaceae). No tienen nombre en Español, en Inglés se les denominan "Wax Gourd". Son plantas bejucosas, rastreras o trepadoras, similares al zapallo y se consume en la misma forma. Los frutos contienen 96% de agua, 0.4% de proteínas, 0.1% de grasa, 3.2% de carbohidrato, 0.3% de materia mineral. También son comestibles los botones florales y las hojas jóvenes como alimento verde o clorofílico. Su sabor es similar al *Sechium edule* (Cucurbitaceae) conocida en Cauca, Huila y Tolima, con el nombre de "Papa de pobre", pero de poco consumo.

Sophocarpus tetragonolobus (Leguminosae). Esta leguminosa, a mi juicio, es la más importante entre los vegetales insinuados. En inglés se le denomina "Winged bean" (Fríjol alado). Es una legumbre excepcional; las vainas verdes, hojas y semillas son ricas en aceite, proteína y vitaminas, y sus raíces que son tuberosas como la yuca son extremadamente ricas en proteína. Todas las partes de la planta son comestibles. Sus semillas son redondas y parecidas a las del fríjol soya en cuanto a su composición. Su promedio de contenido proteínico es del 34% (basado en peso seco) y 17% de aceite. La importancia de esta leguminosa hizo que la Academia de Ciencias de los Estados Unidos nombrara un grupo especial para editar un boletín exclusivamente dedicado a ella. Fue publicado en 1975 y consta de 42 páginas, incluyéndose un amplio resumen en español. En 1934 conseguí unas 10 semillas de fríjol alado las cuales fueron sembradas en la región de Garzón, departamento del Huila, por el biólogo Gustavo Morales. En unos 8 meses obtuvo 30 kilos aproximadamente de fríjoles y raíces tuberosas que tuve ocasión de preparar y comer. Otras semillas sembradas en Popayán fructificaron pero no alcanzamos a recoger raíces tuberosas por aniquilación accidental de la plantación; también logramos cultivarlas en el valle del río Patía. Desafortunadamente su viabilidad es corta y nos quedamos con unos 20 kilos de semilla que ya no germinan. Podemos enviar muestras a quienes deseen investigar el contenido de proteína, aceite, minerales, etc. en el material cultivado en el Huila. Pero no será difícil obtener semillas viables, por cuanto hay varios centros agrícolas que investigan la planta.

FRUTAS

Durio zibethinus (Bombacaceae). Es un árbol de 30-40 m cultivado principalmente en Malasia, Indonesia y Filipinas. Las frutas son de 30 X 20 cm. de un olor muy suigéneris y desagradable para muchos. Se recomienda para regiones húmedas con alturas inferiores a 800 m. No se conoce en Colombia. Víctor M. Patiño trató de introducirlo en 1976 mediante semillas que entregó al Instituto de Fomento Algodonero, pero "se desconoce el destino que corrieron".

Garcinia mangosta (Guttiferae). El mangostín o mangostán ha sido considerado como la fruta de mejor sabor. Se recomienda para regiones con temperaturas entre 20 y 30 grados centígrados. En Colombia se cultiva, con relativa frecuencia en Mariquita, Tolima. Allí lo conocí en 1958. Ocasionalmente lo ofrecen a muy alto precio en acreditados supermercados de Bogotá, de donde obtuve semillas hace un año y logré germinarlas. Dos arbolitos se desarrollan bien: uno en Santander de Quilichao, otro en Popayán, el primero está de mayor tamaño, unos 50 cm.

Una fruta de forma muy similar al mangostín es el Impamo, también de la familia *Guttiferae* (*Clusia,* posible n. sp.) que consumen los habitantes del Macizo Colombiano, principalmente en la población de Valencia. La parte comestible es el arilo, lo mismo que el mangostín. Se podría ensayar una hibridización, pues el ímpamo es más grande que el mangostín.

Se recomiendan en el libro que estamos comentando, otras cinco frutas relativamente bien conocidas en Colombia y otros países neotropicales, pero que conviene divulgarlas a nivel internacional para incrementar su utilización y comercio. Las relacionamos a continuación en el orden alfabético de nombres comunes dados en el libro, los nombres entre paréntesis son los distintivos en Colombia, sigue el nombre científico y la familia botánica. En algunas transcribiremos la información de mayor interés.

Naranjilla (Lulo), *Solanum quitoense.* Solanaceae. Las raíces son susceptibles a nemátodos, virus, hongos y parásitos, que acortan el tiempo de vida y reducen la producción. Esto se presenta generalmente después de dos años y deben ser reemplazadas. Mejor cambiar de sitio como lo hacen en el Ecuador. Se recomienda el uso mensual de fertilizantes y el riego durante los períodos secos.

En el costado occidental de la cordillera Occidental, región de Munchique, he visto los lulos de mayor tamaño en Colombia. Ha ganado el lulo muy buena posición mundial hasta distinguírsele como la fruta de mejor gusto del mundo, ganándole al mangostín, menos en el sureste de Asia.

Pejibaye (Chontaduro, Cachipay), *Guilielma gasipaes,* Palmae. Probablemente el más balanceado entre los alimentos tropicales. Se conoce bastante bien en Colombia. Entre las lecturas selectas recomendadas figura una de Víctor M. Patiño, México, 1958; recomiendo otra del mismo autor en su obra Plantas Cultivadas y Animales Domésticos en América Equinoccial, Colombia, 1963.

Pumelo (Pomelo) *Citrus grandis,* Rutaceae. Es la fruta de mayor tamaño entre los cítricos, mayor que la grape-fruit. Con buena potencialidad para tierras bajas de los trópicos, especialmente aquellas donde el clima, la humedad, y la salinidad impiden el cultivo de otras frutas cítricas. He conocido pomelos de gran tamaño y muy buen sabor procedentes del departamento de Córdoba.

Soursop (Guanábana), *Anona muricata,* Annonaceae. Nativa de América Tropical., Fue una de las primeras frutas introducidas en regiones tropicales del Viejo Mundo y es hoy popular en China, Australia y Africa. Aparte de comerse como fruta puede ser procesada sin perder su sabor y aroma. La fruta contiene un 12% de azúcar, siendo la glucosa la mayor proporción, algo de fructosa y pectina. A la bibliografía recomendada le agrego la siguiente: Córdoba, José Angel, "La Guanábana: Fruta Americana", en Rev. Esso Agrícola No. 3, Nov. 1987, que informa sobre variedades, clima, suelos, análisis químico de la fruta, propagación, plagas, etc.

Uvilla (Caimarón, Uva de monte) *Pourouma cecropiaefolia,* Moraceae. Magnífica fruta de la amazonia colombiana, brasileña y peruana. Las frutas que se producen en racimos grandes son similares a la uva *(Vitis vinifera),* hasta de 4 cm de diámetro, muy jugosa, siempre dulces y también sirven para la elaboración de vino. Su cutícula es un poco ácida y áspera pero puede removerse fácilmente. Los árboles, bastante similares a los yarumos, comienzan a fructificar a los tres años. Son plantas monoicas: hay árboles hembras y machos. Dicen que en algunas regiones los nativos pueden distinguir los sexos por las semillas.

SEMILLAS OLEAGINOSAS

Babassú (Táparos). Son palmas de las regiones húmedas del norte de Suramérica y pertenecientes al género *Orbignya,* con semillas que pueden contener hasta 70% de aceite. Se mencionan tres especies en la obra, una de ellas *O. cuatrecasana* Dugand, de la costa del Pacífico, cuyos frutos denominados "táparos" tienen semilla de sabor similar a la del coco y constituye fuente de alimentación de los nativos. Es abundante en el Bajo Calima y actualmente víctima entre una masiva deforestación a cargo de una empresa "papelera". A las referencias bibliográficas les agregamos una interesante tesis de las químicas Irma L. Barreto y Luz A. Kairuz, Facultad de Ciencias de la Universidad Nacional, Bogotá, 1966.

Buffalo Gourd (Chilicote en México) *Cucurbita foetidissima,* Cucurbitaceae. Es una planta rastrera de regiones desérticas de México y el Suroeste de Norteamérica. Sus semillas contienen 30-35% de proteína y 34% de aceite comestible; la pulpa de los frutos desecados se utiliza para alimentación de ganado; sus raíces son muy grandes, hasta de 30 kilos de peso, contienen almidón y bastante humedad para sobrevivir en áreas desérticas. La encuentro recomendable para la Guajira y otras regiones secas de Mercaderes en el departamento del Cauca.

Caryocar, species (Almendrón), Caryocaraceae. Son árboles cuyos frutos dan dos clases de aceite comestible y de diferente sabor: uno se obtiene del pericarpo y otro de la almendra la cual se consume como una de las mejores nueces tropicales. El gaditano José Celestino Mutis describió el *Caryocar amygdaliferum,* de las regiones de Mariquita y Honda, árbol que distinguimos en Colombia con el nombre de almendrón. Y a pesar de haber transcurrido más de 200 años, la planta no ha sido objeto de estudios agronómicos y de mercadeo.

Jesenia polycarpa, es la planta conocida en Colombia con los nombres de "milpesos y seje", que produce un aceite semejante al de olivas. Sirve como alimento, para jabones y cosméticos. El promedio anual de dos racimos de palma adulta es de 30 kg de frutos, de los cuales se extraen 24 litros de aceite. En la estación experimental de Gaviotas, de los Llanos Orientales de Colombia, se han desarrollado cultivos de esta palma.

Jojoba, *Simmondsia chinensis,* Buxaceae. Es un arbusto silvestre en extensas áreas del desierto de Sonora que abarca partes de Arizona, California y México. Sus semillas contienen una "grasa" líquida (ésteres de ácidos grasos y alcoholes), son de impresionante potencial industrial. Es muy difícil producir sintéticamente grasa líquida comercial. Y como la esperma de ballena ha sido la única fuente de grasa líquida, la jojoba se está convirtiendo en la única fuente por cuanto las ballenas, animales en vía de extinción, están rígidamente protegidas. La cualidad más importante del aceite de jojoba es su inalteración por el calentamiento repetido a altas temperaturas sin cambiar su viscosidad. Además, el aceite puede ser hidrogenado para solidificarlo en forma que se pueda usar para poliches, papel carbón y excipiente de numerosos productos químicos y farmacéuticos. Las semillas de jojoba contienen un 50% de aceite y la torta residual hasta un 35% de proteína, utilizable en la alimentación de animales. Su única limitación es que la planta es dioica y no es posible determinar previamente cuáles semillas producirán arbustos hembras y machos. Y es necesario esperar 3 años, cuando se presentan flores para poder suprimir una cantidad adecuada de individuos machos. Como se trata de un arbusto de unos 3 m de alto, parte de arbolitos machos pueden utilizarse como recurso de leña.

Por las cualidades descritas anteriormente y por tolerar temperaturas extremas en áreas desérticas, la jojoba está alcanzando un alto nivel como planta de importancia económica. Y mucho se debe a la información dada en la obra que estamos comentando. Por el año de 1978 se estaban cultivando 1.000 hectáreas de jojoba en los Estados Unidos; se han establecido también plantaciones en México e Israel. En Colombia, según información en el diario El Espectador de febrero 22/87, se iniciaría en Antioquia el cultivo de jojoba con una inversión de 710 millones de pesos. Como lectura selecta agregamos: "Products from Jojoba, A Promising New Crop for Arid Lands", National Acad. Sc., Washington, D.C. 1975.

PLANTAS PARA FORRAJE

Acacia albida, Leguminoseae. Arbusto con espinas hasta árbol grande que crece en las sabanas de Africa Oriental y Occidental. Tiene la particularidad de producir follaje y frutos durante la estación seca. Sus hojas y frutos son apetecidos por toda clase de ganado y constituyen buena fuente de proteína en áreas con veranos prolongados.

Brosimun alicastrum (Ramón en México), Moraceae. Es un árbol hasta de 20 m, nativo de México y Centroamérica. Tiene raíces profundas que le permiten mantenerse en buen estado en regiones secas o durante veranos prolongados. Su pericarpio dulce es consumido por el hombre, también sus semillas como nueces. El ganado apetece mucho las hojas y ramas jóvenes. Su madera también se utiliza, pues el diámetro de los árboles puede alcanzar hasta 1 m. A las lecturas selectas le agregamos: Gómez-Pompa, Arturo, en Rev. Academia Colombiana de Ciencias No. 61, 1986.

Cassia sturtii, Leguminoseae. Es un arbusto australiano, introducido a Israel en donde se estudia y experimenta como forraje.

Saltbushes (Matas salinas), *Atriplex nummularia* y *A. halimus,* Chenopodiaceae. Son hierbas hasta pequeños arbustos con distribución mundial y alta resistencia a la salinidad, por cuanto poseen un mecanismo (en los pelos de las hojas) que les permite excretar la sal absorbida por las raíces. Investigaciones indican que contienen proteínas digestibles y el material seco es como el de la alfalfa.

Tamarugo, *Prosopis tamarugo,* Leguminoseae. Es un arbolito de madera dura nativo del desierto de Atacama, en Chile. Crece a través de una capa de sal a veces hasta de un metro de espesor. La calidad de sus cápsulas y hojas permite que se alimenten ovejas casi en la misma proporción en que se hace en las mejores zonas forrajeras del mundo.

OTROS USOS (MISCELANEAS)

Es el VII y último capítulo del libro del cual transcribimos únicamente partes de los resúmenes. En unos pocos casos ampliamos la información.

Palma Buriti *(Mauritia flexuosa).* Posiblemente sea la palmera más abundante en todo el mundo, pero nativa del Amazonas y sin mayor uso comercial, sin embargo, productos como almidón, fruta, fibra y madera obtienen los nativos y pobladores de la Amazonia.

Candelilla, *Euphorbia antisyphilitica.* Es una planta herbácea de los desiertos de México que tiene las hojas cubiertas de una cera de valor comercial. Una empresa mexicana, con subsidio, la ha producido y exportado a los Estados Unidos durante varios años. La planta puede reproducirse por estacas y comienza a producir cera a los 2-5 años.

Bijao, *Calathea lutea,* Marantaceae. Sus hojas, que son como del tamaño de las del banano, producen por el envés una cera de color blanco desprendible fácilmente por medio mecánico. Su importancia y usos son comparables con la cera de carnauva. Es abundante y colonizadora en regiones amazónicas y de la Costa del Pacífico de Colombia.

Guar, *Cyanopsis tetragonoloba,* Leguminosae. Herbácea anual similar a la soya, cuyas semillas tienen alto contenido de proteína y una goma con varios usos: desde permitir que el agua fluya con más facilidad a través de una manguera de incendio hasta endurecer helados. Es la fuente más prometedora de goma entre los vegetales. Crece bien en diversos suelos y se puede rotar con algodón, sorgo, maíz y vegetales. La planta es muy adecuada para regiones semiáridas y tolera un poco la salinidad. Actualmente se cultiva en Paquistán, India y los Estados Unidos. Existe maquinaria adecuada para la cosecha.

Guayule, *Parthenuim argentatum*, Compositae. Es un arbusto nativo de regiones desérticas del norte de México y del suroeste de los Estados Unidos, que produce un látex, que al procesarlo, es químicamente igual al caucho obtenido de los árboles amazónicos del género *Hevea*. En 1978 el presidente Carter asignó por ley una inversión de 30 millones de dólares para investigación y desarrollo de caucho natural de Guayule. México también ha invertido grandes sumas en el proceso de industrialización. Colombia, aunque tiene regiones aptas para cultivarlo, debe esperar y observar con cautela el proceso económico del caucho natural. Pues actualmente el caucho sintético, derivado del petróleo, lo ha sustituido parcial o totalmente en la elaboración de numerosos productos, menos en las llantas para aviones y otras de gran tamaño que requieren caucho natural sin mezcla. La tendencia hacia la producción de vehículos livianos, como automóviles favorece al caucho sintético. Pero al ser el petróleo **un recurso no renovable** es muy posible que el caucho natural alcance en el futuro un tremendo valor comercial. Colombia debe poner atención a sus plantaciones que se iniciaron en la región de Urabá, con auspicios y asesoría parciales de los Estados Unidos, uno o dos años después de haber estallado la Segunda Guera Mundial y que naturalmente fueron prácticamente abandonadas cuando terminó el conflicto en 1945. Se suponía que los cultivos de Urabá comenzarían a producir caucho a mediados de la década del 50. Según comunicación personal del Dr. Schultes, quien colaboró en la selección de clones procedentes de Leticia, Colombia, y resistentes a una enfermedad de la hoja, la plantación alcanzó a producir caucho. Si se están destruyendo las selvas del Bajo Calima, que no se recuperan diciéndonos mentiras, debemos al menos intentar hacer allí plantaciones de *Hevea*. Palmas como *Orbignya* (táparos) hay tanto en la Amazonia como en el Chocó. Son numerosos los géneros botánicos, inclusive especies como el barbasco *Ryania speciosa* var. *chocoensis* (veneno para flechas), que se encuentra en los dos grandes ecosistemas de selvas húmedas tropicales separadas por los Andes.

Ramio, *Bohemaria nivea*. La fibra de este arbusto, alto y perenne, proveniente de Asia Oriental, tiene la cualidad de no encogerse ni estirarse como otros. Pero su uso es restringido debido a que posee una goma que se adhiere fuertemente a la fibra. Parece que no progresaron los intentos de desarrollarla en Colombia, departamento del Valle. Mejor es la fibra *Cannabis*, pero...

Hierba de aluvión, *Paspalum vaginatum*. Graminae. Es un pasto altamente tolerante a la sal y se recomienda para producción de nueva vegetación en áreas que sufren inundaciones con agua de mar y para dar estabilidad a playas arenosas. Se ha cultivado con éxito en Australia.

Espirulina, *Spirulina platensis* y *S. maxima*, Cyanophyceae. Son algas de alto contenido proteínico que crecen en aguas saladas y alcalinas. Contrario a otras algas, permiten su cosecha con redes. Su sabor es agradable y se usan para consumo humano en regiones aledañas al lago Chad de Africa; también se consume en México. La Spirulina desecada no es susceptible de fermentación y es fácil de almacenar. La cantidad de proteína cruda puede alcanzar hasta 72%; tiene un alto contenido de vitaminas, particularmente la B12.

Seguramente para el botánico conocedor de las flores de las regiones tropicales son muy pocas las especies recomendadas aquí y pueden cuestionar la omisión de otras admiradas por ellos. Deben tener en cuenta que numerosas plantas muy útiles adolecen de datos, entre otros: contenidos de carbohidratos, proteínas, aceites, minerales, vitaminas, etc.; tiempo transcurrido entre la siembra y la primera cosecha; rendimiento actual por hectárea; regiones donde se cultiva actualmente. Casi todos estos datos, con pocas excepciones, acompañan la información de cada especie. Las plantas no solamente fueron tamizadas por los 20 miembros del panel reunido en Washington sino también mediante consultas a numerosos especialistas de diversas partes del mundo. Así, fue la labor de muchos, pero especialmente de tres personas que coordinaban los grupos: Noel Vietmeyer, Edward S. y Ayensu y Richard Evans Schultes.

La anterior bibliografía sobre 36 plantas subutilizadas incrementa las referencias para un curso de Botánica Económica como el dictado en la Universidad Nacional de Colombia en el año de 1963, en el cual se consideran las principales plantas usadas por el hombre, su origen botánico y en la historia, sus constituyentes químicos que las hacen útiles, tóxicas y adictivas; su desarrollo en las culturas prehistóricas y modernas.

PROGRAMA DEL CURSO DE BOTANICA ECONOMICA. U. NAL. 1963

I. Conferencias a cargo del profesor Schultes:

- La Botánica Económica y sus relaciones con otras ciencias.
- Clasificación de las plantas con relación a la Botánica Económica.
- Alimentos: aspectos generales de nutrición; cereales y seudocereales; origen, evolución e importancia del maíz; plantas productoras de azúcar; raíces y frutas amiláceas; proteí-

nas y grasas en las plantas; importancia de las verduras y frutas.

- "Simbiosis" de las plantas y el hombre.
- Fibras de origen vegetal.
- Aceites esenciales de las plantas. Especias y perfumes.
- Estimulantes y bebidas con cafeína.
- Plantas productoras de alcoholes.
- Plantas de fumar y masticatorias.
- Plantas narcóticas del Viejo y Nuevo Mundo.
- Plantas venenosas.
- Plantas medicinales de antaño y del presente.
- Plantas medicinales para el futuro. Investigaciones actuales sobre nuevos agentes terapéuticos.
- Maderas de importancia económica.
- Papel y productos similares.
- Tanino y colorantes vegetales.
- Grasas, aceites, ceras, gomas y resinas de origen vegetal.
- Caucho y látex de otras plantas.
- Plantas fósiles de importancia económica; carbón, petróleo, ámbar.
- Pasado y futuro de la Botánica Económica, su posición académica y nivel práctico-educacional.

Como no todos los estudiantes que tomaron el curso eran egresados de carreras del área de las Ciencias Naturales, se hizo un ciclo previo de conferencias sobre constituyentes químicos de las plantas; organografía vegetal, sistemas de clasificación, herbarios, floras y otras bibliografías botánicas, a cargo de los profesores Eduardo Calderón Gómez y Alvaro Fernández Pérez. El curso tuvo una duración de seis semanas incluidas las prácticas de laboratorio para las cuales se siguió el manual "Plants and Human Affairs" por R. E. Schultes y Albert Hill, Harvard, 1960. La alianza para el Progreso facilitó la traída de materiales y bibliografía, que en su mayor parte fue donación de la Universidad de Harvard a la Nacional de Colombia.

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PROPUESTA DE UN PROGRAMA INTERNACIONAL MULTIDISCIPLINARIO PARA EVALUAR LOS USOS ETNOMEDICOS DE LAS PLANTAS INDIGENAS DE TROPICOS AMERICANOS[1]

Por *D. D. Soejarto*[2,3], *M. L. Quinn*[2] *y N. R. Farnsworth*[2]

RAZONAMIENTO

Las plantas son todavía una fuente importante en la medicina para mantener la población humana en el mundo entero en buena salud. Según la estimación de la Organización Mundial de la Salud (OMS), alrededor de 80% de la población mundial de 4 mil millones todavía dependen de la medicina tradicional en las necesidades primarias para el mantenimiento de la salud (Farnsworth et al., 1985). Tenemos que reconocer el hecho que una proporción mayor de la medicina tradicional involucra el uso de extractos vegetales o sus principios activos.

En un país como la República Popular de China, con una población de un mil millones, la terapia medicinal primaria todavía se realiza en la forma de extractos vegetales (Anon., 1975; Farnsworth & Loub, 1983).

Aún en los Estados Unidos de América, donde los sintéticos dominan el mercado de fármacos, los productos derivados vegetales todavía constituyen una parte importante de las drogas de prescripción médica. Basado en el análisis de los datos de venta de drogas de prescripción médica en los Estados Unidos, desde el año de 1959 a 1973, Farnsworth & Morris (1976) descubrieron que un promedio de 25% de las prescripciones llenadas contenían uno o más principios activos derivados de las plantas. Aunque existían variaciones, éstas sólo oscilaban entre los 23,12 y 28,22%. Esta tendencia continuó hacia el año de 1980, cuando el valor monetario de los productos vegetales se calculó en 8 mil millones de dólares (Farnsworth & Soejarto, 1985).

La importancia de los productos vegetales para el mantenimiento de la salud también se puede ver en otros países desarrollados, tales como Inglaterra y la República Federal Alemana (Corrigan, 1985).

A pesar de estos hechos innegables, poco interés existe entre las compañías farmacéuticas estadounidenses de investigar las plantas como fuentes de medicinas nuevas (Farnsworth & Loub, 1983; Farnsworth et al., 1985; Tyler, 1986). El interés industrial de investigar las plantas con fines medicinales se encuentra principalmente en los países de China y Japón. Esto significa que la vía está abierta para que los científicos en los países en vía de desarrollo organicen e implementen programas de investigación de carácter multidisciplinario, para explotar y utilizar estos recursos naturales, donde se encuentran en abundancia.

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1 Este trabajo fue presentado en la reunión satélite de etnofarmacología, como parte del Cuarto Congreso Latinoamericano de Botánica, Medellín, Colombia, 29 de junio a 5 de julio, 1986. Agradecemos a los miembros del Comité del Programa de Interciencia de Recursos Biológicos Nuevos/Poco Utilizados, convenido durante esta reunión, por las sugerencias y críticas constructivas sobre el contenido de esta propuesta.

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De éstos, se pueden derivar productos galénicos económicos, estables, estandarizados, seguros, y efectivos, y que son aceptables en estos países, debido a los valores culturales existentes en el cuido de la salud. Además, tales programas pueden llegar hacia el descubrimiento de las sustancias biológicamente activas, con mira hacia su utilización como drogas medicinales.

La necesidad de iniciar tales programas de investigación es aún más apremiante hoy en día. Según algunos cálculos (Melville, 1978), aproximadamente el 10% de las plantas con flores (angiospermas) se destinan a desaparecer en el año 2000. De estas plantas han llegado nuestros compuestos medicinales más impórtantes (Tyler et al., 1981; Farnsworth & Soejarto, 1985). El valor monetario de tales especies sólo en los Estados Unidos de América se ha calculadò en 3248 millones de dólares (Farnsworth & Soejarto, 1985). Para la zona tropical, el asunto es más serio.

El número de las especies de las plantas con flores que se encuentran en los bosques pluviales tropicales se han calculado en 155 mil, o el 65% de todas las especies de angiospermas en el mundo entero (Prance, 1977). Considerando la velocidad alarmante de la desaparición de estos bosques, calculada según una fuente (Burley, 1986) en 27 millones de acres (alrededor de 110 mil kilómetros cuadrados) al año en el mundo, un valor incalculable de recursos medicinales se destinan a desaparecer para siempre en el año 2000, si nosotros no actuamos.

Con la desaparición de los bosques, debido al avanzamiento de la civilización, desaparecerá también nuestro conocimiento sobre las virtudes medicinales de las plantas que se ha edificado a través de experimentos y errores por las sociedades primitivas durante los milenios (Schultes, 1986).

Ya es un hecho innegable que el descubrimiento de la mayor parte de nuestras medicinas provenientes de las plantas, ha sido basado en la información derivada de los estudios etnobotánicos y etnomédicos de las especies indígenas de diferentes partes del mundo (Véase también Farnsworth et al., 1985).

Aunque los estudios en la búsqueda de nuevos compuestos medicinales de las plantas se han llevado a cabo en los países latinoamericanos, y también en el mundo entero, el alcance de estos estudios es algo limitado. Existen ciertos datos que sustentan esta afirmación.

Desde 1974, hemos llevado a cabo un programa de computarización de la literatura mundial de los productos naturales que llamamos NAPRALERT (NAtural PRoducts ALERT). En el presente, el banco de datos computarizados de NAPRALERT contiene más de 35.000 especies de organismos, de los cuales, la gran parte representa los angiospermas. Alrededor de 80 mil citas bibliográficas se encuentran en NAPRALERT. (Para otros artículos sobre NAPRALERT, véase Soejarto, 1985).

Basado sobre los datos que hemos computarizado, sólo Argentina, Brazil y México tienen programas muy activos en la investigación sobre productos naturales. Identificamos el nivel de las actividades por el número de los artículos de investigación que se han publicado en el país. Por el período de 1970-1986, más de 100 artículos han sido publicados por cada uno de estos países: Argentina con 151, Brazil con 374, México con 186 (Tablas 1 y 2). Hemos incluido en esta tabulación sólo los artículos que se encuentran publicados en las revistas científicas reconocidas, tanto en el país como internacionalmente. Las comunicaciones privadas, los informes internos, y las publicaciones en revistas menos conocidas/locales que no han llegado a nuestra atención, no han sido incluidos. No obstante, creemos que los datos de NAPRALERT nos dan un reflejo fiel y exacto del nivel de actividades científicas sobre las investigaciones de los productos naturales en América Latina durante los pasados 16 años.

PROPUESTA

Basado sobre los argumentos arriba presentados, se propone el establecimiento de un programa internacional multidisciplinario para evaluar los usos etnomédicos de las especies vegetales indígenas y selectas de los trópicos americanos.

Esta propuesta tiene una base sana y válida, tal como se ha demostrado por el hecho, en que un alto porcentaje de los compuestos medicinales útiles han sido descubiertos por medio de las investigaciones científicas de las plantas, motivadas por sus usos en la terapia tradicional. Según nuestro análisis, de las 119 sustancias químicas derivadas de las plantas que hoy en día se están utilizando en el mundo como medicamentos importantes, el 74% han sido descubiertos a través de los estudios químicos, diseñados para aislar los principios activos ligados al uso de estas plantas en la terapia tradicional (Farnsworth et al., 1985).

OBJETIVOS

Los objetivos del programa propuesto son:

1. *Corto Plazo* (FASE I)

Desarrollar una fuente de salario para los cultivadores y las industrias farmacéuticas locales, y comprende:

1.1. Selección de las especies indígenas que tienen historia de utilización para ciertos tipos de actividad biológica, a través de la revisión y la evaluación de datos en la literatura, y/o a base de sus usos terapéuticos establecidos.

1.2. Investigar la eficacia (para aquella actividad biológica seleccionada), la inocuidad, y la toxicidad de los extractos.

TABLA 1

Nivel de las actividades de investigación basado sobre el número de publicaciones[1]

País	Total de citas Bibliográficas 1970-86 en el Banco de Datos de NAPRALERT	Número de citas bibliográficas con la dirección del primer autor dentro del país	Porcentaje de publicaciones hechas por autor dentro del país %
CENTROAMERICA Y MEXICO			
Bélize	20	0	0
Costa Rica	102	33	32
El Salvador	14	1	7
Guatemala	46	5	11
Honduras	18	3	17
México	526	186	35
Nicaragua	9	0	0
Panamá	43	4	9
SURAMERICA			
Argentina	193	151	78
Bolivia	45	0	0
Brazil	653	374	57
Chile	170	84	49
Colombia	98	22	22
Ecuador	53	7	13
Guiana Francés	7	0	0
Guayana	67	2	3
Surinam	8	1	13
Paraguay	57	8	14
Perú	159	16	10
Uruguay	17	4	24
Venezuela	77	43	56

1 Datos compilados junio de 1986; la mayor parte de las publicaciones incluidas en esta Tabla comprende trabajos fitoquímicos.

TABLA 2

Nivel de actividades de investigación basado sobre el número de publicaciones por año

País[1]	Número de publicaciones por año[2]
Brasil	23
México	12
Argentina	9
Chile	5
Venezuela	3
Costa Rica	2
Colombia	1
Perú	1

1 Países con número de publicaciones menos de uno por año han sido excluidos.

2 Estos números se obtienen, dividiendo el número de las citas bibliográficas con la dirección del primer autor dentro del país (Tabla 1) por 16 (1970-86). Los datos fueron compilados en junio de 1986.

1.3. Preparar extractos estabilizados y estandarizados, con fines de su utilización en la terapia, para aquella actividad biológica seleccionada.

2. *Largo Plazo* (FASE II)

Descubrir las sustancias químicas vegetales con una actividad biológica definida, que servirán de base como fuentes de compuestos medicinales nuevos.

2.1. Selección de las especies indígenas con historia de usos etnomédicos para ciertos tipos de actividad biológica, a través de la revisión y la evaluación de los datos en la literatura, y/o a base de sus usos terapéuticos establecidos.

2.2. Aislamiento e identificación de los principios activos que se encuentran en los extractos, a través de la fraccinación química guiada por ensayos biológicos, con fines de realizar los estudios clínicos (humanos).

2.3. Realizar estudios sobre la toxicidad y la mutagenicidad de los compuestos químicos purificados.

Un esbozo que comprende las dos fases de los objetivos y el flujo de las actividades del programa propuesto se presentan en la Fig. 1.

ETAPAS OPERACIONALES

Para la realización del programa propuesto, se hace apelación a las entidades o asociaciones de carácter internacional, tal como el Programa Interciencia de Recursos Biológicos Nuevos/Poco Utilizados o el Convenio Andrés Bello, a auspiciar y

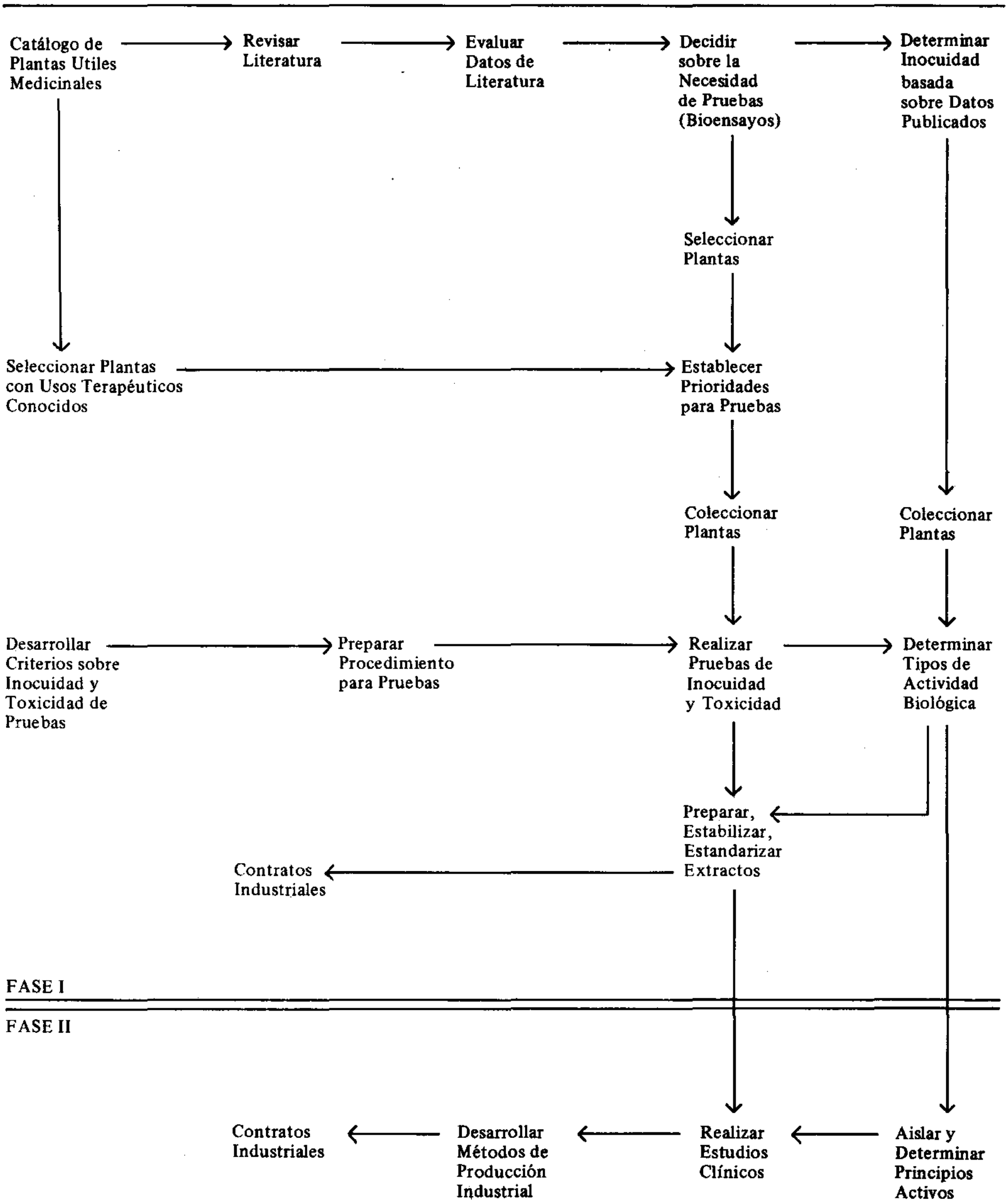

FIGURA 1. Flujo de Eventos para la Evaluación de las Plantas con Documentación Histórica de Usos Etnomédicos.

poner en marcha el programa propuesto. Tal(es) entidad(es) formará(n) una Junta Directiva, cuya responsabilidad será de asentar la política y las pautas de la operación. Esta Junta designará un Comité Ejecutivo, quien supervisará y evaluará el progreso del programa, a lo largo de su operación y de su existencia.

Se cree que tres etapas operacionales se necesitan para la implementación:

ETAPA 1: *Personal y Facilidades*

La tarea primordial del Comité Ejecutivo es de realizar un inventario del personal científico, las facilidades, y los equipos existentes en los países miembros. Este Comité finalmente seleccionará los individuos (quienes conformarán el cuerpo científico del programa), definirá los criterios de la selección de las plantas a investigar, elaborará una lista de las facilidades y equipos para ser utilizados, y aquellos para ser nuevamente adquiridos, determinará el(los) centro(s) de estudio, esbozará la estructura organizacional del programa entero y de cada centro, delineará el plan y las etapas de desarrollo del programa durante todo el período proyectado, realizará el análisis de costo, identificará e iniciará el acercamiento con las entidades/agencias de financiamiento, y finalmente escribirá una propuesta detallada y concreta para ser suministrada a aquella entidad/agencia de financiamiento, quien haya indicado un interés al programa propuesto. El Comité, además, debe delinear las prioridades para la implementación del programa.

Por lo menos un año debe ser asignado para esta ETAPA 1.

ETAPA 2: *Desarrollo de Documentos de Trabajo y Fortalecimiento Institucional*

En caso de su financiamiento, el Comité Ejecutivo debe estar preparado para responder inmediatamente con el desarrollo y el asentamiento de documentos de trabajo (procedimientos) en varias áreas de este programa multidisciplinario (a saber, la colección de las muestras vegetales, las extracción y fraccionación químicas, los ensayos biológicos, y los estudios de toxicidad), y con un esquema del flujo de los ensayos biológicos y el patrón de la confirmación de aquellos extractos o compuestos purificados que demuestran actividad biológica.

El entrenamiento del personal debe comenzar durante esta etapa, y comprenderá, tanto de duración corta (1 año o menos), como de duración larga (3-5 años, hacia doctorado), en una o más instituciones colaboradores fuera del país del centro de estudio.

Simultáneamente, la selección de las plantas para ser investigadas ("especies candidatas") debe comenzar durante esta etapa, basada en la revisión y la evaluación de la literatura. Una vez seleccionadas, se delegará la colección de las muestras, para la extracción química y para los demás estudios posteriores. Además, estas plantas puedan ser utilizadas por el(los) personal(es) en el período de entrenamiento en el exterior del centro de estudio, o puedan ser también asignadas para los ensayos biológicos y aislamiento, en las instituciones colaboradoras, hasta tanto que el(los) centro(s) propio(s) llegue(n) a funcionar.

Los estudios de la eficacia, la toxicidad y la inocuidad de extractos vegetales, seguidos por estudios de estabilización y estandarización de los extractos, se pueden llevar a cabo en el(los) centro(s) en formación.

ETAPA 3: *Pleno Funcionamiento de los Centros*

Esta etapa corresponde al pleno funcionamiento del programa propuesto. Las siguientes actividades del(los) centro(s) comprenderá(n):

a. Selección continuada de especies candidatas.
b. Estudios continuados sobre la actividad biológica, la estabilización y la estandarización de extractos.
c. Aislamiento químico y elucidación de estructura de los principios vegetales activos guiados por ensayos biológicos.
d. Estudios de eficacia e inocuidad (toxicidad, mutagenicidad) de los compuestos purificados.

Esta etapa debe ser proyectada por un período mínimo de 5 años, y anualmente, debe haber una evaluación del progreso de trabajo por parte del Comité Ejecutivo.

Hacia el final de esta etapa, una revisión general y una evaluación del progreso del programa debe ser realizada, como base de solicitar la continuación del soporte financiero.

Es durante esta etapa, en que el Comité Ejecutivo del Programa debe explorar la manera de desarrollar la tecnología apropiada para transferir los resultados de la investigación del(los) centro(s) a los sectores privados (cultivadores e industrias).

JUSTIFICACION DEL PROGRAMA PROPUESTO

1. El programa propuesto, bajo una implementación bien ejecutada y dirigida, se espera descubrir nuevas sustancias químicas biológicamente activas, que sean útiles para la terapia moderna.
2. Además, como un objetivo de largo plazo, se espera que el descubrimiento de los principios vegetales biológicamente activos resulte llegar hacia el desarrollo de una industria farmacéutica, dentro de uno o más de los países miembros.
3. Se espera que el programa propuesto resulte en el fortalecimiento institucional y en la edificación del saber dentro de los países miembros, en los campos de etnofarmacología, química de los productos naturales, ensayos biológicos, y en la fitoterapia.
4. El programa propuesto está en acuerdo con el deseo de los Países Miembros de la *31a. Asamblea Mundial de la Salud,* para ejecutar la resolución de "Drug Policies Management: Medicinal Plants" (Anon., 1978), que incluye:
   a. El inventario de las plantas medicinales utilizadas en diferentes países.
   b. La estandarización de la nomenclatura de las plantas medicinales comúnmente usadas.
   c. La evaluación de la eficacia y de la inocuidad de las plantas.
   d. La diseminación de la información sobre las plantas medicinales.

e. El establecimiento de los centros de investigación y de entrenamiento, para evaluar la eficacia de la medicina tradicional.

5. El programa propuesto contribuirá al cumplimiento del deseo de los 158 Estados Miembros de la Organización Mundial de la Salud (OMS) en la implementación de la "Estrategia Global de la Salud para Todos para el Año 2000" (Organización Mundial de la Salud, 1980).

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UNA REFERENCIA DEL SIGLO XIX SOBRE EL SEDANTE YOCO *(Paullinia yoco)*

Por Víctor Manuel Patiño [1]

Hace 20 años publiqué la única noticia que conocía entonces sobre menciones de la bebida yoco, producida por un bejuco de las Sapindáceas, *Paullinia yoco* R.E. Schultes & Killip, del Putumayo-Caquetá, de autor del siglo XIX, en este caso el cura explorador Juan María Albis (Patiño, 1967, III, 259-262; 260-262).

Una publicación consultada posteriormente permite enriquecer la bibliografía del yoco, bebida de importancia entre las tribus indígenas del piedemonte andino oriental ecuatorial. Se debe a un personaje que actuó en la Nueva Granada a mediados del siglo XIX en posición relevante, hasta el punto de que llegó a ser presidente de la República. Se trata del controvertido político, el general José María Obando, que ejerció la presidencia en el período 1853-1854, año este último en que fue depuesto por el sedicioso general José María Melo. A raíz de la derrota que Obando había sufrido en el sector de Cali conocido como La Chanca el 11 de junio de 1841 (Riascos Grueso, 1949, 33), tuvo que exiliarse al Perú para no caer en manos de sus enemigos; pero en vez de viajar por mar o por el callejón interandino, pues tenía cortados todos los caminos, lo hizo por los altos afluentes del Amazonas, el Putumayo y el Marañón, entre septiembre de 1841 hasta el 22 de febrero de 1842 en que llegó a El Callao, procedente del puerto norteperuano de Huanchaco. Al pasar el 30 de septiembre de 1841 por el caño Caucayá habitado por indios macaguajes (la referencia dice equivocadamente Cancayá), hace esta observación:

"Ellos como todos los del Territorio, usan mucho como bebida de la infusión o maceración de la corteza de un bejuco muy grueso, llamado *yoco* que abunda en todos los puntos cálidos de aquellos bosques.

"Para estos indios es tan indispensable su yoco como lo es la coca para los de Tierra-adentro y demás que viven a las inmediaciones de Popayán.

"Esa bebida, el yoco, tiene propiedades muy singulares; su sabor, sumamente amargo al principio, acompañado de un olor repugnante, a poco de tomarla se siente irse endulzando gradualmente la boca. En corta cantidad es febrífuga y estomacal: en agua fría y en cantidad mayor es purgante, y en agua tibia sirve de vomitivo. Es también narcótica, mas, luego que ha pasado el narcotismo deja en el cuerpo y en el alma un bienestar inefable; siendo ésta tal vez la causa principal que estimula a hacer un uso tan constante de esta bebida" (Obando, 1880, 55). No deja de tener interés el hecho de que un político en huida hubiera puesto atención a las regiones por donde pasaba y tomado nota de los productos y de las costumbres de las tribus observadas durante el viaje. En esa época el Caucayá, afluente del Putumayo, no se sabía a qué país pertenecía; pero después ha pasado a formar parte de la geografía colombiana. En su desembocadura se halla ahora Puerto Leguízamo.

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EL PROFESOR RICHARD EVANS SCHULTES

*Por Hernando García Barriga**

Hace cuarenta y seis años, una mañana del mes de agosto de 1941, se me anunció la llegada de un visitante que preguntaba por mí en la oficina del Instituto de Ciencias Naturales de la Ciudad Universitaria; un joven Botánico, bostoniano, que acababa de culminar sus estudios con el grado Ph.D. de la Universidad de Harvard, Estados Unidos de Norte América y que se proponía hacer un viaje de exploración e investigación sobre el "Caucho" ***(Hevea)*** que crece silvestre en las partes bajas, a orillas de los principales ríos del Amazonas y Vaupés y en otras regiones de nuestras selvas.

Estábamos en plena Segunda Guerra Mundial, y el caucho, la quina y otras materias primas vegetales de reconocida importancia en tales momentos, se habían agotado en el comercio; por lo cual la Corporación para el Desarrollo del Caucho del gobierno de los Estados Unidos, encomendó tan importante misión a este científico que se iniciaba en la ciencia de la Botánica. El primer diálogo con el doctor Schultes, como todos los que de aquí en adelante se iban a suceder eran de tal interés que se prolongaban por varias horas.

Mis experiencias como explorador botánico, resultaban interesantes para él por su absoluto desconocimiento, entonces, de las condiciones tropicales del país y consiguientemente de los típicos enclaves de sus selvas con los misterios de su flora única en el mundo, por demás rica en especies nuevas para la ciencia, a la cual él, tan brillantemente, arrancaría secretos inefables que luego pasarían a los Herbarios y Bibliotecas de Harvard y de la Universidad Nacional de Colombia. El joven e ilustre visitante de Harvard se asombraba con mis primeros relatos sobre las experiencias gozadas y sufridas como colector de especímenes en el territorio de nuestras selvas, sobre los recorridos a través de sus caudalosos ríos interrumpidos por los peligrosos "Raudales" o "Cachiveras" que hacen la navegación difícil y la prolongan fuera de lo previsto para esquivar sus funestas consecuencias, con el paso a pie por los "baradores", con todos los materiales de trabajo como las prensas, papel periódico, formol, la comida, objetos personales, cargados a la espalda en unas cuantas idas y venidas, y lo que es más penoso, la propia lancha o "curiara" halándola sobre rodillos de madera, de modo que pocos metros se avanza cada día hasta salvar totalmente el raudal, cuando se vuelve a tirar la lancha al agua para continuar la marcha. Los indígenas habitantes de estas selvas, que la hacen amable con su modo de ser francos, ingenuos, alegres, guardadores de los secretos por muchos años acumulados y conservados por tradición paternal y que el botánico poco a poco ha recibido de ellos con el trato afectuoso, para transmitir a los demás científicos, como generosamente lo ha hecho el doctor Schultes en sus innumerables artículos y publicaciones. Son los indígenas los que conocen los enigmas de muchas de las plantas que viven en ese mundo varias veces extraño a nosotros; son los indios, quienes con su "sexto sentido" nos orientan en la selva y nos libran de muchos riesgos, y si estamos enfermos, con plantas maravillosas nos curan; son, pues, nuestros amigos y compañeros quienes nos hacen posible el subsistir en estos lugares tan intrincados y tan llenos de insospechados peligros.

Esos fueron necesariamente los temas principales de nuestra primera entrevista; la base del cordial comportamiento.

Si de improviso a mi presencia llegó el doctor Schultes con el complejo atuendo de sus ponderadas virtudes, igualmente a él abría, súbitamente, sin reservas mis recuerdos vividos en la actividad botánica. De allí que resulte en este escrito, de una vez adentrándome en los secretos de la selva, medio en el cual el doctor Schultes por años vivió la auténtica y tradicional colombianidad. Fundamentamos nuestra amistad en la lealtad y en el intercambio de nuestras apreciaciones científicas; del análisis since-

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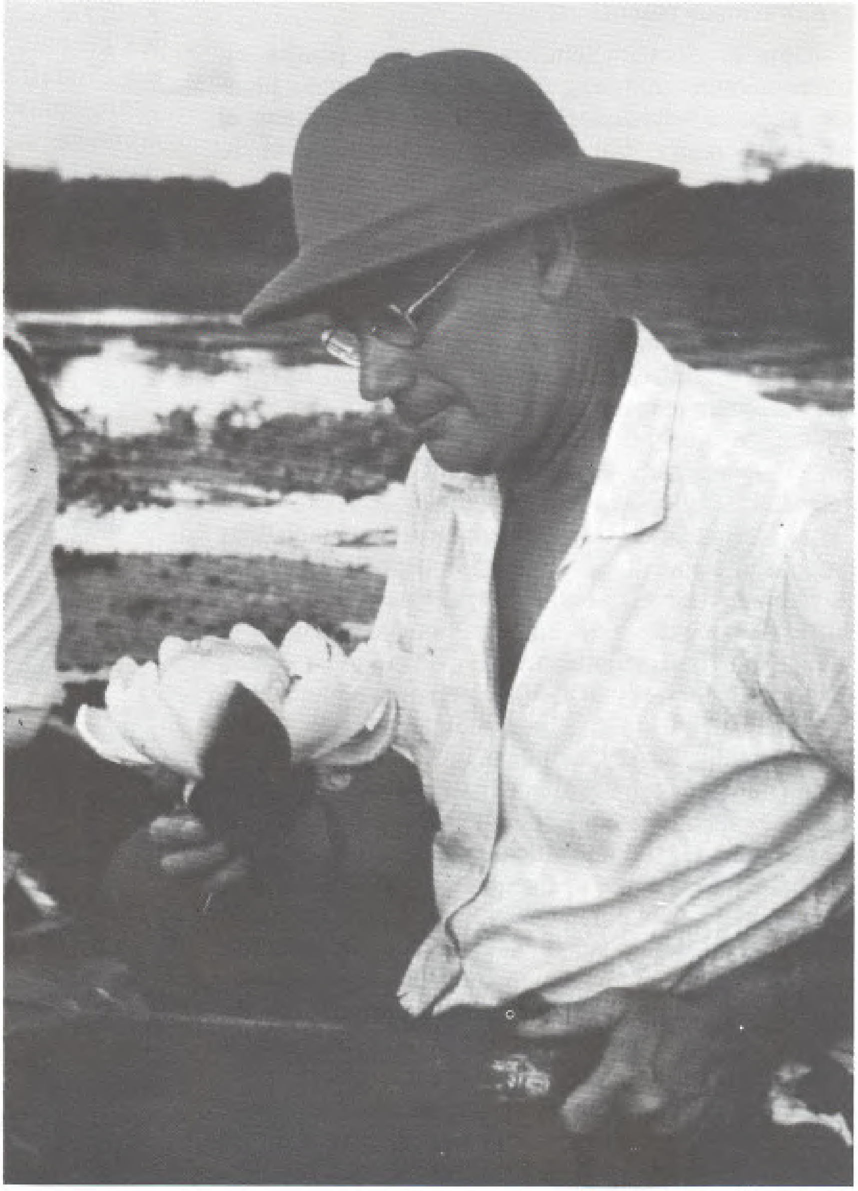
ro de nuestras experiencias; de la eficacia receptiva del consejo que, como tal a nosotros llegaba y llega el mandato de los ordenamientos de las leyes botánicas; la confianza y la fe con que yo recibía y acepto agradecido los autorizados conceptos del Doctor y Profesor de Harvard.

Todas aquellas experiencias y muchas más, las vivió el doctor Schultes insospechadamente a lo largo de los doce años de permanencia en esos inmensos territorios. De éstos y de sus planes futuros hablábamos mientras en su primera visita le mostraba el naciente Herbario Nacional Colombiano y los principios del Jardín Botánico plantado con nuestro esfuerzo en los alrededores del primer edificio de la Ciudad Universitaria, inaugurado el seis de agosto de 1938. Allí con Pérez Arbeláez y con José Cuatrecasas trasladamos las instalaciones que, dos años más tarde, conformarían el Instituto de Ciencias Naturales. En las antiguas instalaciones reposaban ya las primeras colecciones de la flora colombiana de nuestros páramos y del Caquetá, Putumayo y Llanos Orientales, coleccionadas por Mutis, José J. Triana, José Cuatrecasas, E.P. Killip, W.A. Archer, Pérez Arbeláez y el suscrito; colecciones que fueron complementadas en los doce años subsiguientes por el doctor Richard E. Schultes con las de Putumayo, Amazonas y Vaupés principalmente, fiel testimonio de su amor a la botánica y de sus afectos y dedicación a las tierras colombianas, que sólo abandonaba para viajar a Boston y visitar a sus padres, recoger el correo y ordenar sus trabajos escritos en la selva sobre sus rodillas, para publicarlos, ya en el "Botanical Museum Leaflets", de la Universidad de Harvard, publicación de la cual fue su Editor desde 1957, ya en otras revistas científicas como Economic Botany. Lloydia, Caldasia y Mutisia, de Estados Unidos las primeras y de Colombia las dos últimas. Igualmente, aprovechaba sus salidas de la selva colombiana para ordenar, clasificar y rotular en el Museo Botánico de Harvard su inmensa colección de plantas (hasta hace poco, más de veinte mil especímenes o números botánicos) que por quintuplicado recogía en la selva para sendos envíos a otras instituciones científicas, con el fin de enriquecer sus Herbarios, sin olvidar, claro está, el nuestro al que le tenía preferencia y que guarda valiosos especímenes "autóctonos" de la flora Amazónica, tan escasamente representada en el Herbario Nacional Colombiano. Debido a que con el doctor Schultes coleccionábamos hasta doce duplicados de la misma planta, ésta quedaba debidamente representada en los principales herbarios del mundo, para facilitar el estudio de especialistas en determinados grupos (familias) de plantas que pueden ofrecer cambios morfológicos según el hábitat, como consta en diversos estudios realizados. Del acervo de estos

Doctor Richard Evans Schultes examinando la *Hevea nítida* (Sabana de Jisijisimo – Vaupés).



En Leticia junto a plantas de *Victoria regia*.

(Foto Timoteo Plowman).

especímenes selváticos, el doctor Schultes en varios escritos hace constar sus descubrimientos extractados de la vida de los nativos de la selva, para atribuir valores específicos a plantas dedicadas al alimento, al vestido, a la pesca, a la caza o como medicinales, insecticidas, balsámicas, cauchos, resinas, aceites y gomas de mascar, tintes y fibras; propiedades antes desconocidas en los medios científicos y que, gracias a la actividad desplegada por el doctor Schultes, el cultivo de tales plantas y su explotación como materia prima llegó rápidamente a extenderse entre creadores de algunas industrias.

Nuestra amistad se inició, pues, en aquel día de agosto de 1941, y se consolidó al haber sido compañeros en varias expediciones exploratorias en el interior del país, pero muchas más en el Vaupés y el Amazonas; las primeras a nuestros famosos y únicos "parámos" como los de Guasca y Sumapaz, estudiados quizá por todos los famosos botánicos que nos han visitado, contribuyendo de manera definitiva al conocimiento especializado de nuestra flora paramuna, siendo el primero el doctor José Cuatrecasas hacia el año de 1932. Unánime ha sido entre los científicos la admiración por el paisaje único de la vegetación, la mayoría acaulerosuletum, con grandes extensiones de *Espeletia;* a unos cuatro mil metros sobre el nivel del mar, con temperaturas de 23 grados centígrados, al mediodía, bajo 0 al anochecer y con irradiaciones solares muchas veces intolerables por la presencia de los rayos ultravioletas. Las especies de *Espeletia* son hermosas plantas endémicas, con sus hojas lanudas de color grisáceo o plateado e inflorescencias erectas con grandes capítulos de color amarillo-quemado o amarillo-oro, especies estudiadas por el inolvidable y nobilísimo botánico doctor Cuatrecasas, nuestro común amigo que dedicara al ilustre botánico bostoniano, como recuerdo de su primer viaje a las alturas de la cordillera Oriental, y por los reconocidos méritos científicos de éste la *Espeletia schultesiana* Cuatr.; destacándose algo particular o coincidencial, en el mismo páramo y a pocos metros, otra especie que amablemente el doctor Cuatrecasas también me dedicara: la *Espeletia garcía-barrigae* Cuatr., dos especies muy bellas, nuevas para la ciencia del mismo lugar y muy afines, como símbolo de la grande amistad entre dos botánicos.

Exploraciones Botánicas:

Con el doctor Schultes, viajamos juntos en diversas oportunidades; descubrimos muchas plantas, algunas novedades geográficas, pero nunca el oro del Guainía, por donde seguramente, más de una vez pasamos por encima de sus minas o nos bañamos en los ríos de donde hoy sacan de sus fondos muchas libras de oro; fuimos a la Macarena, la más antigua de nuestras serranías. Forma parte del sistema de "cerros y sabanas" casmofíticas de nuestra Amazonia y Orinoquia; redescubierto por el doctor Schultes, donde encontramos, quizá, las más antiguas plantas de nuestra flora contemporánea, entre ellas las más notables son *Navia, Vellozia, Paepalanthus, Abolboda, Xyris, Pitcairnia Vaupesia y Cephalocarpus dracaenula.* (Cyperaceae). Estas plantas, presentan asociaciones características que desde el punto de vista fisionómico configuran las llamadas sabanas casmofíticas que a manera de islotes se divisan como partes altas y rocosas de la selva y particularmente en las cimas de los cerros (Tepuyes) de unos 400-500 metros de elevación, tales como el de "Chiribiquete", "Yapobodá", "Isibukurí", "Las Campanas", "Guaranjudá", y "Jirijirimo" y otros tantos dispersos en la inmensidad de la selva, que van desde la Macarena al Brasil, las Guayanas y el oriente de Venezuela. Son los relictos de lo que fue el Escudo de la Guayana, o la así llamada cuarta cordillera, más antigua (Jurásico) que las cordilleras Oriental, Central y Occidental. Son los factores edáficos y por consiguiente geológicos los que condicionaron el surgimiento de las sabanas casmofíticas. Se trata, pues, de sabanas naturales que por su geología, flora y fauna son muy antiguas y en cuya superficie de arenisca sólo pueden crecer vegetales muy especializados. Sin embargo, con el transcurrir del tiempo se consolida el suelo sobre la arenisca; la vegetación selvática desplaza enteramente la vegetación abierta de la sabana, como pudimos observarlo con el doctor Schultes en las sabanas de "Yapobodá" en repetidos viajes que juntos hicimos por los años de 1958 y 60. De modo que los islotes de sabana natural tienden a estrecharse, siempre y cuando predominen las condiciones naturales y el hombre no ejerza su influencia modificadora. Si esto último ocurre, por ejemplo a través de quemas consecutivas o talas intensas del bosque, se presenta un fenómeno opuesto, es decir la sabana natural se extiende. Tal fenómeno se acentúa hacia el norte, como ocurre concretamente en la Orinoquia debido a las influencias climáticas pues sabido es que, los vientos Alisios del noreste condicionan en esta región dos épocas climáticas bien marcadas; la época seca extendida más o menos de noviembre a abril; y la época de lluvias, con duración de mayo a octubre. Evidentemente la época seca favorece las quemas naturales o artificiales y la extensión de la vegetación graminoidea ostensiblemente heliófila.

El doctor R.E. Schultes se ocupó, particularmente en las sabanas de "Yapobodá", "Chiriquete", "Jirijirimo" y "Guaranjudá", del estudio de la familia *Velloziaceae,* muy afín a las *Amarilladaceae,* con los géneros *Vellozia* (para Sur América) y *Barbacenia* (Sudáfrica) rara por su morfología, fisiología y porte arborescente. Si se exceptúan las palmas, como se sabe, son raras las Monocotiledóneas que presentan este porte arborescente; ejemplos notables son la *Dracaena* de las Islas Canarias, *Yucca* que se halla cultivada en nuestros parques y jardines y *Pandanus* de Malaya. Pero, *Vellozia,* además presenta raíces internas, y en ésto es única. La radicación de *Vellozia* es homorhízica, es decir que el punto vegetativo, al mismo tiempo que produce hojas, también produce raíces; pero los primordios y, por consiguiente, las raíces desarrolladas, después de originarse en el periciclo, no rompen la corteza, sino que continúan su crecimiento entre ésta y el cilindro central, formando así un paquete interno de raíces, recubierto por la corteza (Hans Weber: Mutisia No. 13 Marzo 21, 1953). Unicamente al alcanzar el suelo las raíces emergen de la corteza y se extienden superficialmente sobre las areniscas de las sabanas casmofíticas, su hábitat característico. El distinguido científico estudió en su conjunto esta familia, resultando casi todas sus especies nuevas, haciéndolas figurar en forma destacada en sus escritos consignados en revistas científicas de este país y de Estados Unidos, como la *Vellozia macarenensis* R.E. Schultes, *Vellozia dumitiana* R.E. Schultes, *Vellozia phantasmagoria* R.E. Schultes; *Vellozia maudeana* R.E. Schultes, la primera descubierta por él en la Macarena y la segunda coleccionada en el Cerro Isibukuri (Río Kananarí, en 1951). En las expediciones de finales del año de 1951 y en la de 1952, a las que fui invitado por el doctor Schultes, estuvimos ocupados en el estudio de la flora de la parte central de la hoya del río Apaporis, uno de los más desconocidos de la Amazonia de Colombia. Esa parte de la vastísima cuenca Amazónica había permanecido inexplorada, debido a las dificultades existentes para llegar a ella. Es una región selvática, casi por completo despoblada, cuyas vías fluviales que a ella dan acceso son prácticamente innavegables entre otras cosas por sus "Raudales". De esta zona, es la *Vellozia lithophila* R.E. Schultes. Además de estas especies, encontramos otras plantas que por el porte, belleza y hábitat merecen especial mención en esa comarca; son: la *Navia lopezii* L.B. Smith ex R.E. Schultes, la *Navia caulescens var. minor y la Pitcarnia vaupesis.* Esta última era buscada por Martius, en el siglo pasado, allí y en el cerro de Cupatí (río Caquetá, al frente de La Pedrera) por presumirla nueva especie; nosotros anduvimos con mejor fortuna y la encontramos formando grupos densos en la cumbre del cerro.

Algo verdaderamente asombroso fue, cuando en mi primer ascenso por el río Kuduyarí, afluente del río Vaupés, a dos días de Mitú, el día 4 de Noviembre de 1952, encontré en las extensas sabanas de Yapobodá un *Paepalanthus* gigantesco de dos metros de alto y con una inflorescencia blanca; planta verdaderamente maravillosa de la familia *Eriocaulaceae* por alcanzar este tamaño; en general, son pequeñitas rosetas, que viven en nuestros pará-

Río Apaporis: Soratama. Richard Evans Schultes, Hernando García Barriga e Isidoro Cabrera. Diciembre 15-19, 1951.

mos a más de tres mil metros sobre el nivel del mar. El doctor Schultes, cuando le conté en Mitú este descubrimiento, viajó al otro día presuroso al sitio de origen para conocerla en vivo, y asombrarse también; más tarde, la describió con el nombre de *Paepalanthus moldenkeanus* R. E. Schultes.

Las *Rapateaceae,* comprenden especies endémicas de las sabanas y del interior de la selva, en lugares sombreados y húmedos, poco o nada conocidas, hasta cuando en el año de 1954, conjuntamente con el doctor Luis Eduardo Mora Osejo, Exdirector del Instituto de Ciencias Naturales de la Universidad Nacional y hoy Presidente de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales, las estudiamos y publicamos en el Boletín, Mutisia volumen 1, No. 22 agosto 25, 1954, "Contribución al estudio de las *Rapateaceae* de Colombia", gracias a las expediciones anteriores realizadas por el mismo distinguido Botánico y por otros miembros del Instituto de Ciencias Naturales a la Amazonia Colombiana. En esta publicación describimos varias especies nuevas y constatamos la presencia en el territorio colombiano de las especies *Saxo-Fridericia colombiana* y *Saxo-Fridericia subcordata; la Rapatea paludosa, la Rapatea wettsteinii, la Rapatea muaju* H.García Barriga et L.E. Mora; *Rapatea circasiana* H. García Barriga et L.E. Mora y la *Rapatea schultesiana* H. García Barriga et L.E. Mora; esta especie con justísimo agrado dedicamos al doctor R.E. Schultes; la especie *Schenocephalium martianum* dedicada a Martius y especie propia de La Pedrera, (Amazonas) y que llaman vulgarmente "Florecitas del Caquetá", linda planta que puede lucir en los floreros por varios meses. Hoy con la contribución de Maguire, contamos para la Amazonia colombiana, con doce géneros y treinta y nueve especies de esta familia tan significativa en la taxonomía vegetal como importante por su mucílago en las especies de *Rapatea,* amén de la belleza de su porte e inflorescencia en los otros géneros, como la "flor de Inírida" *Guacamaya superba* Maguire que bien podría tener puesto preferencial en jardines y floreros. Es interesante anotar que muchas de las especies de la familia *Rapateaceae* registradas para la flora colombiana también se encuentran, como lo constatamos, en Territorio Federal del Amazonas y en el estado Bolívar, Cerros Guiquimima y Carrao-tepuí de Venezuela.

Las *Xyridaceae,* plantas muy especiales que crecen en las sabanas de arenisca como las especies del género *Xyris* y las del género *Abolboda* con sus bellas flores azules que cubren la mayor parte de la sabana, semejando un *graminetum.* Gracias a las colecciones de Schultes, los doctores Jesús M. Idrobo y Lyman B. Smith, pudieron hacer la monografía de la familia, publicada en la Revista Caldasia en el Volumen Sexto No. 29 de 1954; con un resultado sorprendente para la Flora Colombiana, ya que sólo se conocían unas dos o tres especies en el centro de nuestro país; hoy, según los autores nombrados se presentan para la flora de Colombia treinta y cuatro especies, de las cuales veintiocho pertenecen al género *Xyris* y seis al género *Abolboda.* De este género los autores le dedicaron al doctor R.E. Schultes por su contribución inmensa (más de 96 números recolectados por él, en el Vaupés y Amazonas), la *Abolboda schulthesii* Idrobo & Smith.

Qué decir de la importancia y belleza de aquellas plantas pequeñas que casi siempre están sumergidas en las charcas y que estudió el doctor Alvaro Fernández Pérez en su magnífica monografía "Plantas insectívoras *Droceraceae* y *Lentibulariaceae,* publicada en la revista "Caldasia" en los números 41 de 1964 y 43 de 1965; especies de hábitat terrestre o de sabanas de arenisca, con cuyas trampas atrapan larvas e insectos pequeños de los cuales derivan su sustento.

Entre las investigaciones botánicas del doctor Richard E. Schultes, en el campo de la taxonomía vegetal, se cuentan sus trabajos sobre especies del género *Sarauia* de los bosques alto-andinos y de los subpáramos, descritas por él y dedicadas generosamente a sus colegas así: la *Sarauia garcía-barrigae* R.E. Schultes, descubierta en fecha julio 20 de 1947 en el Sub-Páramo "Alto de Peñones" sobre la carretera del Líbano a Murillo, con el número 12.276 (Plantae Colombianae XIII, investigaciones specierum *Sarauiae,* por Richard E. Schultes, Mutisia volumen 1 No. 3 Jun. 1952). En aquella misma publicación describe otra nueva especie la *Sarauia kallima* R.E. Schultes del páramo de Sonsón (Antioquia) y hace referencia a la *Sarauia chillanta* R.E. Schultes descrita también por él. En la Revista Caldasia Volumen 1 No. 9. 1944 (Plantae Colombianae. VI) describió el doctor R.E. Schultes la *Saurauia cuatrescasana,* dedicada al doctor José Cuatrecasas, sistemático explorador botánico y descubridor de muchas especies en Colombia. Así mismo encontramos algunas otras como la *Sarauia intensa* R.E. Schultes, *Sarauia omichlophila* R.E. Schultes y otras más como la que descubriéramos juntos (Caldasia Volumen 1 No. 6 de 1943) *Saurauia putumayones* R.E. Schultes et H. García-Barrigae, bella planta de abundantes flores blancas y muy fragantes, cuyos frutos comestibles se conocen con el nombre de "Moquillo" en el Huila, Río Villalobos, de donde es oriunda esta especie. La *Sarauia rigidissima* R.E. Schultes, especie de los Farallones de Cali y otras.

Merece, también, especial mención como estudio sistemático del doctor Richard E. Schultes el verificado sobre el género *Herrania,* de la familia *Sterculiaceae,* cuya investigación dio resultados muy interesantes, como el descubrimiento de varias especies entonces desconocidas. Se trata de plantas americanas principalmente de las selvas amazónicas; sólo unas pocas son del interior del país, de climas medios como la *Herrania lacinifolia* Goudot, que encontré en el año de 1939 en los cafetales de la

Comisión Inglesa para el estudio del Cacao: Amazonas Río Kuduyarí (Agosto a Diciembre 1952).

Vereda de "Calamonte", Municipio Falán, departamento del Tolima y cuyos frutos se conocen con el nombre común de "Cacao Silvestre" por su parecido al verdadero Cacao *(Theobroma Cacao L.)*. Me ocupé del estudio de este género al determinar la especie encontrada en Falán. Resultaron dos especies nuevas: la *Herrania cuatrescasana* H. García Barriga y la *Herrania dugandii* H. García-Barriga, (Tres especies de *"Herrania* de la flora colombiana"; volumen 1 No. 2, 1941). El doctor R.E. Schultes había coleccionado algunas especies en el Putumayo y en el Vaupés, por lo que en este material pudo hacer un trabajo taxonómico de mucha importancia tanto para la botánica sistemática como para la económica. Así, en Caldasia Volumen 1 No. 9-1944, aparecen publicadas là *Herrania nitida* (Poeppig) R.E. Schultes y la *Herrania purpurea* (Pittier) R.E. Schultes y en Plantae Austro-Americanae VIII –1953 figuran, la *Herrania breviligulata* R.E. Schultes y en 1954 publica *Herrania camargoana* R.E. Schultes, *Herrania kofanarum* R.E. Schultes, *Herrania kanaukuensis* R.E. Schultes, así como la *Herrania tomentella* R.E. Schultes, de la Serranía de La Macarena, Meta, la *Herrania mycterodendro* R.E. Schultes, coleccionada por su autor en el Caquetá y Amazonas; y otras más.

El doctor Richard Evans Schultes, descubre numerosísimas especies de algunas familias representadas en el Amazonas, Putumayo y Vaupés de las cuales citaremos algunas, por ejemplo de la familia *Araceae* y del género *Anthurium*: *Anthurium atropurpureum* R.E. Schultes et Manguire: *Anthurium idroboanum* R.E. Schultes; *Anthurium macarenense* R.E. Schultes *Anthurium macrocephalum* R.E. Schultes; de otras familias la *Tetrapteris methystica* R.E. Schultes y *Clusia schultesii* Maguire, recolectada en el estado de Amazonas Brasil; la *Combretum wanduraganum* R.E. Schultes; *la Carludovica aumratiaca* R.E. Schultes. La *Bombax sordidum* R.E. Schultes, la *Leitgebia colombiana* R.E. Schultes; *(Ochnaceae) Combretum kariyonorum* R.E. Schultes (Combretaceae) *Rhytidanthera regalis* R.E. Schultes (Ochnaceae) *Rhytidanthera melifera* R.E. Schultes, *Rondeletia rupicola* R.E. Schultes var. *chiribisquetana* R.E. Schultes (Solanaceae); *Quararivea Schultesii* Cuatrecasas (Bombacaseae); *Lindakeria Nitida* Killip et R.E. Schultes; *Solanum Aparoranum* R.E. Schultes (Solanaceae); *Senefeldera chiribiquetensis* R.E. Schultes *(Euphorbiaceae); Paullinia scaberula* R.E. Schultes y la *Paullinia yoco* R.E. Schultes *(Sapindaceae)* muy usada por los Kofanes del río Putumayo, como estimulante, etc. *Aechmea schultesiana* (Martius) Mez (Bromeliaceae); *Roupala colombiana* R.E. Schultes (Proteaceae); *Cynometra zamorama* R.E. Schultes (Leguminoceae), *Graffenrieda fantastica* R.E. Schultes (Melastomataceae); *Roupala saxicola* R.E. Schultes (Proteaceae), *Cuñuria australis* R.E. Schultes, *Cunuria Glabatra* (Euphorbiaceae) y muchas otras.

FAMILIA HYMENOPHYLLACEAE *(Pteridofitos)* DEL PARQUE NACIONAL NATURAL ISLA DE GORGONA

Por *María Teresa Murillo*[1]

RESUMEN

Entre los helechos reportados hasta el presente en las islas de Gorgona y Gorgonilla, el Género más representativo es *Trichomanes,* del cual se han encontrado 9 especies consideradas en este trabajo; se incluye una clave a nivel específico, descripciones cortas de los taxa y su distribución en Colombia.

ABSTRACT

Among the ferns reported until now from the Gorgona and Gorgonilla island, the most representative genus is *Trichomanes.* In this paper nine species of this genus have been registered and considered; a key at specific nevel, short descriptions about taxa and their distribution in Colombia are included.

INTRODUCCION

Deseo dedicar este artículo al Doctor RICHARD E. SCHULTES, quien siempre ha demostrado interés por mi trabajo, y me ha brindado amplia colaboración, además de sus oportunos consejos.

El objetivo es el de dar a conocer uno de los Géneros de Pteridofitos más representativos en la isla de Gorgona, por lo cual se hace una clave para las especies, descripción de cada una de ellas, nombres vulgares y usos cuando éstos se conocen.

Acerca de la isla Gorgona, se han publicado interesantes trabajos; quizá lo primero en conocerse fue su Geología, trabajo realizado por el Doctor AUGUSTO GANSSER (1950); posteriormente se hicieron otras expediciones a la isla, y fruto de ellas fueron nuevas publicaciones, entre éstas la de HENRY VON PRAHL *et al.* (1979), donde se hacen diversos reportes faunísticos de vertebrados e invertebrados y algunos sobre algas. Con respecto a flora terrestre, se conocen entre otras las colecciones hechas por KILLIP & GARCIA B., A. FERNANDEZ, C. BARBOSA y la realizada en 1986 por los profesores GUSTAVO LOZANO y ORLANDO RANGEL, del Instituto de Ciencias Naturales de la Universidad Nacional con los estudiantes de Postgrado, quizá ésta ha sido la más exhaustiva, ya que ha permitido conocer la existencia de gran número de familias, géneros y especies vegetales de esta zona.

Entre los Pteridofitos, uno de los géneros con más especies representativas es Trichomanes, el cual pertenece a la familia Hymenophyllaceae, que fue descrita y válidamente publicada por Link en 1833. Se citan ejemplares de otras localidades con el fin de dar a conocer la distribución de las especies en el país.

HYMENOPHYLLACEAE Link, Handb. Erken. Gew. 3: 36.1833.

Plantas epífitas o terrestres; rizoma velloso, corto y erecto, o largo y postrado; pelos marrones a ferruginosos; pecíolo muy variable en longitud, no articulado, algunas veces alado, glabro o velloso, al menos hacia la base; lámina fértil diferente de la estéril, o más comúnmente iguales, simples, pinnado-pinnatífida, bipinnada o 4-pinnada; márgenes frecuentemente ciliados, algunas veces glabros o con pelos marginales estrellados; venación pinnada, raras veces flabelada, con venas falsas presentes o ausen-

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tes; involucro valvado-semicircular, o turbinado o acopado, inserto o exserto; esporangios con anillo oblicuo, sésiles, sobre un receptáculo filiforme, prolongación de una vena; esporas triletes.

CLAVE DE GENEROS

Involucro valvado-semicircular con receptáculo más corto que el involucro . . . . *Hymenophyllum*

Involucro turbinado o acopado con receptáculo más largo que el involucro . . . . . *Trichomanes*

Hasta el presente, el género *Hymenophyllum*, no ha sido reportado en la isla Gorgona. Del género *Trichomanes* se han reportado nueve especies, de las cuales nos ocupamos a continuación.

CLAVE PARA LAS ESPECIES DE TRICHOMANES

a. Frondas heteromórficas, las fértiles más largamente pecioladas.

b. Trofófilos pinnados hacia la base, pinnatífidos hacia el ápice; venas falsas entre las verdaderas . . . . 8. *T. pinnatum* Hedw.

b. Trofófilos pinnatífidos; no se presentan las venas falsas.

c. Esporófilos con lámina de 4-6 mm ancha, involucros continuos, incluidos en el tejido laminar . . . . 3. *T. diversifrons* (Bory) Mett.

c. Esporófilos con lámina muy reducida de 1 mm ancha, involucros peciolados, separados . . . . 7. *T. osmundoides* DC.

a. Frondas uniformes (monomórficas).

d. Rizoma corto, erecto o suberecto, con las frondas agrupadas.

e. Lámina pinnatífida, pecíolo conspicuamente alado desde la base, involucros insertos . . . . 2. *T. daguense* Weath.

e. Lámina 3-4 pinnatífida, pecíolo alado sólo hacia el ápice, involucros exsertos . . . . 4. *T. elegans* Rich.

d. Rizoma largo con las frondas distantes.

f. Pelos estrellados, más o menos numerosos en las márgenes de la lámina.

g. Lámina entera o irregularmente hendida, venación flabelada, labios del involucro tan largos como anchos . . . *9. T. punctatum ssp. sphenoides* (K ze.). W. Boer.

g. Lámina bipinnatífida, venación pinnada, labios del involucro dos veces más largos que anchos . . . . 5. *T. gourlianum* Grev.

f. No hay pelos estrellados en las márgenes de la lámina.

h. Involucros peciolados, lámina pinnatífida, cortamente peciolada, pecíolo, ca 5 mm, rizoma glabrescente . . . . 1. *T. ankersii* Parker.

h. Involucros sésiles, lámina bipinnado-pinnatífida, con pecíolo de 2 cm o más de largo, rizoma conspicuamente velloso . . . . 6. *T. hymenophylloides* v.d. B.

1. **Trichomanes ankersii** parker ex Hooker et Greville, Ic. Fil. 2. pl. 201. 1831.

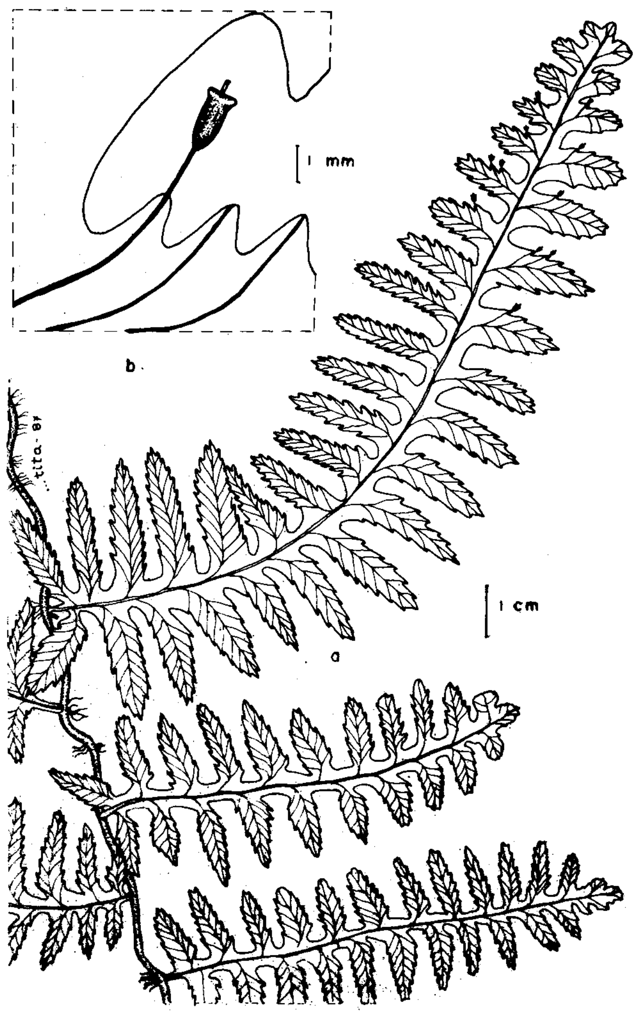

Fig. 1. ***Trichomanes ankersii*** **Parker (G. Lozano-5107). a. hábito; b. fragmento fértil.**

N.v. "Peretio" Huitoto; "Mejewai" Muinane; "Doropejecj" Miraña; "Bama" Andoque.

Planta epífita, con tallo trepador sobre troncos de árboles, esparcidamente velloso; frondas sésiles o muy cortamente pecioladas; lámina pinnatífida, pinnas más o menos crenadas, con tricomas esparcidos, más abundantes en la haz y sobre las nervaduras; involucros exsertos, peciolados.

Usos. Preparado con savia del bejuco Agraz (Doliocarpus sp.) y en mixtura con otros helechos, y tomado en infusión, quita el dolor de cabeza. Las frondas maceradas se toman en infusión de agua fría, contra la fiebre y calofríos. También es empleada como vomitivo.

Distribución. En bosque muy húmedo tropical, de 100-1200 m. alt..

AMAZONAS: Bocas del Río Yarí en el Río Caquetá, Ago 2-17-1978, *M. Pabón et al. 469;* Río Caquetá, Pto. Miraña, Dic 1978, *M. Pabón 733;* Río Popeyacá Feb 25-1952, *R. E. Schultes et al. 15627;* Caño Aduche, Nov 9-1981, *C. La Rotta 74;* Río Caquetá, Araracuara, en Terrazas, Dic 24-1976, *C. Sastre et al. 4964.* AMAZONAS-VAUPES: Río Apaporis, entre el río Pacoa y el Río Kananarí, Jul 3-1951, *R. E. Schultes et al. 12864, 12721.* ANTIOQUIA: Chigorodó, carretera a Turbo, Dic 20-23-1962, *H. García B. 17662;* Zona Cauchera de Villa Arteaga, Ene 1-1953, *I. Cabrera 60;* Valle del Río Anorí, entre Dos Bocas y Anorí, Ago 1-1977, J. D. *Shepherd 823.* CAQUETA: Solano, 8 km SE de Tres Esquinas, Mar 9-1945, *E. L. Little, Jr et al. 9549, 9717.* CAUCA: Municipio de Guapi, Isla de Gorgona, May 1986, *G. Lozano et al. 5087, 5107, 5153;* Río Naya cerca de El Pastico, Feb 23-1983, *A. Gentry et al. 40616, 40620, 40636.* CHOCO: Hoya del Río San Juan, Quebrada La Sierpe, Abr 1-1979, *E. Forero et al. 4452;* Río San Juan, estribaciones del Cerro de La Mojarra, Jun 25-1983, *E. Forero et al. 9503;* Corcovada, parte alta del Río San Juan, Abr 24-25-1939, *E.P. Killip 35262;* Bahía Solano, Quebrada Jellita, Feb 22-1939, *E.P. Killip et al. 33513;* al sur del Río Condoto, entre Quebrada Guarapo y Mandinga, Abr 22-1939, *E.P. Killip 35154;* Quibdó, Samurindó, alrededores del Río Atrato, Mar 13-1967, *K. Mägdefrau 1465;* alrededores del Río Nuquí, Jun 23 1947, *O. Haught 5468;* Río Mutatá, ca 3 km arriba de su unión con el Río El Valle, NW de Alto del Buey, Feb 7-1971, *D.B. Lellinger et al. 185;* ca 10 km NE de Puerto Mutis (Bahía Solano), Ene 27-1971, *D.B. Lellinger et al. 66;* Serranía del Baudó, Feb-Mar 1967, *H.P. Fuchs et al. 22035; A. Gentry et al. 40954;* Mojarras de Tadó, 8.5 km al E de Istmina, Feb 20-1971, *D.B. Lellinger et al. 396;* Río El Salto, 9 km W de Andagoya, Feb 231971, *D.B. Lellinger et al. 467.* NARIÑO: Mun de Barbacoas, entre La Florida y Vuelta del Mayo, Nov 22-1967, *L.E. Mora. 4334;* Costa del Pacífico, corregimiento de Herrera, cuenca del Río Mira, ca del caserío de Candelillas, Abr 27-29-1953, *J.M. Idrobo 1413.* PUTUMAYO: El Pepino en bosque virgen de la finca San Luis, Nov 17-1972, *W. Hagemann 1457;* 1967, *W. Schwabe 67/739.* SANTANDER: Carare en campo Capoto, May 27-1978, *J.E. Pedroza 1.* SANTANDER DEL NORTE: Catatumbo, Campo Río de Oro, May 14-1959, *H. Bischler 2430;* Bellavista arriba de Pipeline, Sep 14-1946, *M.B. & R. Foster 1684.* VALLE: Río Calima (región del Chocó) La Trojita, Feb 19-Mar 10-1944, *J. Cuatrecasas 16607;* Agua Clara, de Buenaventura a Cali, Jun 6-1944, *E.P. Killip et al. 38915;* Córdoba, Feb 17 1939, *E.P. Killip et al. 33414;* carretera de Buenaventura a Calima, Sep 17-1967, *W. Hagemann 454.* VAUPES: Río Piraparaná, raudal Koro, Ago 30-1952, *R.E. Schultes et al. 17079;* Mitú y alrededores, Jul 1975, *James L. Zarucchi 1404A.*

2. **Trichomanes daguense** Weatherby, Contrib. Gray Herb. **95**: 36, pl. 8, fig. 2. 1931.

Fig. 2. *Trichomanes daguense* Weatherby (G. Lozano 5143). a. hábito; b; involucros.

Plantas epífitas; rizoma corto, erecto, con abundantes tricomas marrones en el ápice; pecíolo conspicuamente alado desde la base; lámina pinnatífida; venación pinnada; pinnas irregularmente crenadas, con escasos tricomas en los márgenes y sobre los nervios; involucros incluidos en el tejido laminar, en los ápices de las pinnas, con labios ensanchados y receptáculo largamente exserto.

Distribución. En bosque secundario, húmedo, desde el nivel del mar hasta ca 275 m.

CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 Jun 28-1986, *G. Lozano et al. 5102, 5143, 5155;* lado E de la Isla Gorgona, Feb 11-1939, *E.P. Killip et al. 33190, 33195;* Chuare, Dec 23-1946, *O. Haught 5381.* CHOCO: carretera Quibdó a Istmina, entre Yuto y Certegui, Sep 11-1976, *E. Forero et al. 2761;* región de Corcovada arriba del Río San Juan, Abr 24-25-1939, *E.P. Killip 35265;* Río El Salto, 9 km W de Andagoya, Feb 23-1971, *D.B. Lellinger et al. 469, 470;* bosque al sur de Condoto, entre Quebradas Guarapo y Mandinga, Abr 22-28-1939, *E.P. Killip 35165.* VALLE: 10-15 km E de Buenaventura, Abr 12-1939, *E.P. Killip 34943;* de Buenaventura a Cali, Jun 10-1944, *E.P. Killip et al. 39022;* carretera a Calima, Sep 17-1967, *W. Hagemann 451.*

3. **Trichomanes diversifrons** (Bory) Mett. ex Sadeb. Nat. Pflanzenf. 1 (**4**): 108. 1899.

Hymenostachys diversifrons Bory, Dict. Class. Hist. Nat. 8: 462. 1825.

Planta terrestre; tallo corto, erecto, cubierto de tricomas negruzcos; frondas dimórficas, agrupadas, las estériles pinnatífidas, algunas veces con ápice flageliforme, radicoso, con pecíolo esparcidamente velloso, de longitud variable, pero siempre más

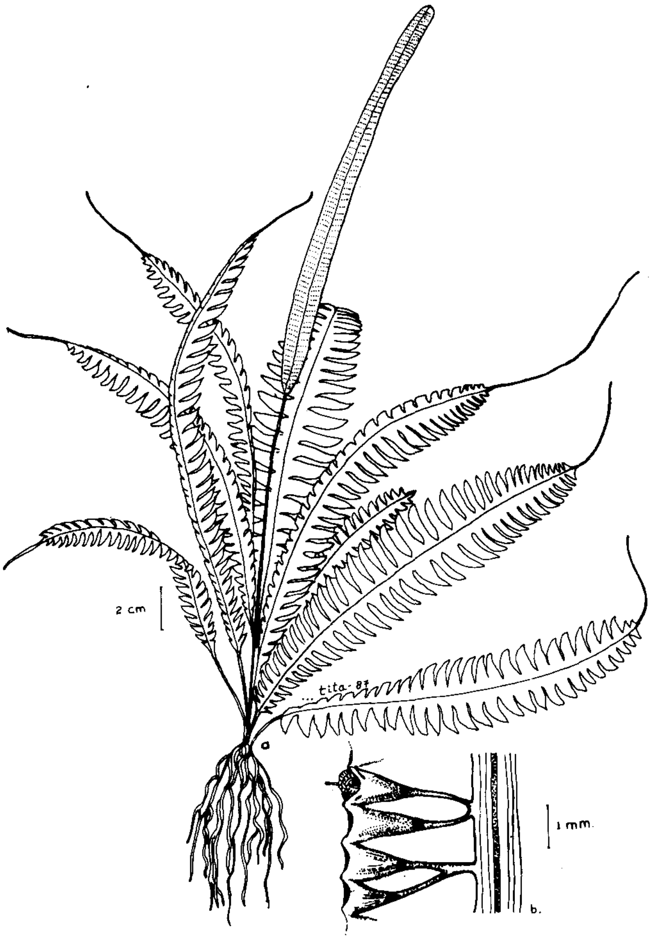

Fig. 3. *Trichomanes diversifrons* (Bory) Mett. (**G. Lozano 5246**). a. hábito; b. involucros.

corto que el de las frondas fértiles; éstas con lámina linear-lanceolada; nervadura irregularmente anastomosada formando a veces un retículo; esporófilos largamente peciolados, con lámina linear-lanceolada, con una línea de involucros a cada lado del margen, continuos, sumergidos en el tejido laminar; receptáculo exserto hasta ca 5 mm.

Usos: Los indios Siona lo usan como bebida refrescante, después de tomar el yage. Maceran las hojas con agua, pero sin hervir y luego beben la poción. (Colección Ricardo Yaiguaje y Jean Langdon No. 40).

Distribución: En bosque lluvioso, sobre barrancos y terrenos húmedos y sombríos, de 50-900 m. alt.

AMAZONAS: Río Igaraparaná, corregimiento La Chorrera, Jul 9-1974, *C. Sastre 3605.* ANTIOQUIA: bosque ca de Guapá, 53 km al sur de Turbo, Abr 28-1945, *O. Haught 4608;* ca Río León, 15 km W de Chigorodó, Mar 12-1962, *Ch. Feddema 1852;* Planta Providencia, en el Valle del Río Anorí, entre Dos Bocas y Anorí, Jun 26-1976, *J.D. Shepherd 444;* Municipio de Mutatá, Villa Arteaga, Feb 16-20-1955, *R.E. Schultes et al. 18689;* Municipio de Segovia, Río Pocuné, por la carretera que conduce a Zaragoza, Abr 27-1983, *J.I. Santa 585.* BOLIVAR: de Norosi a Tiquisio, tierras de Loba, Abr-May 1916, *H.M. Curran 141.* CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 Jun 28-1986, *G. Lozano et al. 5246.* CHOCO: Municipio de Nóvita, vereda Curundó, margen izquierda del Río Ingará, Ene 12-1983, *P. Franco et al. 1084A, 1098;* Loma del Cuchillo, ca 15 km WSW de Chigorodó, Mar 9-1971, *D.B. Lellinger et al. 645;* Mojarras de Tadó, 8.5 km E de Istmina, Feb 20-1971, *D.B. Lellinger et al. 378;* camino de Maniquía al E de Bahía Solano, Ene 26-1971, *D.B. Lellinger et al. 34;* arriba del Río Truandó, 5 km NE de la confluencia del Río Nercua, Mar 4-1971, *D.B. Lellinger et al. 559;* Municipio de Riosucio, Parque Nacional Natural Los Catíos, alrededores del Campamento de Tilupo, May 31-1976, *E. Forero et al. 1725;* Región del Río Baudó, Feb 2-Mar 29-1967. *H.P. Fuchs 22152.* META: Sierra de La Macarena, Plaza Bonita, Nov 19-1949, *W.R. Philipson et al. 1492.* SANTANDER: alrededores de Puerto Berrío, entre los Ríos Carare y Magdalena, Jul 1-1934, *O. Haught 1295.*

4. **Trichomanes elegans** Rich., Acta Soc. Hist. Nat. Paris 1: 114. 1792.

N.v. "Lorito", "Gallito", "Yerba lora", "Catanica", "Navigardora" en Chocó; "Deneme", "Denemeva" Miraña; "Bo-ko-ne" Makuna; "Boo-ge-et" Maku.

Planta terrestre, erecta, hasta 0.60 m alta; rizoma corto, erecto, con tricomas marrón oscuras en el ápice; pecíolo pardo-oscuro, terete, con tricomas dispersos; lámina 3-4-pinnatífida de color verde

Fig. 4. *Trichomanes elegans* Rich. (**G. Lozano 5088**). a. hábito; b. pínnula.

oscuro brillante o más comúnmente verde-azulosa iridiscente, con raquis alado; nervadura pinnada; involucros exsertos, en los cuales casi siempre sobresalen los receptáculos.

Usos: Las hojas maceradas en agua fría, se toman contra la gripa, en dolencias pulmonares, de garganta y para bajar la fiebre. (M. Pabón Nos. 605 y 1033). Contra el veneno de lanzas envenenadas se aplica el jugo de la planta en forma de emplasto. (R.H. Warner No. 258).

Distribución. En lugares húmedos y sombríos de bosque, de 40-1500 m alt.

AMAZONAS: Leticia, Oct 22-1968, *M. Takeuchi s.n.;* Feb 1-1969, *C. Sastre 478;* Santa Isabel; Maloca de Miguel Miranda, Dic 1978, *M. Pabón 605;* Leticia, camino hacia Tarapacá, km 17, Jul 14-1965, *G. Lozano et al. 319.* AMAZONAS-VAUPES: Soratama, Abr 2-1952, *R.E. Schultes 16135;* Raudal Yacopí, Río Apaporis, Feb 18-1952, *R.E. Schultes et al. 15451;* Río Ricapuyá, abajo del Río Piraparaná, Sep 25-1952, R.E. *Schultes et al. 17658;* Río Caquetá, Santa Isabel, May 22-1980, *M. Pabón 1033.* ANTIOQUIA: Quebrada Tirana, cerca del Río Anorí, 9 km norte de Madreseca, May 10-1944, *E.L. Core 671;* Municipio de Zaragoza, corregimiento de Providencia, arriba de la confluencia de Quebrada Tirana, Feb 11-1971, *D.D. Soejarto et al. 2780;* Municipio de Mutatá, carretera a Pavarandogrande, 3 km adelante del puente sobre el Río Sucio, Dic. 8-1982, *Bernal* y *Galeano 426.* CAQUETA: Florencia, Dic 1930, *E. Pérez A. 625;* Región de Florencia, Morelia, Vereda de Santander, Ene 19-1969, *J. Cuatrecasas 27214;* Florencia, Quebrada de Las Perdices, Mar 29-1940, *J. Cuatrecasas 8850.* CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 Jun 28-1986, *G. Lozano et al. 5088.* CHOCO: Barbacoas, May 1853 - Ene 1856, *J. Triana 658/2;* al sur de Cabo Corrientes, Río Encanto, May 15-1974, *R.H. Warner 258;* en las cercanías de Bahía Solano, Jun 30-1958, *P. Pinto et al. 146;* al lado derecho del río Condoto, Ago 23-1955, *J.M. Idrobo 1844;* Quibdó, alrededores de Lloró, Mar 23-1967, *K. Mägdefrau 1472;* Municipio San José del Palmar, vereda La Holanda, Ene 14-1983, *P. Franco et al. 1241;* Municipio San José del Palmar, hoya del Río Torito, Mar 13-1980, *E. Forero et al. 7261;* Región del Río Baudó, Feb 2 - Mar 29-1967, *H.P. Fuchs 22263, 21928;* Río San Juan, arriba de Nonamá, margen izquierda del río, Mar 28-1964, *A. Fernández et al. 6202;* Municipio de Nóvita, vereda Curundó, margen izquierda del Río Ingará, Ene 12-1983, *P. Franco et al. 1083, 1099;* Región de Corcovada, arriba del Río San Juan, Abr 24-25-1939, *E.P. Killip 35319;* Municipio de El Carmen, vereda El Doce, carretera Medellín a Quibdó, km 150, margen izquierda del Río Atrato, Ene 10-1980, *Bernal* y *Galeano 101;* carretera Tutunendó hacia El Carmen, alrededores del campamento "El Doce", Abr 27-1979, *E. Forero et al. 5951;* carretera Panamericana, adelante del Río Pato, Abr 23-1979, *E. Forero et al. 5713;* Municipio de Quibdó, carretera Quibdó a Tutunendó, Sep 6-1976, *E. Forero et al. 2581.* META: Reserva Nacional de La Macarena, colinas entre Pico Renjifo y Cuchilla Sur, Abr 4-1957, *J.M. Idrobo 2523;* Sierra de La Macarena, selva entre los Ríos Guejar y Sansa, Ago 29-1950, *J.M. Idrobo 526;* Ene 26-1950, *W.R. Philipson et al. 2251;* Sierra de La Macarena, vereda El Tablazo, orillas de Caño Diamante, May 29-1973, *M.L. Chaparro et al. 078;* May 27-1973, *E. Forero et al. 810;* Quebrada Playón, Río Manzanares, 42 km W de Villavicencio, Ago 29-1944, *M.L. Grant 10026.* NARIÑO: Tumaco, alrededores de Salahonda, Jul 8-1955, *R. Romero C. 5313;* Municipio de Tumaco, km 90, a 20 km de la Guayacana, Nov 20-1967, *L.E. Mora 4259.* PUTUMAYO: El Pepino, Nov 17-1972, *W. Hagemann 1472.* SANTANDER: alrededores de Barrancabermeja, valle del Río Magdalena, entre los ríos Sogamoso y Colorado, Ago 30-1934, *O. Haught 1343.* SANTANDER DEL NORTE: Campo 84, arriba de Pipeline, Sep 16-1946, *M.B. & R. Foster 1723, 1711;* región del Sarare, Hoya del Río Cubugón, entre El Caraño y El Indio, Nov 12-16-1941, *J. Cuatrecasas 13044, 13259.* VALLE: Sabaletas, km 29 de Buenaventura a Cali, Jun 4-1944, *E.P. Killip et al. 38755;* Río Dagua hacia La Delfina, Sep 21-1967, *W. Hagemann 521;* Municipio de Buenaventura, Nov-Dec 1979, *J. van Rooden et al. 466;* Yatacué, campo de la CVC en Anchicayá, Feb 25-1983, *A. Gentry et al. 40788.* VAUPES: alrededores de Mitú, Oct 20-1976, *E.W. Davis 182;* Río Cuduyarí, Oct 6-1939, *J. Cuatrecasas 7135;* en Montfort, Nov 29-1952, *R. Romero C. 3816;* Río Piraparaná, cabeceras del Caño Teemeña, Sep 10 1952, *R.E. Schultes et al. 1737.*

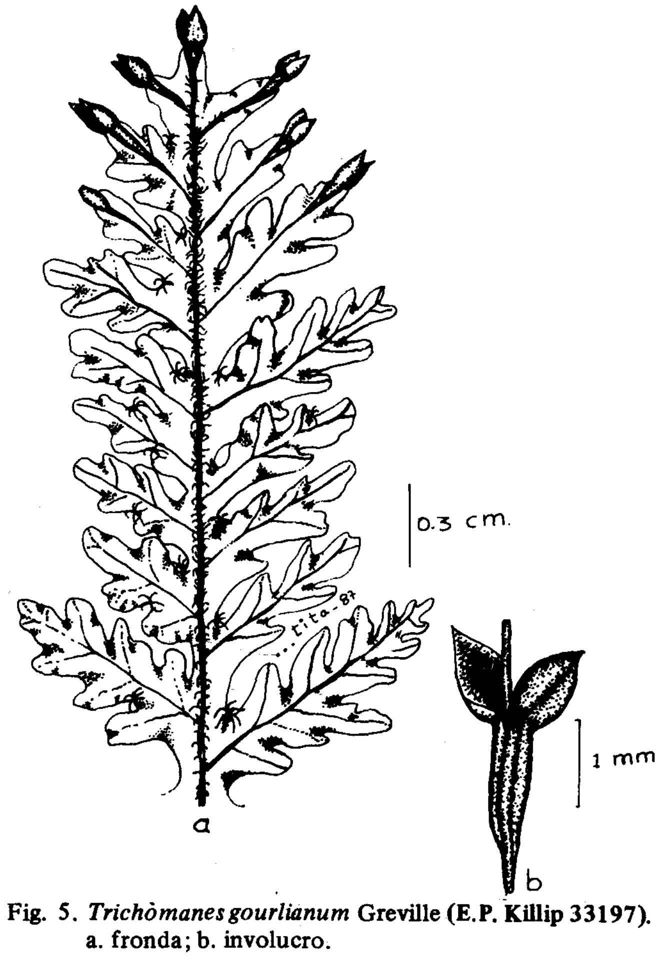

Fig. 5. ***Trichòmanes gourlianum*** **Greville (E.P. Killip 33197). a. fronda; b. involucro.**

5. **Trichomanes gourlianum** Greville, in Smith ex Seemann, Bot. Voy. Herald, 240. 1854.

Plantas epífitas; rizoma largo, postrado, cubierto por abundantes tricomas marrón oscuro a casi negros; pecíolo relativamente corto, velloso al igual que el ráquis y las nervaduras por el envés; lámina bipinnatífida con pelos estrellados en los senos formados por los segmentos; nervadura pinnada; involucros en los segmentos apicales, incluidos en el tejido laminar, excepto los labios que son dos veces más largos que anchos.

Distribución: En bosque, sobre troncos húmedos, de 30-1300 m alt.

CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 - Jun 28-1986, E. *P. Killip et al. 33197.* CHOCO: Bahía Solano, Quebrada Jellita, Feb 22-1939, *E.P. Killip et al. 33543;* Mojarras de Tadó, 8.5 km de Istmina, Feb 20-1971, *D.B. Lellinger et al. 400, 402;* NW de Alto del Buey, confluencia de los ríos Mutatá y Dos Bocas, Feb 10-1971, *D.B. Lellinger et al. 332;* Río Mutatá, ca 3 km arriba de su unión con el Río El Valle, NW de Alto del Buey, Feb 6-7-1971, *D.B. Lellinger 157.* NARIÑO: Costa del Pacífico, corregimiento de Herrera, cuenca del Río Mira, ca del Caserío de Candelillas, Abr 27-29-1953, *J.M. Idrobo 1398.*

6. **Trichomanes hymenophylloides** v.d. Bosch, Ned. Kruidk. Arch. 5 (3): 209. 1859.

Planta regularmente epífita, a veces terrestre; rizoma largamente postrado, velloso; pelos marrón oscuro; pecíolo más corto que la lámina, angostamente alado hacia el ápice; lámina oblonga u obovada, tripinnada o tripinnatífida, reducida o no en la base, ráquis alado, glabra o con tricomas pequeños esparcidos; venas libres, furcadas en el ápice de los segmentos; involucros sumergidos en el tejido laminar del segmento, ensanchados en el ápice, receptáculo exserto.

• Distribución: En bosque húmedo y nublado, de 50-2000 m alt. CAUCA: Municipio de Guapi, Isla de Gorgona, Feb 11-1939, *E.P. Killip et al. 33191.* CESAR: Sierra de Perijá, alrededores de la Laguna de Juncos, Dic 16-1944, *O. Haught 4499.* CUNDINAMARCA: San Miguel, Oct 20-1972, *W. Hagemann 1265;* carretera Bogotá a Fusagasugá, entre San Miguel y La Aguadita, Ago 27-1967, *W. Hagemann 194.* CHOCO: Municipio de El Carmen de Atrato, carretera a Urrao, ca 15 km al NO de la cabecera municipal, Nov 7-1985, *G. Galeano et al. 722.* MAGDALENA: Sierra Nevada de Santa Marta, Transecto del Alto Río Buriticá, Jul 16-1977, *R. Jaramillo et al. 5159-A.* META: Sierra de La Macarena, Pico Renjifo, Ene 21-1950, *W.R. Philipson et al. 2176.* SANTANDER: alrededores de Barrancabermeja, valle del Magdalena, entre los Ríos Sogamoso y Carare, Jul 7-1936, *O. Haught 1921.*

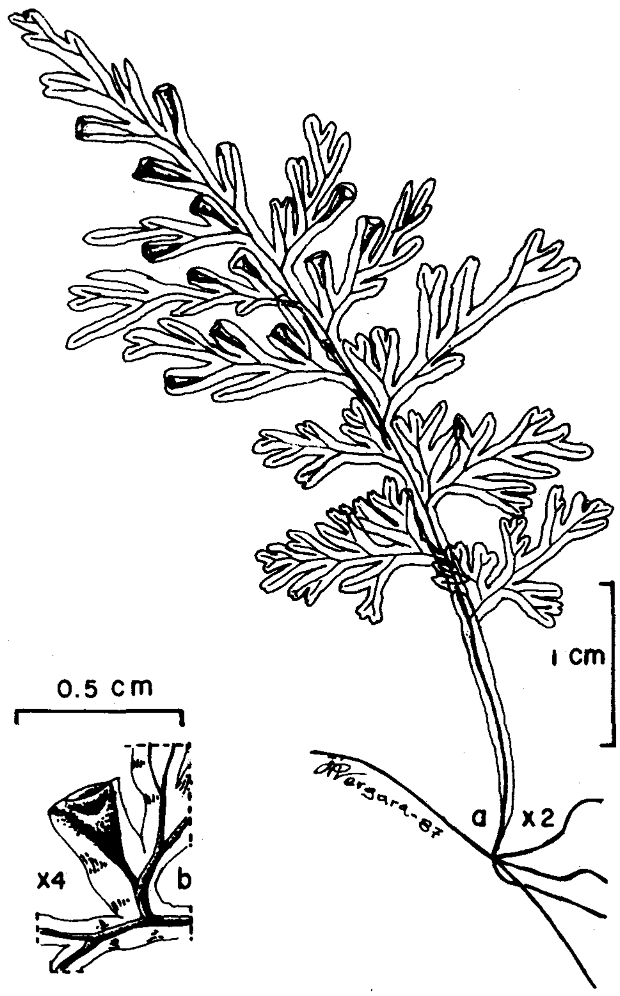

Fig. 6. *Trichomanes hymenophylloides* v.d. Bosch **(E. P. Killip 33191).** a. fronda; b. involucro.

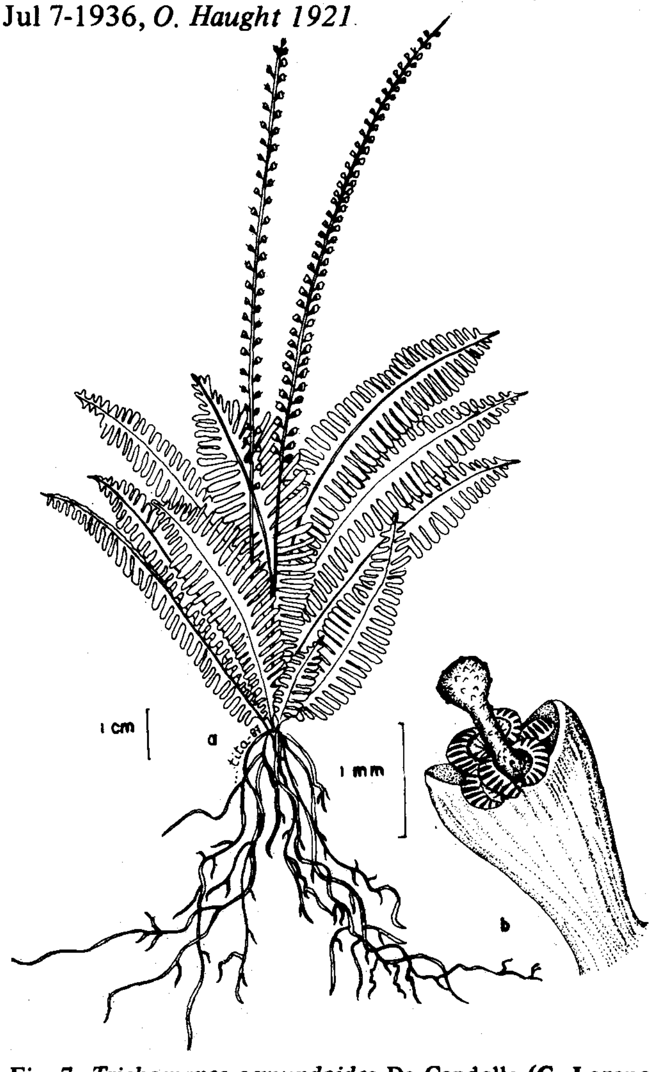

Fig. 7. *Trichomanes osmundoides* De Candolle **(G. Lozano 5085).** a. hábito; b. involucro.

7. **Trichomanes osmundoides** De Candolle, Poiret, Encycl. Meth. Bot. VIII. 65. 1808.

Planta terrestre; rizoma corto, erecto, velloso; pelos color castaño oscuro; frondas dimórficas; las estériles con pecíolo más corto que el de las fértiles, lámina pinnatífida, ráquis velloso por el envés; venas pinnadas, una a dos veces furcadas; esporófilos largamente peciolados, lineares, no existe lámina, sólo un ráquis alado en el cual a lado y lado se encuentra una hilera de involucros estrechamente marginados, con receptáculo largamente exserto.

Distribución: En barrancos sombreados de bosque húmedo, 50-850 m alt.

CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 Jun 28-1986, *G. Lozano et al. 5085.* CHOCO: Río Mutatá ca 3 km arriba de su confluencia con el Río El Valle, NW de Alto del Buey, Feb 7-1971, *D.B. Lellinger 184;* Río El Salto, 9 km W de Andagoya, Feb 23-1971, *D.B. Lellinger et al. 471;* Cupica, Feb 10-1947, *O. Haught 5563.* VALLE: Bahía de Málaga o Magdalena, isla de Málaga, Mar 5-1978, *N. Hollander et al. s.n.*

8. **Trichomanes pinnatum** Hedw., Fil. Gen. Sp. pl. 4. fig. 1. 1799. N.v. "Chiman" Ticuna; "Rabo de chucha" Chocó.

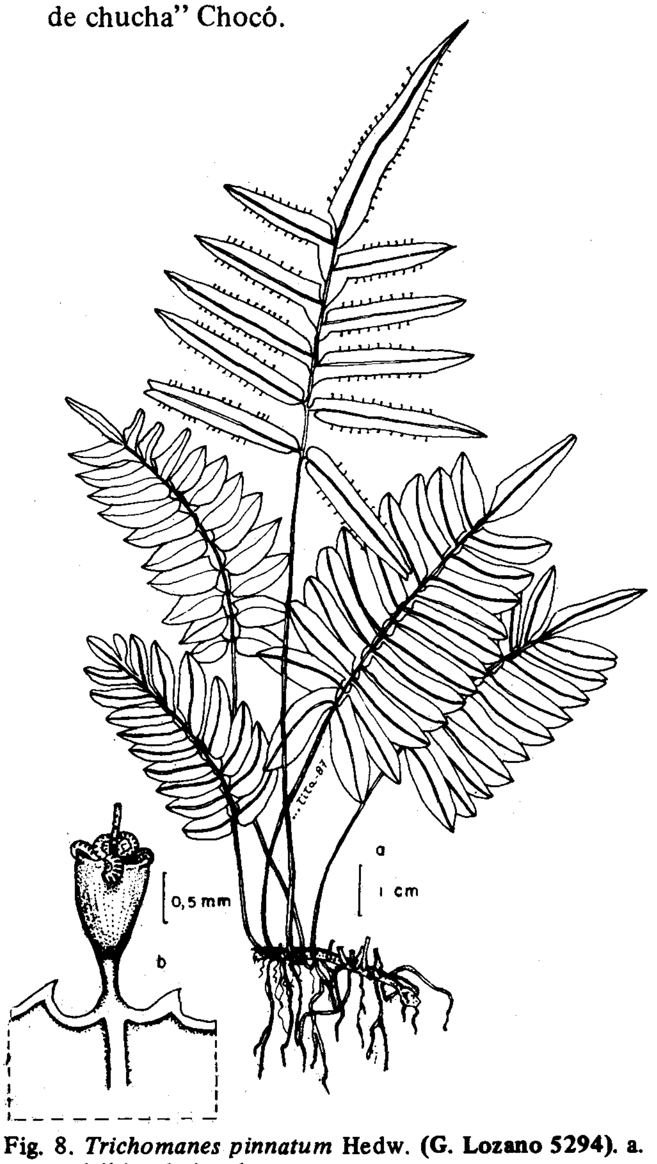

Fig. 8. *Trichomanes pinnatum* **Hedw. (G. Lozano 5294). a.** hábito; **b**; involucro.

Plantas terrestres; rizoma corto, erecto o suberecto, velloso; pelos de color castaño oscuro; frondas dimórficas; las estériles cortamente pecioladas; pecíolo estrechamente marginado hacia el ápice; lámina pinnada, pinnatífida hacia el ápice, el cual con frecuencia es flagelado y prolífero; pinnas comúnmente glabras, numerosas, muy próximas unas de otras, con márgenes serrados, o con apariencia de ciliados a causa de los ápices de las venas que son muy prolongados; venas pinnadas, una vez furcadas, numerosas, aproximadas, con muchísimas venillas falsas transversales entre ellas; esporófilos largamente peciolados, lámina pinnada, pinnatífida hacia el ápice; las pinnas distantes, no muy numerosas, con raquis estrechamente alado, no prolíferas en el ápice; venación como en los trofófilos; involucros exsertos, numerosos, en los márgenes de las pinnas, receptáculos largos, exsertos.

Usos. La planta se usa para curar el veneno de la culebra "equis". Dos onzas de zumo de la planta en una onza de aguardiente, dos veces al día según el caso. (E. Pérez A. 1937).

Distribución: Crece en lugares sombreados, húmedos, generalmente en capote de bosque, del nivel del mar hasta ca 1000 m alt.

AMAZONAS: a 10 km de las bocas del Río Hamaca-Yacú, Feb 3-1969, *R. Echeverry E. 1791;* Leticia, en el bosque cerca del Río, Oct 22-1968, *M. Takeuchi s.n.;* Araracuara, Ago 8-1977, *J.M. Idrobo 8960;* Río Igará-Paraná, afluente del Putumayo, corregimiento La Chorrera, Jun 20-1974, *C. Sastre 3414, 3125.* AMAZONAS-VAUPES: Río Apaporis, Soratama, Abr 2-1952, *R.E. Schultes et al. 16137;* entre el Río Pacoa y el Río Kananarí, Ago 20-1951, *R.E. Schultes et al. 13692.* ANTIOQUIA: Colinas a 6 km E de Guapá, May 14-1945, *O. Haught 4666;* Municipio de El Triunfo, paraje El Doradal, Oct 7-1978, *J.I. Santa 381;* Zona Cauchera de Villa Arteaga, Ene 1-1953, *I. Cabrera 61.* CAUCA: Municipio de Guapi, Isla de Gorgona, May 28 Jun 28-1986, *G. Lozano et al. 5294;* Río Naya, ca El Pastico, Feb 23-1983, *A. Gentry et al. 40628.* CAQUETA: Florencia, Dic 1930, *E. Pérez A. 641;* Solano, 8 km SE de Tres Esquinas, Mar 4-1945, *E.L. Little Jr. et al. 9548, 9521;* ca a la desembocadura de Quebrada Las Dalias en el Río Orteguaza, Mar 6-1944, *F.J. Hermann 11227.* CESAR: 10 km E. de Codazzi, Nov 10-1943, *O. Haught 3833.* CHOCO: ca Punta San Francisco Solano, 10 km NE de Puerto Mutis, Ene 27-1972, *D.B. Lellinger et al. 79;* barrancos de Loma del Cuchillo, ca 15 km WSW de Chigorodó, Mar 9-1971, *D.B. Lellinger et al. 638;* Mojarras de Tadó, 8.5 km E de Istmina, Feb 20-1971, *D.B. Lellinger et al. 411;* camino a Maniquía E de Puerto Mutis, Ene 26-1971, *D.B. Lellinger et al. 35;* alrededores del Río Monomacho, al pie de colinas de la Serranía del Darién, Mar 18-1971, *D.B. Lellinger et al. 708;* Río El Salto, 9 km W de Andagoya, Feb 23-1971, *D.B. Lellinger et al. 483;* bosque al sur del Río Condoto, entre Quebradas Guarapo y Mandinga, Abr 22-28-1939, *E.P. Killip 35145;* Serranía de

Baudó, Mar 5-1983, *A. Gentry et al. 40951;* Feb 2 Mar 29-1967, *H.P. Fuchs et al. 21932;* Municipio de Quibdó, carretera Quibdó a Yuto, Jun 29-1983, *E. Forero et al. 9589;* Río San Juan, estribaciones del Cerro de La Mojarra, Jun 25-1983, *E. Forero et al. 9510;* Quibdó, Samurindó, Mar 23-1967, *K. Mägdefrau 1467.* CUNDINAMARCA: Valle de Gazaguan, Mesa Negra, 6 km NW de Medina, Oct 7-1944. *M.L. Grant 10450.* META: Puerto López, Jul 29 Ago 1-1944, *E.L. Little Jr. et al. 8326, 8377;* ca 20 km SE de Villavicencio, Mar 17-1939, *E.P. Killip 34239;* Sierra de La Macarena, Barrancos del Río Güejar ca desembocadura del Río Sansa, Ene 21-1968, *J. Thomas et al. 1474;* margen izquierda del Río Guayabero, Ene 16-1959, *P. Pinto et al. 193;* Caño Entrada, Dic 15-1949, *W.R. Philipson 1747;* Caño Ciervo, Ene 7-1950, *W.R. Philipson et al. 2052;* trocha entre el Río Güejar y el Caño Guapayita, Dic 20-28-1950, *J.M. Idrobo 749.* NARIÑO: Costa del Pacífico, en la cuenca del Río Telembí, May 6-10-1953, *J.M. Idrobo et al. 1448.* SANTANDER: alrededores de Barrancabermeja, valle del Magdalena, entre los Ríos Sogamoso y Colorado, Ene 24-1934, *O. Haught 1269.* SANTANDER DEL NORTE: Catatumbo, Puerto Barco, May 19-1959, *H. Bischler 2599;* Catatumbo, Campo Río de Oro, May 14-1959, *H. Bischler 2429;* Catatumbo, Campo Tibú, May 16-1959, *H. Bischler 2462;* Bellavista, arriba de Pipeline, Sep 14-1946. VALLE: Bajo Calima, ca 15 km N de Buenaventura, Feb 15-1983, *A. Gentry et al. 40342;* carretera Cali a Buenaventura, entre los Ríos Dagua y Anchico, Sep 16-1967, *W. Hagemann 448;* Río Naya, arriba de Puerto Merizalde, Feb 23-1983, *A. Gentry et al. 40688;* Río Raposo, Costa del Pacífico, Mar 30-1963, *J.M. Idrobo 5303;* cerca de 18 km E de Buenaventura. Feb 14-1939, *E.P. Killip 33252.* VAUPES: Mitú, alrededores, Sep 21-1939, *J. Cuatrecasas 6934.* VICHADA: ca 8 km E de Gaviotas, Dic 25-1973. *G. Davidse 5175.*

9. **Trichomanes punctatum** Poiret ssp. sphenoides (Kunze) W. Boer, Acta Bot. Neerl. 2: 277-330. 1962.

Trichomanes sphenoides Kunze, Farrnkr. 216, t. 88 f. 2. 1840.

Plantas epífitas, con rizoma largo, postrado, cubierto de abundantes trichomas marrón-oscuro a casi negros; pecíolo de la fronda de 3 mm a casi 1 cm de largo; lámina muy variable en forma y tamaño, entera, triangular o suborbicular, con ápice crenado o irregularmente lobado, base cuneada a decurrente, con márgenes provistos de tricomas estrellados; venas flabeladas, varias veces furcadas; involucros parcialmente sumergidos en el tejido laminar; labios del involucro casi tan largos como anchos, con bordes oscuros, casi negros.

Distribución: En bosque tropical lluvioso de 20-760 m alt.

AMAZONAS: Río Caquetá, alrededores de Araracuara, colina frente al Araracuara, Corregimiento

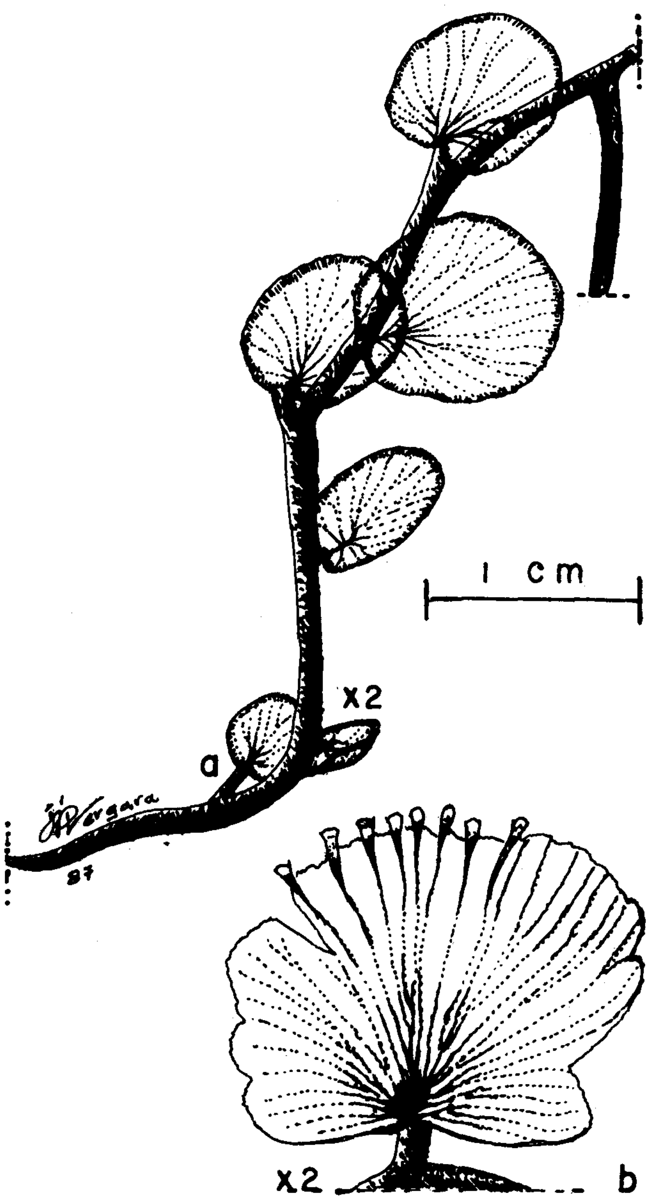

Fig. 9. *Trichomanes punctatum* ssp. *sphenoides* (Kze.) W. Boer (**G. Lozano 5357**). a. hábito; b. fronda con involucros.

Puerto Santader, Nov 10-22-1982, *J.M. Idrobo et al. 11417.* CAQUETA: Solano, 8 km SE de Tres Esquinas, abajo de la desembocadura del Río Orteguaza, Mar 5-1945, *E.L. Little et al. 9595.* CAUCA: Municipio de Guapi, Isla Gorgona, May 28 - Jun 28-1986, *G. Lozano et al. 5198, 5357.* CHOCO: Andagoya, Abr 20-30-1939, *E.P. Killip 35050;* W. de Puerto Mutis (Bahía Solano), Ene 25-1971, *D.B. Lellinger et al. 2;* arriba del Río Truandó, 5 km NE de la confluencia del Río Nercua, Mar 4-1971, *D.B. Lellinger et al. 565.* META: Sierra de La Macarena, Bocas del Río Duda, Nov 25-1975, *J.M. Idrobo 8341.* SANTANDER: alrededores de Barrancabermeja, valle del Magdalena, entre los Ríos Sogamoso y Colorado, Feb 17-1935, *O. Haught 1565.* VALLE: valle del Río Digua, La Margarita, Abr 4-5-1939, *E.P. Killip 34885.*

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DOS NUEVAS ESPECIES COLOMBIANAS DE SAURAUIA *(Actinidiaceae)*

Por *Djaja Djendoel Soejarto*[1]

Entre los materiales de *Saurauia* recientemente recibidos en el Field Museum en calidad de préstamo o como regalo para la determinación, en el transcurso de la revisión de Actinidiaceae para la Flora Mesoamericana, varios ejemplares provenientes del Departamento del Chocó no se podrían identificar con ninguna especie americana conocida hasta el momento (Hunter, 1966; Keller & Breedlove, 1981; Soejarto, 1980, 1982, 1985). Posterior a estudios cuidadosos, descubrí que estos ejemplares pertenecen a especies que no habían sido descritas hasta el momento.

Se presentan a continuación las descripciones taxonómicas de estas especies.

Saurauia alloplectifolia Soejarto, sp. nov.

Arbor parva. Folia obovata, 20-30 cm longa et 10-15 cm lata coriacea, apice abrupte acuminata, basi late cuneata, margine manifeste setaceo-serrulata, supra glabra, infra sparse pubescentia. Flores ca. 8 mm diam., sepalis parce pubescentibus, partibus expositis in alabastro trichomatibus obsitis, imbricatis et intus glabris, staminibus ca. 15.

TYPUS: Colombia: Departamento del Chocó: "Carretera Tutunendo - El Carmen, alrededores del campamento "El 12", Alto Río Atrato, alt. entre 520 y 620 m, 28 Abril 1979" (en flor), *E. Forero, R. Jaramillo, H. Y. Bernal, H. León & M. M. Pulido 6047* (holotipo, COL-194641; isotipos, COL-194640 y MO-2717709).

FIGURA 1. Foto del holotipo de *Saurauia alloplectifolia*. Soejarto.

Arbol pequeño de 2 m de altura, ramitas escasamente pubescentes, las partes juveniles con pubescencia aún más densa, de tricomas hinchadas y aplanadas en su base, mezcladas con excrescencias minuciosas, dando apariencia blanquecina-harinosa. Hojas simples, espiraladas, sin estípulas, penninervadas, aglomeradas en el ápice de las ramitas y subapicalmente; las láminas obovadas, 20-30 cm de largo, 10-15 cm de ancho coriáceas, de color moreno-olivo en estado seco, aún más oscuro en el haz, repentinamente acuminadas en el ápice con un acumen de unos 10 mm de largo, anchamente cuneadas en la base, los márgenes prominentemente y rígidamente setaceo-aserrulados, en la 1/5 parte inferior enteros, con dientes diminutos de 1 mm de

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largo y la distancia entre ellos de 5 mm, los nervios secundarios prominentes, de 16-17 pares, en la parte mediana de la lámina formando una V con un ángulo de 90-110°, la distancia entre ellos de 1-1.5 cm, levemente derechos o arqueando hacia los márgenes, anastomosados al llegar a los mismos, los nervios terciarios elevados en el envés, levemente más prominentes que la nervación menor reticulada, partiendo de los nervicios secundarios en una orientación perpendicular hacia el nervio primario, adelgazándose al llegar en el punto intermedio entre dos nervios secundarios adyacentes, formando un enlace ondulado más o menos paralelo a los nervios secundarios, el haz glabro y liso, el envés esparcidamente pubescente, las tricomas a lo largo del nervio primario de tipo estrigoso-setoso hasta de 5 mm de largo, rígidas e hinchadas en la base, mezcladas con aquellas minuciosas de tipo radiado, mientras aquellas a lo largo de los nervios menores son minuciosas, de tipo radiado; pecíolos subcilíndricos, de 1-2 cm de largo, de 3 mm de grosor, en la parte superior canaliculado, esparcidamente pubescentes con tricomas de igual tipo de aquellas a lo largo del nervio primario. Inflorescencias tirsiformes, axilares, subapicales, moderadamente ramificadas, algo derechas, de 50-70 flores, de 15-21 cm de largo, de unos 9 cm de ancho, subglabras a lo largo del pedúnculo, minuciosamente harinoso-pubescentes en las partes juveniles, pedúnculo de 9-12 cm de largo, brácteas foliosas, obovadas u oblanceoladas ó lanceolado-lineares, hasta de 12 mm de largo y 6 mm de ancho, subglabras ó minuciosamente harinoso-pubescentes. Flores aproximadamente de 8 mm de ancho, aglomeradas en las partes terminales de las ramas laterales de los tirsos, botones florales subglobosos, hasta de 3 mm de diámetro, pedícelos cilíndricos, hasta de 4 mm de largo, minuciosamente harinoso-pubescentes, bracteólas subulado-lanceoladas, de 4-5 mm de largo, subglabras; sépalos 5, obovados ú obovado-orbiculares, arredondeados en el ápice, aproximadamente de 4 mm de largo y 3 mm de ancho, partes expuestas en el botón minuciosa y esparcidamente harinoso-pubescentes con tricomas de tipo radiado, partes imbricadas e interiores glabras, todos marginal y oscuramente ciliados; pétalos 5, blancos en el estado fresco, ovado-oblongo, aproximadamente de 5 mm de largo, 3 mm de ancho, arredondeados y algo ondulados en el ápice, fusionados en la base y adnados a los estambres, y caducan juntos con éstos en una unidad; estambres aproximadamente 15, filamento 1.5 mm de largo, pubescente en la base con tricomas café-rojizas de tipo filiforme, anteras amarillas en estado fresco, cordadas, de 0.7 mm de largo; ovario subgloboso, glabro, de 1 mm de diámetro, 5-loculado, oscuramente 5-sulculado, estilos obsoletos. Frutos desconocidos.

En cuanto a la morfología foliar, esta especie presenta una similaridad sorprendente a algunas especies del género *Alloplectus (Gesneriaceae),* del cual se ha derivado su nombre, por ejemplo *A. panamensis* Morton.

El patrón de la nervación terciaria de *S. alloplectifolia,* en el cual los nervios terciarios parten de los secundarios y se adelgazan en el punto intermedio entre dos de estos adyacentes, formando así un enlace entre sí de manera ondulada más ó menos paralelo a los nervios secundarios, es el carácter más distintivo de esta especie. En otras especies americanas del género *Saurauia,* los nervios terciarios conectan dos nervios secundarios adyacentes de manera continuada y más ó menos paralela, sin formar un enlace en el punto intermedio. Así que esta característica representa una desviación del patrón normal de la nervación terciaria en este género.

Otra característica importante de esta especie nueva es la manera de la aglomeración de las flores en las partes terminales de las ramas laterales de las inflorescencias.

Las demás características de esta especie la colocan en afinidad con *Saurauia parviflora* Tr. & Pl. de la parte sur de Colombia (Valle, Cauca y Nariño), en el lado Pacífico. Estas dos especies se distinguen en la siguiente manera:

1. Hojas normalmente angostamente elípticas u obovadas, con pecíolos y nervio primario subglabros o esparcidamente pubescentes, con tricomas estrigosas; flores de 12-17 mm de ancho, estambres 40-70; Valle, Cauca, Nariño . . . . *S. parviflora* Tr. & Pl.

1. Hojas anchamente obovado-elípticas, pecíolos y nervio primario esparcidamente pubescentes con tricomas rígidas, de base hinchada y aplanada; flores aproximadamente de 8 mm de ancho, estambres menos de 20; Chocó . . . . *S. alloplectifolia* Soejarto.

En el sistema de clasificación propuesta por Soejarto (1980), esta especie nueva pertenece a la Serie *Parviflorae.*

Aparentemente, *Forero et al. 6047* es un individuo funcionalmente estaminado, una condición evidente de la naturaleza obsoleta de los estilos y de un alto porcentaje del polen fértil (99%) (examinado según el método publicado previamente - Soejarto, 1969).

Saurauia chocoensis Soejarto, sp. nov.

Arbor ad 5 m alta, ramuli farinoso-pubescentes. Folia obovata, 12-25 cm longa, 5-10 cm lata, chartacea vel membranacea, ápice caudato-acuminata, basi rotundato-cuneata, margine subtiliter atque irregulariter setaceo-serrulata, nervis secundariis 16-19 prominentibus, supra sparsim pubescentia, infra farinoso-pubescentia, epidermide utrinque striata. Thyrsi 100-150-floribus, omnino minute atque dense farinoso-pubescentes. Flores 7-9 mm diam., sepalis extus minute atque dense farinoso-pubescentibus, intus parce glabris.

TYPUS: Colombia. Departamento del Chocó: "Junction of Río Catru and Río Dabasa, very wet, steep slope in an advanced secondary forest, alt. 100 m, 1973" (en flor), *J. White & R. Warner 70* (holotipo, F-1816566).

Otras colecciones: Departamento del Chocó: "Short walk up Río Pavasa from a schoolhouse, on edge of river, primary forest, treelet, 5 m tall, petals white, stamens yellow, sweet fragrance, fruits edible and sweet, altitude 50-100 m, May 19, 1974" (en flor), *R. H. Warner 268* (F); "Quibdó-Bolívar road, 41-56 km E of Quibdó, altitude 350-400 m, remnants of tropical pluvial forest, 5° 47' N, 76° 35' W, tree 4 m tall, buds white, June 11, 1982" (en flor), *Al Gentry & J. Brand M. 36719* (F, MO).

Arboles hasta de 5 m de altura, ramitas cilíndricas, partes juveniles harinoso-pubescentes, con tricomas plumuloso-estrigosas mezcladas con aquellas radiadas, partes más viejas glabrescentes. Hojas simples, espiraladas, sin estípulas, peninervadas, aglomeradas desde el ápice hacia una distancia detrás del ápice de las ramitas; las láminas obovadas, 12-25 cm de largo, 5-10 cm de ancho, cartáceas o membranáceas, moreno-olivo en estado seco, aún más oscuro en el haz, acuminadas o caudado-acuminadas en el ápice, con acumen hasta de 1.5 cm de largo, cuneadas a rotundado-cuneadas en la base, los márgenes fina e irregularmente setaceo-aserrulados, con dientes de 1.5 mm de largo, y distancia entre ellos de 2-3 mm, en la 1/3-1/4 parte inferior oscuramente aserrulados, nervios secundarios prominentes, de 16-19 pares, en la parte mediana de la lámina formando una V con un ángulo de 90-100°, la distancia entre dos adyacentes de 0.7-1.5 cm, derechas o levemente arqueadas, todos arqueando al llegar hacia los márgenes, terminándose en los mismos de manera dicotomizante, los nervios terciarios elevados, más prominentes que la nervación menor reticulada, partiendo de los nervios secundarios de la manera paralela y conectando dos de éstos de manera continuada, el haz esparcidamente pubescente, con tricomas de tipo setuloso y limitándose a lo largo de los nervios, el envés minuciosamente harinoso-pubescente, la pubescencia blanquecina y se limita principalmente a lo largo de los nervios, con tricomas de tipo estrellado-radiado, ambas superficies epidermales estriadas, pecíolos cilíndricos, delgados, 5-7 cm de largo, 1-1.5 mm de diámetro, levemente canaliculados en el lado adaxial, densamente harinoso-pubescentes con tricomas plumuloso-setosas mezcladas con aquellas de tipo radiado a estrellado-radiado. Inflorescencias tirsiformes, axilares, subapicales, delgadas, muy ramificadas, algo flexuosas, de (50-) 100-150 flores, 10-20 cm de largo, 6-40 cm de ancho, minuciosa y densamente harinoso-pubescentes, de tricomas plumuloso-setulosas mezcladas con aquellas de tipo radiado o estrellado-radiado, pedúnculo delgado, 3-7 cm de largo, brácteas subuladas, hasta de 5 mm de largo, minuciosa y densamente harinoso-pubescente. Flores 7-9 mm de ancho, botones globosos, hasta de 2 mm de diámetro, pedícelos muy cortos, 1-2 mm de largo, muy delgados, bracteolas subuladas, ambos pedícelos y bracteolas minuciosa y densamente harinoso-pubescentes;

FIGURA 2. Foto del holotipo de *Saurauia chocoensis*. Soejarto.

sépalos 5, oblongo-elípticos a ovados u obovados, 2-2.5 mm de largo, 1-2 mm de ancho, obtusos o rotundados en el ápice, los dos exteriores normalmente más pequeños, todos minuciosa y abundantemente harinoso-pubescentes en el lado externo, tricomas algo adpresas, de tipo radiado o estrellado-radiado, parcialmente pubescentes en el lado interno, con tipo similar de tricomas, marginalmente ciliolados; pétalos 5, blancos en estado fresco, oblongo-obovados, 3-4 mm de largo, 2-2.5 mm de ancho, rotundados y frecuentemente emarginados en el ápice, fusionados en su base y adnados a los estambres, caducando juntos con éstos en una unidad; estambres 19-20, filamento muy delgado, de 1.5-2 mm de largo, pubescente en su base con tricomas de tipo filiforme, anteras amarillas en estado fresco, oblongos a oblongocordados, 0.7-1 mm de largo; ovario subgloboso, 1 mm de diámetro, glabro, 5-loculado, oscuramente 5-sulculado, estilos 3-5, obsoletos a 1 mm de largo. Frutos desconocidos.

Esta especie nueva está muy afín a *Saurauia pseudoleucocarpa* Busc., que se distribuye en las zonas bajas del pacífico, desde Chocó al sur hacia Cauca. Las dos especies tienen distribución simpátrica en el Chocó.

Las características más importantes que identifican esta especie nueva son la textura membranácea de las hojas, la presencia de estriaciones en ambas superficies epidermales foliares, el largo tamaño de los pecíolos (dos veces mayor que en *Saurauia pseudoleucocarpa),* la densa y blanquecina pubescencia de las inflorescencias, la pubescencia de los sépalos, y el bajo número de los estambres.

Esta especie nueva pertenece a la Serie *Parviflorae* dentro del sistema de la clasificación propuesta por Soejarto (1980), y se distingue de *S. pseudoleucocarpa* en la siguiente manera:

1. Hojas con 16-19 nervios secundarios y con superficies epidermales estriadas, pecíolos 5-7 cm de largo, sépalos abundantemente harinoso-pubescentes en todas sus superficies . . . . *S. chocoensis* Soejarto.
1. Hojas con 20-30 nervios secundarios y con superficies epidermales lisas, pecíolos 2-3 cm de largo, sépalos parcialmente pubescentes en el lado externo, glabros en el lado interno . . . . *S. pseudoleucocarpa* Busc.

AGRADECIMIENTOS

Deseo expresar mis agradecimientos a los directores de John G. Searle Herbarium (Field Museum of Natural History) (F), Chicago, del Departamento de Botánica de Missouri Botanical Garden (MO), St. Louis, y del Herbario Nacional Colombiano, Instituto de Ciencias Naturales - Museo de Historia Natural (COL), Bogotá, por poner en mi disponibilidad los ejemplares de *Saurauia* citados en este trabajo, para el presente estudio. A Dr. Rolf Singer, Field Museum of Natural History, deseo agradecer su gentileza en leer y corregir las descripciones Latinas, y a Sr. Ron Testa, fotógrafo de Field Museum of Natural History, por las fotos de los ejemplares tipos que aparecen en Figuras 1 y 2.

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THE COLOMBIAN SPECIES OF *Cyphomandra*

Por *Lynn Bohs* *

The genus *Cyphomandra* includes some 50 species of small trees native to Central and South America, one of which, *C. betacea*, the tomate de árbol or tree tomato, has attained some economic importance as an edible fruit crop. There are two centers of species diversity in the genus, one in the Andean area of South America and the other in the Atlantic coastal rain forest of southeastern Brazil. Like many other members of the Solanaceae, *Cyphomandra* is often found in disturbed sites such as roadsides and forest margins, and also exploits light gaps in the primary forest. The plants are rapid-growing and often short-lived, their presence in any one area being ephemeral. On the other hand, some individuals may become very large and persist in a location until they can no longer tolerate being shaded out by taller canopy trees.

Cyphomandra appears to be most closely related to the genus *Solanum* because both share the trait of poricidal anther dehiscence. In 1845, Otto Sendtner segregated *Cyphomandra* from *Solanum* on the basis of the enlarged anther connective, still the most important criterion for recognizing the genus. The connective tissue is much thicker than that of the anther thecae, and the connective stands out as a swollen area running the length of the anthers on the abaxial side; it sometimes protrudes adaxially as well.

Another useful character for recognition of *Cyphomandra* is provided by its distinctive architecture. Growth begins as a single upright axis with 2/5 phyllotaxis. This trunk produces a terminal inflorescence, and the plants begin to branch out laterally from axillary buds on the main stem. These lateral shoots continue to branch sympodially, and result in a spreading crown where all the flowers and fruits are borne. The mature tree thus has an umbrella-shaped appearance that makes it easy to recognize in the field. Further growth in height occurs when a new orthotropic shoot develops from an axillary bud on the old trunk below the branch tier. Most of the species are small trees when full grown, reaching a maximum height of about 10 meters.

The characters most helpful in delimiting species in *Cyphomandra* are leaf shape, type and density of pubescence, corolla color and shape, anther and connective morphology, stigma shape and diameter, and fruit size, shape, and degree of pubescence. Leaf shape in particular must be used with caution, as it can vary considerably on a single plant. The leaves of the trunk and those of the spreading crown may differ in size and shape, as in *C. endopogon* and *C. hartwegii* where the trunk leaves are generally lobed and the crown leaves entire. Leaf size and shape can also vary according to the position of the leaf on a branch. Further discussion of the characters used to delimit species in *Cyphomandra* can be found in Bohs (1986, 1988).

The following is an account of the species of *Cyphomandra* occurring in Colombia, with notes on their differential characters, distribution, vernacular names, and uses. A new subspecies of *C. hartwegii* endemic to Colombia is also described and illustrated. This treatment is based on a taxonomic study of the genus in the western part of its range: Central America and Andean and Amazonian South America. Although *Cyphomandra* includes some of the larger and more obvious members of the Solanaceae and some species have gained importance as economic plants, no comprehensive taxonomic treatment of the group exists, and little is known of its biology. The last taxonomic work of large scope attempted on this

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genus was Dunal's treatment in 1852 for DeCandolle's Prodromus, which is now much outdated. A taxonomic account of the entire genus throughout its range is now being prepared. The present article on the Colombian species is intended to serve until an account of the Solanaceae for the Flora of Colombia or a complete systematic treatment of *Cyphomandra* appears.

KEY TO *Cyphomandra* IN COLOMBIA

1. Herbs or shrubs up to about 1.5 m tall, stem not very woody; anther connective not distinct, the thickened region forming a leathery covering over the dorsal surface of the anther thecae; inflorescences 4-6-flowered; flowering pedicels 4-6 mm long...... 1. *C. allophylla*
1. Shrubs or small trees, usually much taller than 1.5 m, stems obviously woody; anther connective distinct, the thickened region much different in appearance than the thin-walled anther thecae; inflorescences usually 10-100+-flowered; flowering pedicels 10-35 mm long 2
2. Corolla urceolate, divided about 1/2 its length; leaves often pinnately compound ....2. *C. chlorantha*
2. Corolla campanulate or stellate, divided more than 1/2 its length; leaves usually simple 3
   3. Style strongly and abruptly dilated at apex into a peltate or subpeltate stigma 1-3 mm in diameter . .4
      4. Anthers long and narrow, 6-10 X 1-2 mm; corolla 25-45 mm in diameter, the lobes 15-22 X 1.5-2 mm; corolla margins conspicuously villous; trunk leaves frequently lobed.......8. *C. endopogon*
      4. Anthers short and broad, 4-5 X 1.5-2 mm; corolla 15-30 mm in diameter, the lobes 7-15 X 2-4 mm; corolla margins tomentose; trunk leaves unlobed.................. 3. *C. obliqua*
   3. Style not abruptly dilated at apex; stigma clavate to truncate, less than 2 mm in diameter..........5
      5. Foliage and axes densely pubescent-pilose with very abundant hairs 1-4 mm long; fruits pilose . . ..5. *C. pilosa*
      5. Foliage and axes glabrous or pubescent but long hairs (greater than 1 mm) sparse if present; fruits glabrous..........................6
         6. Crown leaves often decurrent at base, basal lobes* less than 1 cm long; apices of anthers connate into a ring...........4. *C. fragilis*
         6. Crown leaves (at least some of them) cordate at base, basal lobes* more than 1 cm long; apices of anthers not connate into a ring 7
            7. Fallen pedicels leaving remnants 1-3 mm long on inflorescence axis; corolla pinkish or white; fruits usually orange, red, or purple when ripe, rarely yellow .... 6. *C. Betacea*
            7. Fallen pedicels leaving remnants less than 1 mm long on inflorescence axis; corolla green, purple, or lavender; fruits usually yellow when ripe.................8
               8. Trunk leaves often lobed; corolla usually green; widespread species ....9. *C. hartwegii*
               8. Trunk leaves always unlobed; corolla usually lavender; endemic to Valley of Sibundoy and surrounding areas...... ....7. *C. sibundoyensis*

* Length of basal lobes is measured parallel to the midrib from the lowest point of the lobe to the insertion of the blade on the midrib.

1. *Cyphomandra allophylla* (Miers) Hemsl. Biol. cent.- amer., Bot. 2: 417. 1882.

Cyphomandra allophylla differs from all other species in the genus in its small stature and rather herbaceous habit, its membranaceous, nearly glabrous leaves which are either pinnately 3-5-lobed or unlobed with cuneate to decurrent bases, the few-flowered, often extra-axillary inflorescences, and the odd shape of the fruits, which are reported to be laterally compressed at maturity. The taxonomic position of this species is not at all clear. The ill-defined anther connective is anomalous in *Cyphomandra,* but the growth habit and branching pattern (as interpreted from herbarium sheets) exhibits features characteristic of the genus. Perhaps when living material is made available and this taxon is further investigated, it will prove to be a species of *Solanum.*

Cyphomandra allophylla ranges from Central America to northwestern South America and occurs in Colombia only at the northern periphery of the country (fig. 1). It is a lowland species found below 300 meters in elevation. There is some evidence that this species prefers seasonally dry areas and may act as an annual or as a perennial which dies back to the roots during each dry season.

The only vernacular names recorded for this species in Colombia are "bleo de gallinazo" and "bleo de golero," but it is known as "hierba de gallinazo" and "hierba gallota" in Panama (Standley 1928). Romero-Castañeda (1965) reports that the leaves are used in salads, broths, and chopped meat dishes. The ripe fruits are also used in stews.

2. *Cyphomandra chlorantha* Rusby, Descr. S. Amer. Pl. 116. 1920.

This species is very similar to *C. diversifolia* of coastal Venezuela and is only weakly segregated from it on the basis of the short-tomentose corollas, the elliptic rather than fusiform fruits, and larger seeds. Both species are distinctive in having purplish urceolate corollas and pinnately compound leaves. Futher studies may show that the differences between the two species are too variable to support recognition of separate taxa and that *C. chlorantha* is better regarded as a synonym of *C. diversifolia.*

Cyphomandra chlorantha is only known at present from four localities in Colombia (fig. 1). It is also found in Costa Rica, Panama, and the Sierra Nevada de Mérida in Venezuela. This species appears to prefer cloud forest and regions with very high rainfalll. It has no recorded vernacular names or uses in Colombia.

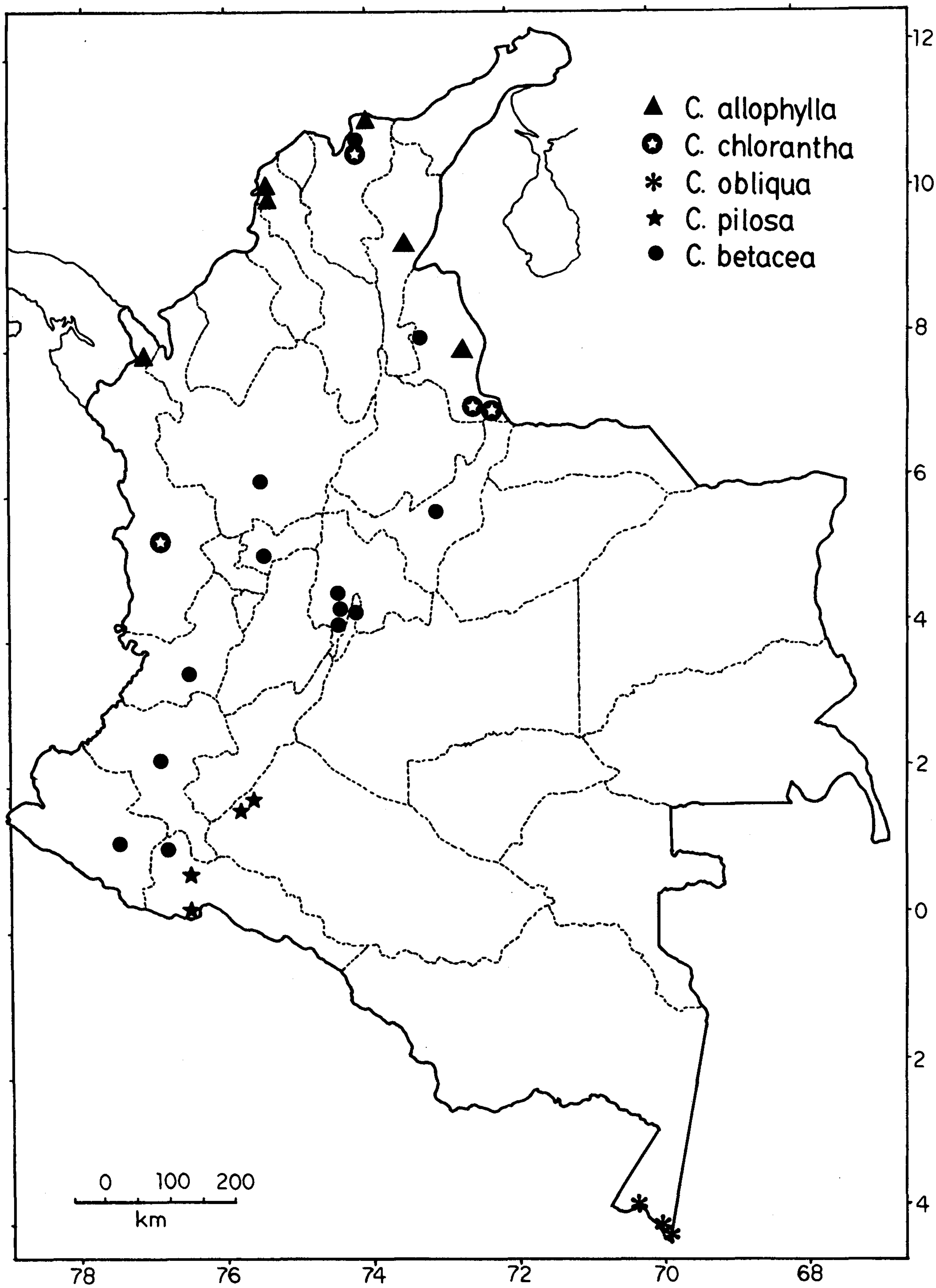

FIGURE 1. Distribution of *Cyphomandra* species in Colombia.

3. *Cyphomandra obliqua* (Ruiz et Pav.) Sendtn. Flora 28: 172. 1845.

This species is easily distinguished from other Colombian species of *Cyphomandra* by the very expanded peltate stigmas with two apical glands, the short anthers with a very gibbous connective, the stellate, coriaceous, greenish corollas with relatively wide and spreading lobes, the inflorescences with nearly contiguous pedicels, and the copious fine puberulence on the leaves and axes. *Cyphomandra obliqua* is abundant in eastern Peru along the Huallaga and Ucayali rivers and its range extends eastward into Amazonian Brazil. It is known so far in Colombia only from the region around Leticia (fig. 1). As this species appears to be of restricted occurrence in Colombia it has no recorded vernacular names or uses. However, in eastern Peru it is known by a number of names (e.g. "chupo sacha") and the leaves and stems are used medicinally in an infusion. The edibility of the fruits is unknown.

4. *Cyphomandra fragilis* Bohs, nom. nov.

Solanum oxyphyllum C. Morton, Contr. U.S. Natl. Herb 29: 49. 1944. TYPE: Colombia, Putumayo, Umbría, 0°54'N, 76°10'W, 325 m, 13 Nov. 1930, *Klug 1776* (holotype, US # 1518016, not seen; isotypes, BM!, F!, GH!, MO!, NY!, US!).

This very distinctive species was first described as a member of *Solanum* section *Geminata* (formerly section *Leiodendron)* by C.V. Morton. However, the prominent anther connective and characteristic branching pattern definitively place it in *Cyphomandra.* Because the name *Cyphomandra oxyphylla* has already been used for a Brazilian species, this taxon is given the new name *C. fragilis.* The epithet reflects the delicate appearance of the foliage and flowers.

Cypomandra fragilis is distinguished from all other species in the genus by its thin, elliptic, nearly glabrous leaves with shallowly cordate to decurrent bases, by the lanceolate buds and slender corolla lobes, and by the very long, slender anthers which are connate by their tips well after anthesis. At present, its relationship to other species within the genus remains obscure.

This species occupies tropical moist forest at elevations from 250 to about 2000 meters on the eastern slope of the Andes in Colombia, Ecuador, Peru, and western Brazil. It is currently known in Colombia from only three sites in Huila, Nariño, and the Putumayo (fig. 2). This taxon has no recorded vernacular names or uses in Colombia.

5. *Cyphomandra pilosa* Bohs, Syst. Bot., 13: 265. 1988.

Cyphomandra pilosa, a recently described species (Bohs, 1988), is the only Colombian species of *Cyphomandra* that is densely pilose with long hairs on the leaves, axes, and fruits. In most cases leaf shape is also useful in recognition, the leaves being all simple and elliptic-ovate to elliptic-oblong with nearly truncate or shallowly cordate bases, the basal lobes generally less than 1 cm long.

This species inhabits tropical wet forest at middle elevations (150-1800 meters) on the eastern slope of the Andes in Colombia, Ecuador, and Peru. Its range in Colombia is restricted to the south central part of the country in Caqueta and Putumayo (fig. 1). It has no vernacular names or uses in Colombia, and the fruits are not known to be edible.

6. *Cyphomandra betacea* (Cav.) Sendtn. Flora 28: 172. 1845.

The familiar tomate de árbol or tree tomato is widely cultivated throughout the world in subtropical regions for its edible fruits. In Colombia this species is commonly planted in dooryard gardens in Andean regions at elevations of 1000 to 3000 meters (fig. 1). The fruits are eaten raw or in salads, and are frequently made into preserves, jellies, desserts, or "jugos"; they may also be cooked or stewed in meat dishes like the garden tomato, *Lycopersicon esculentum.* The plants are usually cultivated only on a small scale, but a few orchards have been established around Cali. Recently, large scale cultivation of this species has been attempted in New Zealand, where the fruits are known as "tamarillos". In spite of the somewhat acid flavor and numerous seeds present in the fruits, *C. betacea* promises to be an interesting potential fruit crop when breeding and improvement work are initiated.

The distinguishing features of *C. betacea* include the entire, deeply cordate leaves covered, like the axes, with a fine velvety puberulence, the usually much-branched inflorescences covered with prominent pedicellar remnants, the sweetly-scented flowers with pink to white, waxy, fleshy, stellate corollas, the cylindrical style with a truncate or subcapitate stigma, and large, glabrous, ellipsoidal or ovoid fruits. Most fruits are red, orange, or purple with orange or reddish flesh when mature, but yellow forms also occur with very light yellow pulp. *Cyphomandra betacea* does not closely resemble other species within the genus, and is apparently known only from cultivation. Further investigations are needed to establish the wild relatives and place of origin of this species.

Aside from "tomate de árbol," other vernacular names for *C. betacea* in Colombia include "tomate," "árbol de tomate," "tomate de agua," "pepino de árbol," and "toronjo." It is known as "chimbal-bé" by Kamsá-speaking people in the Sibundoy region of the Putumayo. In scientific literature, this species has been erroneously referred to as *Cyphomandra crassifolia.*

7. *Cyphomandra sibundoyensis* Bohs, Syst. Bot. 13: 273. 1988.

This newly described species (Bohs, 1988) is restricted to the Valley of Sibundoy and surrounding areas of southwestern Colombia (fig. 2). It is closely related to *C. hartwegii* and resembles it in its stellate corollas, tapered anthers, truncate stigma, and glabrous fruits containing stone cell aggregates. Herbarium material of this species may be difficult to distinguish from *C. hartwegii,* but in the field its large, violet corollas, rather broad fleshy anthers and extremely large fruits and seeds are distinctive. Unlike *C. hartwegii,* no individuals have been found with lobed trunk leaves. The vegetative parts may be sparsely puberulent or pilose when young, but the entire plant is generally glabrous when older.

The fruits of this species are striking, and are among the largest known in the genus. When mature, they are usually creamy yellow outside and contain an abundance of whitish to clear juicy pulp. The watery layer inmmediately surrounding the seeds is reddish or purplish. These large fruits have a very pleasant flavor and deserve attention by plant breeders as a potential fruit crop. The placenta of the fruit has also been used medicinally as a cure for intestinal worms in Sibundoy *(Bohs 2222).* This species is also reputed to have furnished a black, blue, or yellow dye in former times (*Bohs 2222*), but the part of the plant used for this purpose is not known. Names applied to this species in the Putumayo region of Colombia are "tomate salvaje" and "tomate silvestre."

8. *Cyphomandra endopogon* Bitter, Bot. Jahrb. Syst. 54, Beibl. 119: 16. 1916.

This species is found in tropical lowland rainforest at elevations usually well below 1000 meters (fig. 2). It occurs in Colombia only at the southern and eastern periphery of the country. Outside Colombia, its range extends into lowland Amazonian areas of Ecuador, Peru, and Brazil. Disjunct populations also occur in French Guiana and eastern Brazil.

Typical collections of this species are easily recognized by the oblong and obtuse corolla lobes bordered by villous hairs, the obtuse buds, and the broadly expanded stigma at the tip of the filiform, exserted style. Both *C. endopogon* and *C. hartwegii* have long, narrow anthers, often lobed trunk leaves, elongated, sometimes highly branched inflorescences with very short pedicellar remnants, and fruits containing stone cell aggregates. Unlike *C. hartwegii,* this species has a broadly dilated style and peltate stigma. The leaves and axes of *C. endopogon* are usually glabrous, but some fine puberulence may be present and frequently some sparse longer hairs are found on the stem and petioles.

Some collections referable to *C. endopogon* have somewhat smaller flowers with shorter anthers, acute buds and corolla lobes, and less expanded stigmas; in these features they resemble collections of *C. hartwegii.* The fruits of these collections are finely glandular-puberulent, a character which distinguishes them from both taxa, but as this puberulence may disappear on older fruits it may not be a definitive character for recognition. These collections may represent hybrid derivatives of *C. endopogon* and *C. hartwegii,* and their taxonomic position requires further investigation.

The only vernacular names recorded for this taxon in Colombia are "mee oóm be ta ka" by the Kubeos and "wa só a" by the Tukanos of the Amazonian region *(Schultes & Cabrera 13993). Cyphomandra endopogon* is not noted as being used for any purpose in Colombia.

9. *Cyphomandra hartwegii* (Miers) Sendtn. ex Walp. Repert. bot. syst. 6: 579. 1847.

Cyphomandra hartwegii is the most widespread species in the genus, ranging from Mexico to Panama and northern South America. In South America it occurs along the Andes from Colombia to Bolivia with disjunct populations in coastal Venezuela and Suriname. With the exception of the cultivated *C. betacea,* it is the only species of *Cyphomandra* that occurs both east and west of the Andean cordillera. *Cyphomandra hartwegii* is commonly encountered in disturbed areas or light gaps in the forest. It is typically a species of low elevations in Central America, but it can ascend to elevations of 2000 m or more in Andean South America.

Cyphomandra hartwegii can be distinguished by its usually pinnately divided trunk leaves and unlobed, cordiform crown leaves, its green, stellate corollas with acute lobes and a very short tube, its long narrow anthers, its prominently exserted style which is not expanded into the stigma, and its large yellow fruits with large seeds and stone cell aggregates. The pinnately lobed trunk leaves are one of the most obvious distinguishing features of this species, but unfortunately are often absent in herbarium material. The only other species with pinnately lobed trunk leaves known to occur in Colombia is *C. endopogon,* which is Amazonian in distribution and can be distinguished from *C. hartwegii* by its floral structure.

This species is composed of two distinctive elements recognized at the level of subspecies and distinguished by the following key.

KEY TO THE SUBSPECIES OF *Cyphomandra hartwegii*

1. Leaves, stems, and inflorescence axes glabrous to puberulent with hairs 0.5 mm long or less; inflorescences simple or branched (if highly branched, then plants nearly glabrous) . . . . subsp. *hartwegii*
1. Leaves, stems, and inflorescence axes densely pubescent with hairs 1 mm long or more; inflorescences usually highly branched . . . . subsp. *ramosa*

9a. *Cyphomandra hartwegii* subspecies *hartwegii*

This subspecies is much more widely distributed than subsp. *ramosa,* and occurs a number of

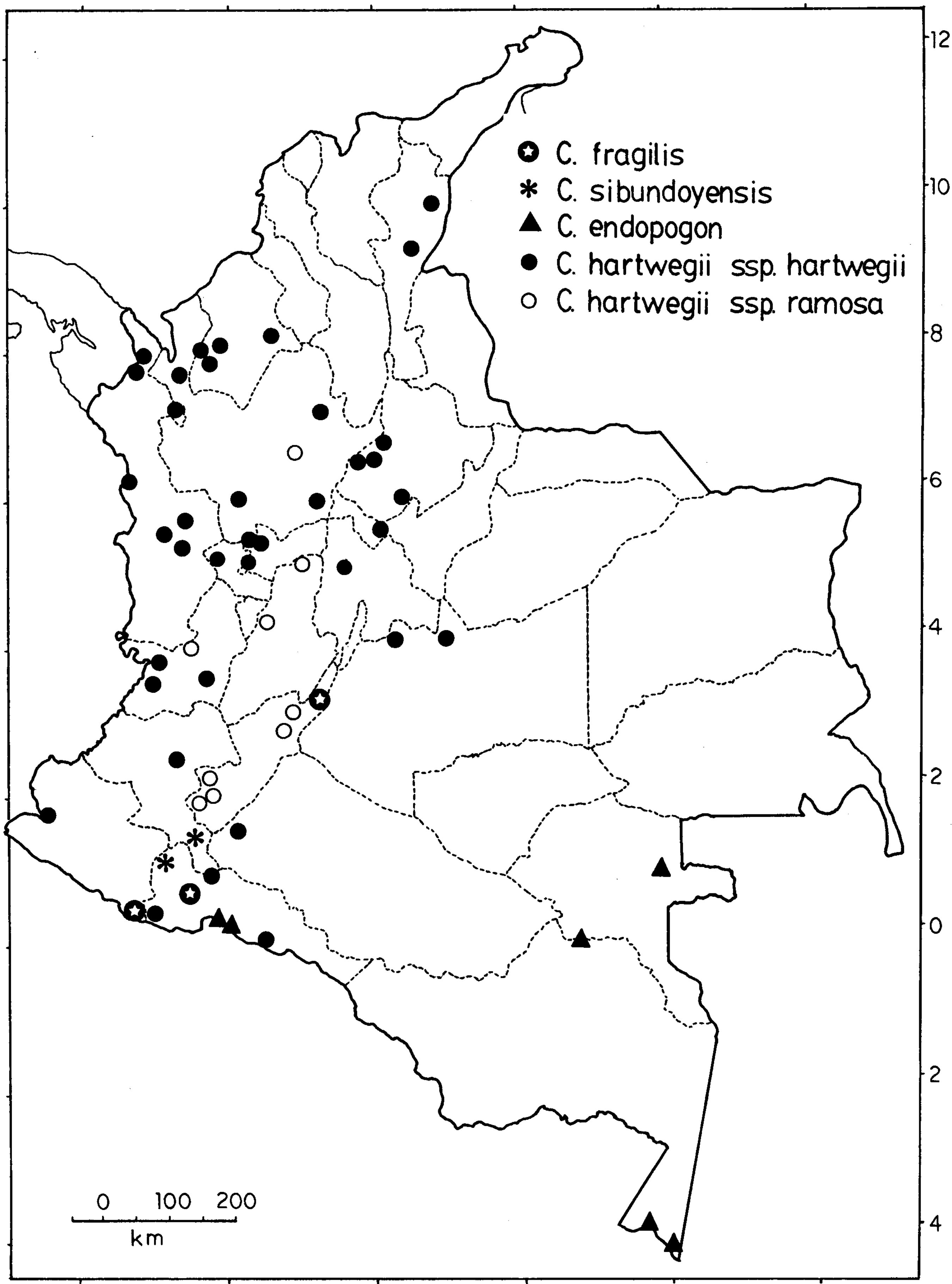

FIGURE 2. Distribution of *Cyphomandra* species in Colombia.

localities in the Andean area and in the coastal lowlands of Colombia (fig. 2). Great variability exists within this taxon, but all members lack the long dense pubescence characteristic of the Colombian subspecies *ramosa* (see below).

Collections of *C. hartwegii* subsp. *hartwegii* from Central America are generally very uniform and have small round fruits. From the Darien south to the interandean valleys of Colombia and Ecuador, however, variation among collections greatly increases, particularly in pubescence, inflorescence branching, and corolla size. There is also an increase in the size of the fruits; it is not known whether this is a natural expression of variability or if it is related to the use of the fruits by man. The existence of such a wide range of forms in northwestern South America may indicate that *C. hartwegii* arose there; on the other hand, such variability may not as much reflect age or ancestry as it does dissected topography and reproductively isolated populations with a patchy distribution in intermontane valleys and forest light gaps.

Members of this species are frequently planted on a local scale for their yellow, mild and sweet-tasting fruits. In Colombia, they are most often eaten in preserves, juices, or sweets, or are candied or made into marmelade (Pittier, 1910; Romero-Castañeda, 1961, 1969). Vernacular names for this species in Colombia include "tomate silvestre," "tomate de monte," "tomate de indio," "naranjilla," "regalgar," "reventadera," "tonga," "Tsutsucuru," and "venenillo."

9b. *Cyphomandra hartwegii* subspecies *ramosa* Bohs, subsp. nov. (fig. 3). TYPE: Colombia, Dept. Huila, Fundación Merenberg, near Santa Leticia, growing in botanical garden area of Merenberg finca, "tree ca. 5 m tall, leaves somewhat coriaceous with faint odor, trunk leaves pinnately lobed, corolla yellow-green, unripe fruits green, pendent," ca. 1300 m, 18 Aug. 1981, *Bohs 1644* (holotype, COL!; isotypes, CAUP!, GH!). Syn. *Cyphomandra kalbreyeri* Bitter, Repert. Spec. Nov. Regni Veg. 17: 347. 1921. TYPE: Colombia, Dept. Antioquia, Amalfi, Quartier Vivera, im Waldeschatten, 1860 m, 10 May 1880, *Kalbreyer 1662* (holotype, B, destroyed; isotype, K!; photos of holotype, F!, G!, GH!, NY!, WIS!).

Ab subspecie typica *Cyphomandrae hartwegii* pubescentia densa foliorum caulium corollarumque, et inflorescentiis ramosissimis differt.

Smal tree 4-6 m tall. *Branches* succulent, densely pubescent, often also sparsely pilose. *Leaf blades* usually heteromorphic, simple, subcoriaceous, those of the trunk unlobed, ovate or elliptic-ovate, 20-28 cm long, 11-13 cm wide, or pinnately (3-)5-9-lobed, 25-40 cm long, 20-35 cm wide, those of the crown unlobed, ovate or elliptic, 7-23 cm long, 6-20 cm wide, (acute-) acuminate at apex, cordate to truncate at base, sparsely to moderately pubescent-pilose adaxially, densely pubescent-pilose abaxially, especially on veins; veins very prominent abaxially, less so adaxially; petioles densely puberulent, pubescent, or pubescent-pilose.

Inflorescence usually highly branched, often 100+-flowered, 8-30 cm long; peduncle 2.5-9 cm long; flowering pedicels 15-20(30) mm long, in fruit 25-35 mm long, unevenly spaced 1-6 mm apart, leaving pedicellar remnants 1 mm long. Inflorescence axes densely pubescent, often also sparsely pilose.

Flower buds ovate-lanceolate, acute to acuminate at apex. *Calyx* moderately to densely pubescent, 3-4 mm high, the lobes deltate, obtuse, apiculate, 1-2 mm long, 2-3 mm wide. *Corolla* light green or whitish, subcoriaceous, stellate, ca. 20-25 mm in diameter, the tube 1 mm long, the lobes 10-15 mm long, 2-3 mm wide, acute at apex, moderately to densely puberulent-pubescent abaxially, nearly glabrous adaxially, tomentose at margin. *Anthers* 4-6 mm long, 1(2) mm wide, narrowly triangular, white, the pores directed upward; connective 5-6 mm long, 1 mm wide, gray, blue, or purplish, narrowly triangular, abaxially slightly shorter than thecae at apex, exceeding them by 0.5-1 mm at base, adaxially present.

Style filiform, 5-7 mm long, 0.2-0.5 mm in diameter, exserted 1-2 mm beyond stamens, not dilated apically; stigma truncate, 0.2-0.5 mm in diameter.

Fruit ellipsoidal or ovoid, obtuse at apex, 5-9 cm long, 3.5-6 cm in diameter, glabrous, yellow; mesocarp with stone cell aggregates; seeds 7-9 mm long, 6-7 mm wide, rugose, scarcely to moderately false-pubescent.

Distributión: Tropical wet forest and cloud forest, 1000-2500 meters in elevation, valleys of the Magdalena and Cauca Rivers, Colombia (fig. 2).

Vernacular names: "Tomate de monte" *(Little 8108)*, "tomate macho" *(Fosberg 20136)*.

Uses: G. Buch informed the author that the fruits are edible but sour, and that they make a good juice when sweetened with sugar. Kalbreyer (#1662) reports that the fruits are used to kill beetles.

ADDITIONAL SPECIMENS EXAMINED. **Colombia.** HUILA: Fundación Merenberg, near Santa Leticia, ca. 1300 m, 18 Aug. 1981, *Bohs 1643* (GH), *1645* (CAUP, COL, GH); Mpio. de La Plata, vereda Agua Bonita, Finca Merenberg, 1200-1300 m, 12 July 1975, *Díaz et al. 484* (COL); ridge between Quebrada la Candela and Río Naranjo, 18 km SW of San Agustín, 1°43'N, 76°18'W, ca. 1900 m, 12 Feb. 1943, *Fosberg 20136* (NY, US); hoya del Magdalena, San Agustín, km 7 carretera a Santa Rosa, "Mesitas", 1860 m, 28 Aug. 1958, *Idrobo et al. 2901* (COL, NY, P); Baraya to Hacienda Pensilvania, 15 km E along trail, 7300 ft, 22 June 1944, *Little 8108* (COL, NY, US); E of Neiva, 1300-1800 m, 1-8 Aug. 1917, *Rusby & Pennell 1003* (NY). TOLIMA: Cajamarca a 15 km hacia Ibagué, 1700 m, 11 May 1983, *López 83-0621* (COL); Prov. de Mariquita, La Palmilla, 2200 m, 1851-1857, *Triana s. n.* (BM, G, P). VALLE: cerca de la Represa del Calima, 1700 m. 12 Aug. 1966, *Espinal 1959* (MO). WITHOUT LOCALITY: *Mutis 1973, 1985, 3566* (US).

This infraspecific taxon encompasses a number of collections found in the valleys of the Cauca and Magdalena rivers in west central Colombia. They can be distinguished from the typical subspecies of *C. hartwegii* by the abundant pubescence found on the vegetative parts and usually on the outside of the corolla lobes and by the highly branched inflorescences. Preliminary crossing experiments performed at Harvard University in Cambridge, Massachusetts. U.S.A. (Bohs, unpubl. data) indicate that these plants have developed incomplete reproductive barriers with *C. hartwegii* subsp. *hartwegii* (as represented by *Rury 580* from Pichincha, Ecuador; subsp. *ramosa* represented by *Buch s.n.* from Huila, Colombia). Full sized fruits were set in 4 out of 10 artificial pollinations using subsp. *hartwegii* as the

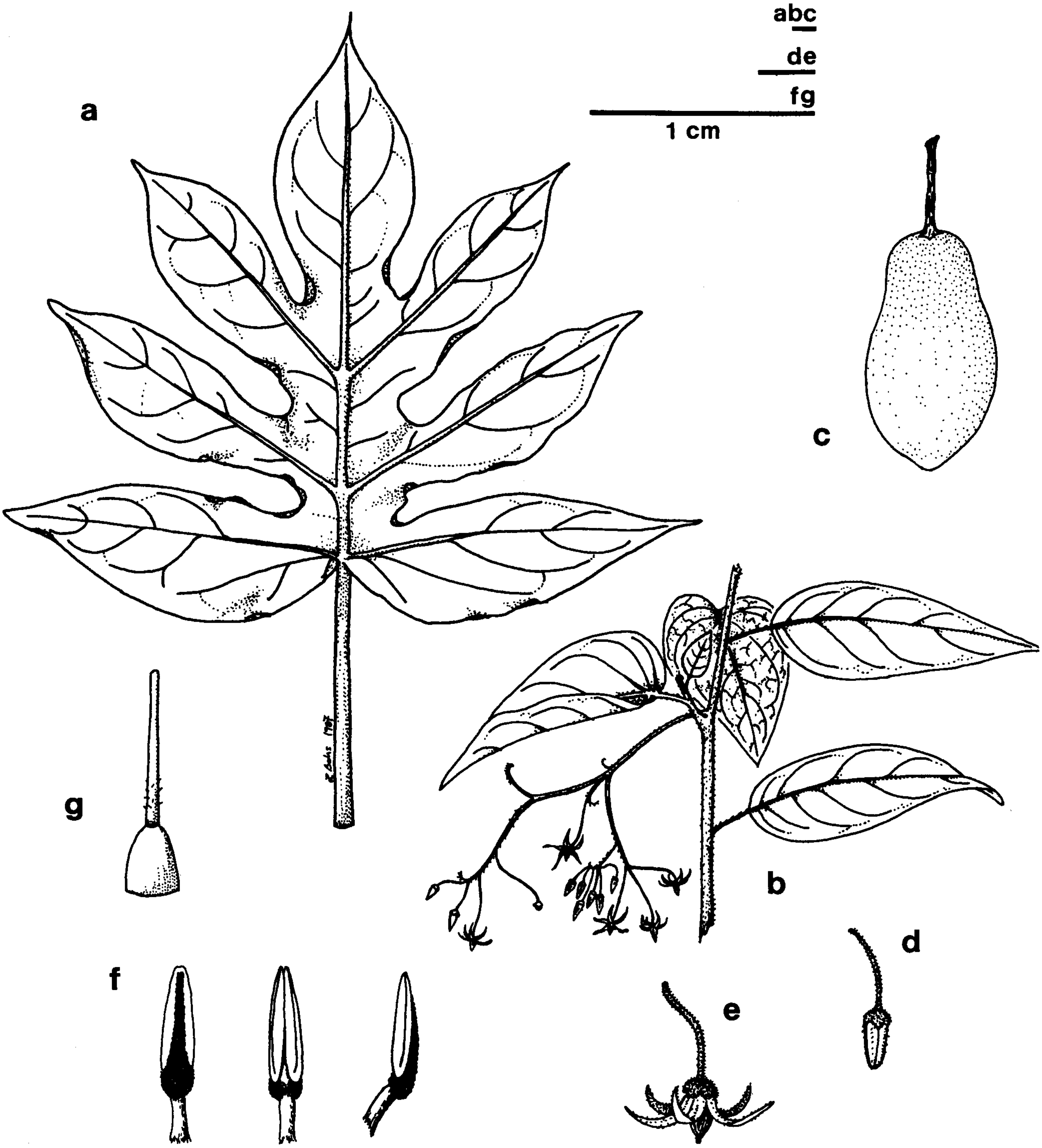

FIGURE 3. *Cyphomandra hartwegii* subspecies *ramosa* Bohs. a. Trunk leaf. b. Crown leaves and inflorescence. c. Fruit. d. Flower bud. e. Opened flower. f. Stamens (left to right: abaxial, adaxial, side view.) g. Gynoecium. (All based on *Bohs 1644.).*

female parent, but all the seeds within remained undeveloped. In the reciprocal cross, the ovary swelled to form a very small fruit after pollination in 4 out of 11 attempts, but did not develop further. The presence of morphological and geographical distinctions as well as evidence for reproductive solation justify delimiting this infraspecific taxon at the subspecific rather than the varietal level. Its great morphological similarity to typical collections of *C. hartwegii,* however, precludes recognition as a separate species.

The distinctive pinnately lobed trunk leaves of this subspecies and greenish flowers with long narrow anthers and truncate stigmas closely resemble those of *C. hartwegii* subsp. *hartwegii.* In overall size, however, the flowers of subsp. *ramosa* are somewhat smaller. The fruits and seeds of subsp. *ramosa* are some of the largest yet found within *C. hartwegii.* They are reportedly edible and may have some potential as a fruit crop after breeding and improvement to reduce the acidic taste and eliminate the large seeds and stone cell aggregates.

The species *Cyphomandra kalbreyeri,* included here as a synonym, has the very pubescent leaves and axes characteristic of *C. hartwegii* subsp. *ramosa* but differs from it in a few respects. The rachises and pedicels of the former taxon are only sparsely pubescent rather than densely so, but this may be a consequence of the method of preparation and preservation of the specimen. The corolla lobes in *C. kalbreyeri* are nearly glabrous outside except on the margins and at the apices, and the anthers are wider than those of subsp. *ramosa,* with the connective occupying less of the abaxial surface. Unfortunately, the holotype at Berlin has been lost, but a fairly good isotype remains at Kew. *Cyphomandra kalbreyeri* was collected from the most northerly locality in the range of subsp. *ramosa,* but nevertheless occupies the Cauca and Magdalena drainage as do the other collections of subsp. *ramosa.*

There is some evidence that subsp. *ramosa* may have a higher altitudinal preference that subsp. *hartwegii,* but this suggestion must be corroborated by additional collections and field work.

The infraspecific epithet reflects the distinctive highly branched inflorescences of these plants. A new name, type, and diagnosis have been chosen because Bitter's original description of *C. kalbreyeri,* although voluminous, does not adequately set forth the distinguishing features of this taxon.

ACKNOWLEDGMENTS

I would like to thank the curators of the herbaria listed for loans of specimens, Drs. R. E. Schultes, R. Tryon, and J. Sperry for reading and commenting on the manuscript, and the greenhouse staff of the Biological Laboratories, Harvard University, for their help in growing plants of *Cyphomandra.* Financial assistance was provided by grants from the Sheldon Fellowship and Anderson-Atkins Fund of Harvard University, the World Wildlife Fund, and Sigma Xi. Special thanks are due to Gunther Buch of the Fundación Merenberg for his kind hospitality and scientific assistance, Dr. A. Fernández-Pérez for logistical help in Colombia, and to Dr. R. E. Schultes for advice, encouragement, and inspiration throughout the study.

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TAXONOMY OF THE *Oenocarpus - Jessenia (Palmae)* COMPLEX IN COLOMBIA

By *Michael J. Balick**

ABSTRACT

Two genera, *Oenocarpus* and *Jessenia*, are recognized in this group of Neotropical palms. In Colombia, four species and three subspecies are found: *Oenocarpus bacaba, O. mapora* subsp. *mapora, O. mapora* subsp. *dryanderae, O. circumtextus* and *Jessenia bataua* subsp. *bataua.* Additional fieldwork is necessary to understand the basic biology of the species in Colombia and the extent of variation amongst local populations.

INTRODUCTION

The genus *Oenocarpus* was described by Martius in 1823. Of the five species discussed in that work, three were taxa found in Colombia: *Oenocarpus bacaba, O. circumtextus* and *O. bataua.* Karsten (1857) described the genus *Jessenia,* based on the Colombian material he named as the type species, *Jessenia polycarpa.*

The two genera were maintained as distinct through a number of publications (e.g. Walpers, 1848-1849; Drude, 1882; Bentham and Hooker, 1883; Drude, 1889). In 1928, Burret examined the taxonomic relationships between the species in these two genera and after a reassessment of the herbarium material and original description of *Oenocarpus bataua* found it to be related to *Jessenia polycarpa.* He then made the new combination *Jessenia bataua* (Mart.) Burret, which redefined the genera into more uniform and natural generic concepts.

The most current taxonomic study of this complex was carried out by Balick (1986) in which twelve taxa were recognized. Table 1 compares the major subdivisions and their component taxa of historical importance in this complex. A summary of the essential morphological differences between *Oenocarpus* and *Jessenia* is presented in Table 2, and a comparison of their floral morphology in Figure 1.

This paper is a summary of my previously-cited monograph, but here I consider only the Colombian species. It is particularly appropriate to include this research in a volume dedicated to Professor Richard Evans Schultes, as he was the person who suggested that I come to Colombia in 1976 to study these palms as part of a palm domestication program of the Centro de Desarrollo Integrado "Las Gaviotas".

Key to the Genera in the *Oenocarpus-Jessenia* Complex.

1. Seeds with homogeneous endosperm; staminate flowers with 6 stamens; pinnae lacking trichomes abaxially or trichomes, if present, needle-like or hair-like .... 1. *Oenocarpus.*

1. Seeds with ruminate endosperm; staminate flowers with (7–) 9-20 stamens; pinnae covered abaxially with peltate to sickle-shaped trichomes .. 2. *Jessenia.*

Description of *Oenocarpus*

1. *Oenocarpus* Martius, Hist. nat. palm. 2: 21-22. 1923. Type species. *Oenocarpus bacaba* Martius. Lectotypified by H. E. Moore (1963).

Large to medium, solitary to caespitose, erect, pleonanthic, monoecious palms; stems slender to massive, whitish gray to black, smooth to fibrous,

* The New York Botanical Garden Bronx; New York 10458 U.S.A.

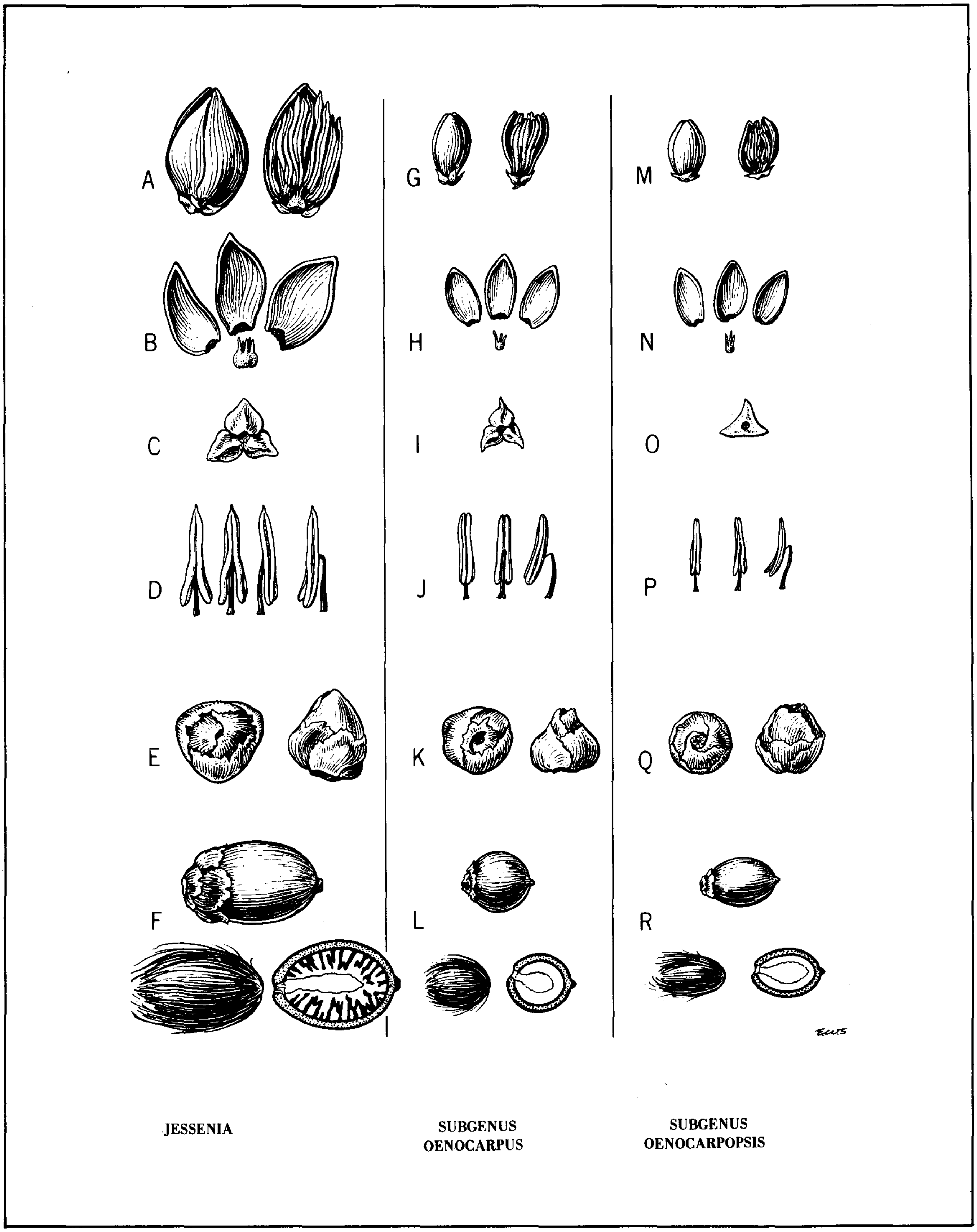

FIGURA 1. Flowers and fruits in the *Oenocarpus-Jessenia* complex. JESSENIA: *Jessenia bataua* subsp. *bataua (Zarucchi and Balick 1851).* A, Staminate flower, x 3.5. B, Petals and rudimentary ovary, x 3.5. C, Calyx, x 6. D, Stamens, x 5.5. *Jessenia bataua* subsp. *oligocarpa (Balick et al. 1231).* E, Pistillate flowers almost at anthesis, x 1.8. *Jessenia bataua* subsp. *bataua (Zarucchi et al. 1851).* F, Fruits, upper with epicarp and cupule intact, lower left showing fibrous seed covering, lower right a cross section showing elongate embryo and ruminate endosperm. SUBGENUS OENOCARPUS: *Oenocarpus bacaba (Steyermark 56066).* G, Staminate flower, x 3.5. H, Petals and rudimentary ovary. x 3.5. I, Calyx, x 6. J, Stamens, x 5.5. K, Pistillate flowers almost at anthesis, x 3.6. *Oenocarpus bacaba (Black 47 - 1522).* L, Fruits, x 0.9. SUBGENUS OENOCARPOPSIS: *Oenocarpus circumtextus (Ducke 12305).* M, Staminate flowers, x 3.5. N, Petals and rudimentary ovary, x 3.5. O, Calyx, x 6. P, Stamens, x 5.5. *Oenocarpus circumtextus (Huebner 41).* Q, Pistillate flowers almost at anthesis, x 3.6. R, Fruits, x 0.9. Drawn by E. W. Smith.

TABLE 1

Major subdivisions and their component taxa of historical importance in the *Oenocarpus* - *Jessenia* complex.

Drude (1882)[a]	Barbosa Rodrigues (1903)[a]
Oenocarpus	*Oenocarpus*
Sect. I. *Distichophyllum* Dr.	Sect. I. *Yandybácaba* Barb. Rodr.
1. *O. distichus*	1. *O. distichus*
2. *O. tarampabo*	2. *O. discolor*
	3. *O. tarampabo*
Sect. II. *Bataua* Dr.	Sect. II. *Bacába* Dr. ex parte
3. *O. bataua*	3. *O. bacaba*
Sect. III. *Bacaba* Dr.	Sect. III. *Bacábay* Barb. Rodr.
4. *O. bacaba*	5. *O. minor*
5. *O. mapora*	6. *O. multicaulis*
6. *O. multicaulis*	7. *O. circumtextus*
7. *O. minor*	Sect. IV. *Patauá* Barb. Rodr.
8. *O. circumtextus*	8. *O. bataua*

Burret (1928)	Balick (1986)
Oenocarpus	*Oenocarpus*
Sect. I. *Euoenocarpus* Burret	Subgen. I. *Oenocarpus*
Subsect. 1. *Distichophyllum* Dr.	1. *O. distichus*
1. *O. distichus*	2. *O. discolor*
2. *O. discolor*	3. *O. tarampabo*
3. *O. tarampabo*	4. *O. bacaba*
Subsect. 2. *Bacaba* Dr. ex parte	5. *O. macrocalyx*
4. *O. bacaba*	6a. *O. mapora* subsp. *mapora*
5. *O. mapora*	6b. *O. mapora* subsp. *dryanderae*
6. *O. minor*	7a. *O. minor* subsp. *minor*
7. *O. microspadix*	7b. *O. minor* subsp. *intermedius*
8. *O. huebneri*	Subgen. II. *Oenocarpopsis* (Burret) Balick
9. *O. intermedius*	8. *O. circumtextus*
10. *O. multicaulis*	*Jessenia*
Sect. II. *Oenocarpopsis* Burret	9a. *J. bataua* subsp. *bataua*
11. *O. circumtextus*	9b. *J. bataua* subsp. *oligocarpa*
Jessenia	
12. *J. bataua*	
13. *J. polycarpa*	
14. *J. oligocarpa*	
15. *J. repanda*	

[a]A consideration of Brazilian species only.

or, when young, covered with remains of sheaths and sheath fibers; base sometimes producing a small mass of slender roots.

Leaves pinnate, spirally to distichously arranged in suberect (when young) or horizontally spreading (when mature) coma; sheaths clasping, somewhat split opposite petiole, thick, coriaceous, lightly furrowed on the inside, smooth on the outside, upper portions fibrous, with fibers reaching to petiole base; petioles concave-channeled and smooth adaxially, convex and smooth abaxially; rachises through-shaped at base, more or less 3– or 4-sided near center, flattened to concave adaxially, flattened to semi-convex abaxially, changing to trigonal towards apex, smooth, more or less ribbed longitudinally, frequently lepidote when young; pinnae numerous, regularly to irregularly inserted along rachis in a single plane or at various angles to rachis; adaxial surfaces glossy green; abaxial surfaces light green to white, linear lanceolate to oblong-lanceolate at center of rachis, plicate, acute to long acuminate, reflexed at attachment, one-ribbed with prominent intermediate veins, smooth adaxially, the abaxial surface smooth, usually with waxy coating (at least when newly unfolded) and, in some species, sparsely to densely covered with needle-like to twisted, hair-like trichomes.

TABLE 2

Comparison of the morphological differences between *Jessenia* and *Oenocarpus*

Oenocarpus	*Jessenia*
Lower surface of pinnae sparsely to densely glaucous.	Lower surface of pinnae with peltate to sickle-shaped to doubly sickle-shaped trichomes.
Leaf sheath with straw-like or wiry fibers to ca. 30 cm long.	Leaf sheath with thin, short hairlike fibers and stout knitting needle-like fibers to 1 m in length.
Staminate flowers with six stamens.	Staminate flowers with 7 to 20 stamens.
Filaments apically inflexed in bud.	Filaments straight or undulate and rarely curved at apex in bud.
Anthers with connective not produced.	Anthers with connective produced.
Endosperm homogeneous.	Endosperm ruminate.

Inflorescence interfoliar in bud, protandrous, weakly to strongly hippuriform (shaped like a horse's tail); peduncle short to elongate, flattened adaxially, bracteate, bearing a sharply 2-edged, flattened prophyll with dentate margins (in *Oenocarpus circumtextus* the prophyll is of unknown construction) and a larger, tubular peduncular bract swollen in the middle, longitudinally somewhat striate, tapering to a sharp point and opening lengthwise; rachis flattened adaxially, frequently lepidote, rachillae simple, inserted laterally and abaxially, arched to pendulous at anthesis, short to elongate, linear to slightly undulate, slender, attenuate.

Flowers unisexual, sessile, borne in triads of two staminate and one pistillate flower proximally on the rachillae, in pairs of staminate or solitary staminate distally or rarely staminate throughout; staminate flowers asymmetrical, sepals three, ovate-lanceolate, acute, centrally somewhat thickened, marginally thin or even somewhat translucent, basally briefly connate to valvate or briefly embricate; petals three, valvate, longitudinally striate, linear to oblong-lanceolate, acute, slightly fleshy, one or two in each flower often somewhat dissimilar, incurved, stamens six, filaments subulate, slender, linear or sometimes curved and bent, apically inflexed in bud, connective not extending beyond locules; anthers dorsifixed at lower junction of thecae, more or less hastate, rounded or blunt apically, versatile, with two easily separated, bilocular thecae, longitudinally and extrorsely dehiscent; pistillode small, trifid; pistillate flowers symmetrical; sepals three, imbricate (except the briefly valvate apex when mature), suborbicular, hooded-concave, somewhat thin when young, becoming larger and fleshier at maturity; staminodes lacking; gynoecium unilocular, uniovulate; ovule erect, anatropous, rarely aborted; style short, thick; stigmas three, reflexed at anthesis, papillate adaxially.

Fruit green when young, covered to a varying degree with wax, becoming dark purple when ripe, globose to ovoid-ellipsoid, obtuse to acute, basally with a shallow, bowl-like cupule of indurate perianth; stigmatic residue apical to slightly excentric; epicarp smooth; mesocarp fleshy, rich in oil, with thin, flattened longitudinal fibers adnate to and completely covering seed; seed ovoid-elliptic to globose; endosperm horny, white, homogeneous; embryo white, clavate, ca. 2/3 as long as seed.

Key to the Subgenera of *Oenocarpus*

1. Trunk smooth in adults; pinnae linear-lanceolate to somewhat broadly linear-lanceolate at center of rachis and lacking a significant acumen; peduncle of inflorescense short and. stout; peduncular bract opening along entire length and falling away.

I. subgen. *Oenocarpus.*

1. Trunk covered with a fibrous reticulum, even in adult stage; pinnae ovate-oblong or oblong-lanceolate at center of rachis, terminating apically in a long narrow acumen 10-22 cm long by 2-3 mm wide; peduncle of inflorescence long and slender; peduncular bract opening along about one-half its length and persistent.

II. subgen. *Oenocarpopsis.*

I. *Oenocarpus* subgen. *Oenocarpus.* Type *Oenocarpus bacaba* Martius.

Oenocarpus Sect. *Distichophyllum* Drude, Martius, Fl. bras. 3 (2): 467. 1882.

Oenocarpus Sect. *Bacaba* Drude, in Martius, Fl. bras. 3 (2): 467. 1882 (in part).

Oenocarpus Sect. *Yandybacaba* Barbosa Rodrigues, Sert. palm. bras. 1: 41. 1903.

Oenocarpus Sect. *Bacabay* Barbosa Rodrigues, Sert. palm. bras. 1: 42. 1903 (in part).

Oenocarpus Sect. *Euoenocarpus* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 292. 1928.

Large to medium, solitary to caespitose palms; stem smooth or, when young, covered with remains of sheaths and sheath fibers, obscurely ringed with leaf scars. Pinnae linear-lanceolate to somewhat broadly linear-lanceolate at center of rachis. Inflorescence strongly hippuriform; peduncle short and stout, bearing a sharply 2-edged, flattened prophyll with dentate margins and a larger, tubular peduncular bract swollen in the middle, tapering to a sharp point and opening along its entire length; both bracts caducous. Staminte flowers with three valvate to briefly imbricate sepals.

Key to the Colombian Species of *Oenocarpus*

1. Rachillae 100-200 or more, usually longer than 80 cm; ripe fruit globose to globose-elongate; pinnae mostly in groups along much of the rachis, except near the apex . . . . 1. *Oenocarpus bacaba.*

1. Rachillae fewer than 100, 75 cm or less in length; ripe fruit ellipsoid-acute to subovoid; pinnae usually (although not always) regularly arranged except for a few and these often at midleaf.

2. Ripe fruit 1.8-2.9 cm long (not including cupule) by 1.4-2.25 cm wide, ellipsoid to ovoid, stem devoid of fibrous covering at maturity . . . . 2. *Oenocarpus mapora.*

3. Abaxial surface of the leaf generally devoid of solitary or tufted, twisted trichomes between the intermediate veins, these, if present, sparsely placed only on the intermediate veins; ripe fruits 1.8-2.5 cm long (not including cupule) by 1.4-2.0 cm wide. Common in lowland Colombia . . . . 2a. *Oenocarpus mapora* subsp. *mapora*

3. Abaxial surface of pinnae densely covered with silvery, solitary or tufted, twisted trichomes between and on the intermediate veins; ripe fruits 2.5-2.9 cm long (not including cupule) by 1.75-2.25 cm wide. In Colombia, found in Chocó: Quibdó and vicinity, Nariño: Tumaco and vicinity, and Valle: Buenaventura and vicinity . . . . 2b. *Oenocarpus mapora* subsp. *dryanderae.*

2. Ripe fruit less than ca. 1.7 cm long (not including the cupule) by ca. 1.1 cm wide, oblong cylindrical, stem with fibrous covering at maturity . . . . 3. *Oenocarpus circumtextus.*

1. *Oenocarpus bacaba* Martius, Hist. nat. palm. 2: 24-25, t. 26. 1823. Type. Brazil. Amazonas: *Martius s.n.* (M?, n.v.). Fig. 2.

Trunk large, solitary, columnar, 8-20 (–25) m high, (12–) 15-25 cm diam. Leaves 7-17 per coma, robust, spirally arranged, fewer in younger or senescent plants; sheath ca. 0.75-1.10 m long, outer surface dull olive-green, inner surface glabrous, upper margins lined with straw-like, brown, flexible

FIGURE 2. *Oenocarpus bacaba* in the Vaupés.

fibers; petiole green to green-brown, ca. 0.6-1.0 m long, gray-lepidote at first, becoming more or less glabrous; rachis green to dark green, unequally 4-sided in cross section towards center, 3.5-6.0 m long, maroon-lepidote when young, vestiture becoming darker or gray with age and frequently falling away; pinnae 75-117 per side, inserted at regular intervals and all in same plane at apex, usually irregularly arranged towards middle and base either singly or in groups of 2-6 (7) at various angles to rachis, linear to linear-lanceolate, acute, somewhat pendulous; basal pinnae (0.65–) 0.7-1.2 m long, 1.5-4.0 cm wide; central pinnae (0.7–) 0.9-1.6 m long, 3-7 cm wide; apical pinnae (fourth from apex measured) (23–) 30-70 (–83) cm long, 1.5-2.5 cm wide. Inflorescences one to several apparent at any one time, creamy-white at anthesis, changing to reddish powdery in fruit; prophyll olive-green, 0.3-1.0 m long, 9-20 cm wide; peduncular bract similar in color, 0.8-2.0 m long, ca. 10 +cm wide, frequently somewhat brown-lepidote; axis distal to peduncular bract scar (7.5–) 14-40 cm long, (2.35–) 3.5-10 cm wide at scar, axis variable in size depending on individual; rachillae ca. 113-200 (–230), (0.55–) 0.8-1.2 (–1.72) m long, 4-7 mm wide, triads on proximal 43-90% of individual rachillae but variable; staminate flowers creamy-white in bud; sepals ca. 1.5-1.75 mm long; petals ca. 3-5 mm long, ca. 1.5-3 mm wide; anthers ca. 3 mm long, filaments brown; pistillate flowers creamy-white in bud, ± 110-190 per rachilla, ca. 4 mm long, ca. 4 mm wide at time of anthesis of staminate flowers. Fruit globose to some what globose-elongate when mature, variable in size, (1.5–) 1.6-2.1 (–22.2) cm long (including cupule), (1.2–) 1.4-2.1 cm wide, (1–) 3-6 g in weight when ripe, stigmatic residue apical to somewhat excentric, pointed, ca. 1 mm long, 2 mm wide; cupule tan, ca. 4-6 mm deep; epicarp grainywaxy; mesocarp pulpy, light purple; fibers ca. 0.5 mm wide.

Representative specimens. COLOMBIA. Amazonas-Vaupés: Rìo Apaporis, entre los Ríos Kananarí y Pacoa, 250 m, 1-15 Dec 1951 (fr), H. *García-Barriga 13914* (US). Meta: About 20 km SE of Villavicencio, ca. 500 m, 17 Mar 1939 (fr), *Killip 34275* (US). Vichada: San Luis, 2 hours by car from Las Gaviotas, 18 May 1978 (fr), *Balick & Vargas 1201* (ECON, COL). Vaupés: Caño Cuduyarí, Zurubí, tributary of Río Vaupés, 200 m, 15 Oct 1939 (fl), *Zarucchi et al. 1815* (ECON).

2. *Oenocarpus mapora* Karsten, Linnaea 28: 274, t. 55. 1857.

Trunk medium to large, caespitose, 2-12 per cluster or more rarely solitary, columnar, 3-16 (–25) m high, 9-15 cm in diameter. Leaves ca. 6-8 per coma, arching, spirally arranged; sheath ca. 45-95 cm long, outer surface dull olive-green to leaden gray, inner surface glabrous, brown, upper margins lined with wiry brown fibers, petiole green to green-brown, ca. 15-95 cm long, ca. 2.5-3 +cm wide at apex, light brown to maroon-lepidote at first, indumentum becoming gray and frequently deciduous, then glabrous; rachis green, unequally 3-sided in cross section towards center, (0.95–) 2.8-5.5 m long, lepidote; pinnae 60-71 + per side, inserted at regular intervals and all in the same plane at apex, often more or less irregularly arranged towards center and base, either singly or in groups of 2-4, at various angles to rachis (some to ca. 75°), linear-lanceolate, acute; basal pinnae ca. 55-75 cm long, 2.0-3.5 cm wide; central pinnae 0.6-1.0 m long, 3.5-5.5 (–7.8) cm wide; apical pinnae (fourth from apex measured) 20-33 cm long, 1.25-2.75 cm wide. Inflorescences one to several apparent at one time, creamy-white at anthesis, changing to reddish powdery in fruit; prophyll olive-green, ca. 25-45 (–57) cm long, somewhat lepidote; peduncular bract of similar color, 50-85 + cm long, ca. 4-8+ cm wide at center, light orange-lepidote when young, becoming dark orange-maroon with age; axis distal to peduncular bract scar 6-20 cm long, 1.9-4.75 cm wide at scar, axis variable in size depending on the individual; rachillae ca. 64-98, 36-73 cm long, ± 2-5 mm wide, triads on proximal 50-60% of individual rachillae; stamimate flowers creamy-white, sepals ± 1.5-1.75 mm long; petals 3-4 mm long, 1.5-2.0 mm wide, anthers ± 1.75-2.75 mm long, filaments brown, slender, straight to somewhat undulate; pistillate flowers creamy-white in bud, 54-97 per rachilla, ± 3.0-3.5 mm long, 4.5-6.0 mm wide at time of anthesis of staminate flowers. Fruit ellipsoid to ovoid, variable in size, 1.8-2.9 cm long (not including cupule), 1.4-2.25 cm wide, stimagtic residue more or less apical, ca. 2 mm long, 1-3 mm wide; cupule tan, ca. 5-9 mm deep, ca. 9-20 mm wide; epicarp grainy-waxy, mesocarp pulpy, lavender to purple, fibers ca. 0.5 mm wide.

Subspecies of *Oenocarpus mapora*

2a. *Oenocarpus mapora* Karsten subsp. *mapora*. Type. Venezuela. Zulia: Perijá de Maracaibo, without date, Karsten s.n. (isotype, LE). Fig. 3.

Oenocarpus multicaulis Spruce, J. Linn. Soc., Bot. 11:142. 1871. Type, Perú. San Martín: Tarapoto, without date, *Spruce hb. palm. 63* (K?, n.v.).

Trunks caespitose, growing 6-12 together or solitary. Pinnae generally devoid of trichomes between the intermediate veins abaxially, or if trichomes present, these mostly simple and bristle-like and appressed to the lamina, or else on the intermediate veins. Fruit ellipsoid to subovoid, variable in size, 1.8-2.5 cm long (not including cupule), 1.4-2.0 cm wide; cupule 5-6 mm deep, 9.16 mm wide.

FIGURE 3. *Oenocarpus mapora* subsp. *mapora* in the Llanos.

FIGURE 4. *Oenocarpus mapora* subsp. *dryanderae* on the Pacific Coast.

Distribution. A widespread species occurring in Costa Rica, Panama, and throughout much of the northern half of South America, up to an altitude of about 1000 m.

Representative Specimens. COLOMBIA. Antioquia: Porcesito, valley of Río Medellín, 110 m, 19 May 1946 (fl), *Hodge 6863* (BH, GH); Peñas Blancas, 29 Apr 1926 (fl), *Juzepczuk & Woronow 4636* (LE), 5 May 1926 (fl), *Juzepczuk 4709* (LE), 25 Apr 1926 (fl), *Woronow & Juzepczuk 4537* (LE). Caquetá: Hetucha near Río Orteguaza, 30 Jul 1926 (fl), *Woronow & Juzepczuk 6320* (LE). Chocó: Cabo Marzo, 13 Sep 1970, *Moore et al. 9873* (BH). Meta: Cabuyaro, Jan 1937, *H. García-Barriga 5103* (US). Nariño: Delta of Río Mira, nr. Tumaco, sea level, Jun 1966 (fl), *Schultz & Rodrígues P. 492* (U), Jun 1966 (fr), *Schultz & Rodrígues P. 502* (U); Norte de Santander: Bellavista on pipeline, ca. 830 m, 15 Sep 1946 (fl), *Foster & Foster 1672* (GH); Petrólea, beginning of pipeline, ca. 60 m, 24 Sep 1946 (fr), *Foster & Foster 1785* (BH, GH). Vaupés, Selva entre Calamar y San José del Guaviare, 240 m, 1 Nov 1939 (fl), *Cuatrecasas 7368* (US). Vichada: Guacamayas, 26 Jul 1976 (fr), *Balick & Hoyos 76-19* (COL, ECON); Topochera, Las Gaviotas, 9 May 1978 (fr), *Balick & Vargas 1199* (COL, ECON). Santander: Puerto Wilches and vic., 100 m, 28 Nov-2 Dec 1926, *Killip & Smith 14808* (GH, NY, US); km 16 between Puerto Wilches and Puerto Santos, 110-115 m, 29 Nov 1926, *Killip & Smith 14845* (A, NY, US); Puerto Wilches, between La Gómez and km 80 of Atlantic railroad, 100-200 m, 19 Apr 1960, *Romero Castañeda 8313* (MO, NY).

2b. *Oenocarpus mapora* Karsten subsp. *dryanderae* (Burret) Balick Adv. Econ. Bot. 3: 110. 1986. Type. Colombia. Valle: Buenaventura, without date, *Dryander 11* (B). Figure 4.

Oenocarpus dryanderae Burret, Notizbl. Bot. Gart. Berlin-Dahlem 11: 865. 1933.

Trunks caespitose, growing fewer than five together or rarely solitary (?). Pinnae densely covered with silvery, solitary and tufted, twisted trichomes abaxially both on and between the intermediate veins. Fruit more or less ovoid, variable in size, 2.5-2.9 cm long (not including the cupule), 1.75-2.25 cm wide; cupule ca. 8-9 mm deep, 15-20 mm wide.

Distribution. Pacific Coast of Colombia.

Representative specimens. COLOMBIA. Chocó: Environs of Quibdó, Road from Quibdó to Yuto, km 7. 21 July 1984, (fr), *King et al. 554* (JAUM, NY, TULV); La Recta, 15 km from Quibdó on the road to Medellín, 14 Jun 1985 (fl) *King et al. 656;* (NY, JAUM); Las Animais, roadside entrance to Panamerican Highway, 2 km from Las Animais on road to Quibdó, 16 June 1985, *King et al. 661* (JAUM, NY, TULV); Nariño: Mun. Tumaco, km 50 from Tumaco on Tumaco - Quibdó road, 19 Jul 1984 (yfr) *M. J. Balick et al. 1659* (JAUM, NY, TULV); Valle: Station Bajo Calima, 4 km upstream from Bajo Calima (Pto. Patiño) on Río Bajo Calima, ca. 32 km NE of Buenaventura, 6 Mar 1975 (fl, fr), *Anderson 18* (INPA); Buenaventura, 3 May 1926, *Cook 74* (US); forests in concession of Cartón Colombia, vic. Buenaventura, 10 Feb 1967, *More et al. 9459* (BH); slope by road nr. Río Anchicayá, vic. Buenaventura, 13 Feb 1967 (fr), *Moore et al. 9479* (BH).

II. *Oenocarpus* subgen. *Oenocarpopsis* (Burret) Balick, Adv. Econ. Bot 114. 1986. Type. *Oenocarpus circumtextus* Martius.

Oenocarpus Sect. *Oenocarpopsis* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 292, 300. 1928.

Medium, solitary palms; stem covered throughout with a dark brown, tightly woven fibrous network, even in the adult state. Pinnae ovate-oblong or oblong-lanceolate at center of rachis. Inflorescence weakly hippuriform; peduncle elongate and thin, bearing a small cryptic prophyll (not seen) completely obscured by a fibrous network and a larger, tubular peduncular bract with a long slender base forming a manubrium and tapering to a sharp point at the apex, splitting along only about one-half its length and persisting. Staminate flowers with three briefly connate sepals.

This subgenus consists of a single species, *Oenocarpus circumtextus.*

3. *Oenocarpus circumtextus* Martius, Hist. nat. palm. 2: 26, t. 26, figs. 3, 4. 1823. Type. Colombia. Amazonas: Cerro de La Pedrera, 1810-1820, *Martius s.n.* (M). The specimen is on four sheets, ticketed 108-111, the first three of which were originally designated as *O. bacaba* and, in 1880, corrected by Drude. Figure 5.

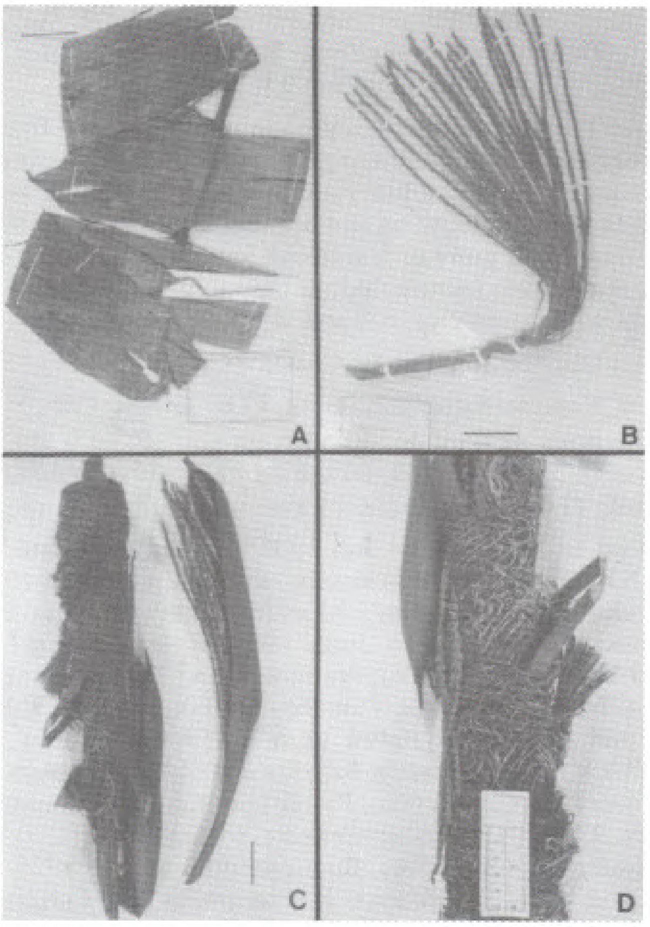

FIGURE 5. *Oenocarpus circumtextus* A. leaves *(Ducke 12305)*; B. panicle *(Martius s.n.)*; C. Portion of stem showing fibrous covering (L) and panicle enclosed by bract (R) *(Huebner 41)*; D. Close up of stem section *(Huebner 41)*.

Trunk medium, ca. 3-6 m high, ca. 10-14 cm diam. Leaves spirally arranged; sheaths completely obscured by a fibrous reticulum; petiole and rachis ca. 3 m long, at first somewhat lepidote, then more or less glabrous; rachis towards apex rounded abaxially and keeled adaxially; pinnae fewer in number than in other species, inserted at regular intervals and all in the same plane, ovate-oblong or oblong-lanceolate; central pinnae ca. 50-70 cm long and 10–12 cm wide, last 10-22 cm forming a long, narrow acumen ca. 2-3 mm wide which is abaxially lepidote; apical pinnae (fourth from apex measured) ca. 24 cm long, ca. 6.75 cm wide. Inflorescences one to several apparent at one time; prophyll (not seen on herbarium material) presumably much reduced and obscured by fibrous reticulum; peduncular bract light brown-tomentose, ca. 90 + cm long including manubrium, ca. 1.5-3 cm wide at middle when closed, ca. 1.1-1.5 cm wide towards base, longitudinally shallowly furrowed. Panicle with peduncle base obscured, axis distal to peduncular bract scar ca. 50 + cm long, ca. 1.0-1.4 cm wide at center, transversely elliptic in cross section. Rachillae 21-32, ca. 28-38 cm long, 3-5 mm wide, attenuate, triads on proximal 21-56% of individual rachillae, variable depending on the individual. Staminate flowers creamy white, sepals ca. 1 mm long, petals ca. 3-4.25 mm long, ca. 1.5-2.0 mm wide, anthers ca. 2-2.5 mm long, filaments brown; pistillate flowers creamy white, (5–) 21-76 per rachilla, sepals ca. 3.5 mm long at time of anthesis of staminate flowers. Fruit oblong-cylindrical, ca. 1.7 cm long (including the cupule), 1.1 cm wide; stigmatic residue slightly excentric; cupule tan, ca. 5 mm deep (according to drawing); epicarp somewhat grainy; mesocarp pulpy; fibers ca. 0.5 mm wide.

Representative specimens. COLOMBIA. Amazonas: Cerro de La Pedrera, 24 Nov 1912 (fl), *Ducke 12305* (MG, US, U); ca. 300 m, Feb 1926 (fl), *Huebner 41* (B).

Description of *Jessenia*

4. *Jessenia* Karsten, Linnaea 28: 387. 1857. Type species. *Jessenia bataua* (Martius) Burret.

Large, solitary, erect , pleonanthic, monoecious palms; stem columnar, frequently massive, gray to black, smooth or, when young, covered with remains of sheaths and sheath fibers and spines, obscurely ringed with leaf scars; base frequently producing a small mass of slender roots. Leaves pinnate, spirally arranged in a suberect (when young) or horizontally spreading (when mature) coma; sheaths partially clasping, somewhat split opposite petiole, thick, coriaceous, lightly furrowed on the inside, smooth on the outside, upper portion lined with a mat of brown fibers, of which some are thin, hair-like, and interwoven, others stout, needle-like, and marginally persistent on the sheath and extending into the center and along lower margins of petiole; petiole smooth, channeled adaxially, convex abaxially, rachis trough-shaped at base, more or less 4-sided near center, flattened to concave adaxially, abaxially flattened to semiconvex, changing to triangular towards the apex, smooth, ribbed longitudinally, lepidote when young; pinnae numerous, regularly arranged and inserted along rachis in a single plane, subalternate towards base, opposite to subopposite centrally, subopposite to subalternate towards apex, broadly linear-lanceolate at center of rachis, plicate, acute basally reflexed at attachment, 1-ribbed with prominent intermediate veins, smooth adaxially, covered with pale (or rarely reddish) peltate to sickle-shaped or doubly sickle-shaped trichomes abaxially.

Inflorescence interfoliar in bud, protandrous, hippuriform; peduncle short, flattened adaxially, bracteate, bearing a sharply 2-edged, flattened prophyll with dentate margins and a larger, thick, tubular peduncular bract swollen in middle, tapering to sharp point and opening lengthwise, both bracts deciduous; rachis flattened adaxially, frequently lepidote, with simple rachillae inserted laterally and abaxially, arched to pendulous at anthesis, elongate, linear to slightly undulate, slender, attenuate.

Flowers unisexual, sessile, borne in triads of two staminate and one pistillate flower proximally on rachillae, in pairs of staminate or solitary staminate distally, usually devoid of flowers in ultimate portion, occasionally the slender apex of rachillae terminating in several solitary, small, staminate flowers, inflorescence rarely entirely staminate; staminate flowers asymmetrical, sepals three, obtuse, acute, imbricate, petals three, valvate, longitudinally striate, more or less lanceolate, acute, slightly fleshy, one or two in each flower often dissimilar, incurved, stamens (7, 8) 9-20, filaments awl-shaped, slender, straight or undulate and rarely curved at apex in bud, inserted at lower junction of thecae and extending along juncture with a connective produced; anthers dorsifixed, linear, tapering to a point, versatile, with two divergent bilocular thecae, sagittate basally for half their length, longitudinally and extrorsely dehiscent, pistillode rudimentary, trifid; pistillate flowers symmetrical; sepals three, imbricate, fleshy, suborbicular, hooded-concave, completely enclosing the corolla in bud; petals three, imbricate (except for the briefly valvate apex when mature), suborbicular, hooded-concave, somewhat thin when young, becoming larger and fleshier at maturity; staminodes lacking; gynoecium usually unilocular, uniovulate, rarely 2-locular and with two ovules; ovule erect, anatropous; style short, thick, stigmas three, reflexed at anthesis, papillate adaxially.

Fruit one-seeded or rarely two-seeded, ovoid-ellipsoid, obtuse with a shallow bowl-like cupule of indurate perianth at its base; stigmatic residue apical to slightly excentric; epicarp slightly grainy-waxy, smooth, thin; mesocarp fleshy, rich in oil, with thin, flattened longitudinal fibers adnate to and completely covering the seed; seed ovoid-ellipsoid, endosperm horny, ruminate; embryo white, cylindrical-clavate, ca. 2/3 as long as seed.

In Colombia this genus consists of a single taxon, *Jessenia bataua* subsp. *bataua.* In Venezuela and Trinidad a second subspecies. *J. bataua* subsp. *oligocarpa* is recognized.

4. *Jessenia bataua* (Martius) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 302. 1928.

   Oenocarpus bataua Mart. Hist. nat. palm. 2. 1823. 23, t. 24-25.

   Jessenia polycarpa Karst. Linnaea 28. 1856.

Trunk columnar, 14-25 (–28) m high, (12–) 19-25 (–27) cm diam., internodes spaced 20 cm or more apart on lower portion of stem, much closer towards apex.

Leaves 8-16 per coma, fewer in younger or senescent plants; sheath 0.6-1.4 m long, outer surface dull olive-green, inner surface brown, with stout needle-like fibers to 1 m long; petiole green, 0.2-1.0 m long, ca. 5-8 cm wide apically, ca. 8-12 cm wide basally; rachis light green to dark green, 3-8 + m long, red to light-brown-lepidote when young, vestiture becoming gray with age and falling away; pinnae 65-108 per side, glossy dark green adaxially; basal pinnae ca. 0.6-1.5 m long, 2.5-2.75 + cm wide; central pinnae (0.75–) 1.0-1.7 (–2.0) m long, (4.5–) 6-11 (–14) cm wide; apical pinnae (fourth from apex measured) 15-70 cm long, 1.5-3.5 cm wide.

Inflorescences 1-3 (4+) apparent at any one time, creamy white at anthesis: prophyll olive-green, variable in size but often ca. 75 +cm long, ca. 20-25 cm wide; peduncular bract of a similar color but frequently thinly striped with yellow or brown, 1-2.3 m long, (8–) 9-18 (–19) cm wide, often somewhat lepidote; axis distal to peduncular bract scar (15–) 22-40 (–50) cm long, (4.6–) –11 (–20) cm wide at scar, axis variable in size depending on individual, sometimes developing a reddish-velvety tomentum that is deciduous with age; rachillae ca. (116–) 135-350 (–423), (50–) 70-120 (–140) cm long, (2–) 4-6 (–7–9) mm wide; staminate flowers creamy white in bud, fragant; sepals ca. 1.5 mm long; petals 4-7 (–8) mm long, ca. 2-4 mm wide; stamens ca. 5-6 mm long; anthers ca. 2.5-5 mm long, filaments brown; pistillate flowers creamy white in bud, subtly fragrant at anthesis; sepals ca. 4-6 mm long at time of anthesis of staminate flower.

Fruit green with a waxy cast when young, becoming dark purple-black when ripe, rounded at the apex, variable in size, (2.3–) 2.5-4.0 (–4.75) cm long (not including the cupule), 2.0-2.75 (3.0 in the rare 2-seeded fruits) cm wide at center, (5–) 6-15 (–16 +) g in weight when ripe; stigmatic residue ca. 1-2 mm long, 2-3 mm wide; cupule tan, ca. 5-10 mm deep; mesocarp pulpy, purple or lavender-white; fibers ca. 1 mm wide; endosperm waxy-white, penetrated by light to dark brown rays, embryo white.

Key to The Subspecies of *Jessenia bataua*

1. Pinnae covered with many trichomes on abaxial surface; rachillae gently tapering uniformly throughout; pistillate flowers usually 40-90, borne on proximal 40-60% of rachilla; staminate flowers ca. 4-7 (–8) mm long, stamens (7–) 9-20. Panama and the Amazon and Orinoco Valley, Andean foothills, and Pacific coastal territory . . . . 4a. subsp. *bataua.*
1. Pinnae with whitish waxy covering on abaxial surface, trichomes generally few and scattered; rachillae thickened proximally on portion bearing pistillate flowers; pistillate flowers usually 3-54 in number, borne on proximal 10-25% of rachilla; staminate flowers ca. 4-5 mm long, stamens (7–) 9-10 (–11). Restricted to northern and northeastern Venezuela, Trinidad, Guya-

na, and Surinam, not found in Colombia . . . . 4b. subsp. *oligocarpa*

4a. *Jessenia bataua* (Martius) Burret subsp. *bataua.* Type. Brazil. Amazonas: Without date, Martius s.n. (M?, n.v.) Figure 6).

Oenocarpus bataua Mart., Hist. nat. palm. 2: 23, t. 24, 25. 1823. Type. Brazil. Amazonas: Without date, *Martius s.n.* (M? n.v.). *Jessenia polycarpa* Karsten, Linnaea 28: 388. 1857. Type. Colombia. Meta: Llano de San Martín, 1853, *Karsten s.n.* (isotype, LE).

Pinnae with abaxial surface light to green to gray, usually densely covered with peltate to sickle-shaped to doubly sickle-shaped trichomes (more apparent in newly-emerged leaves). Rachillae more or less uniform in thickness throughout, lacking strongly pronounced bracts subtending staminate pair or solitary flower, rachillae (116–) 135-270 (–285) in number, with triads on proximal (20–) 40-60 (–65%) of individual rachillae, this quite variable, depending on individual. Stimate flowers 5-7 (–8) mm long with (7–) 9-20 stamens. Pistillate flowers usually (15–) 40-90 (–119) per rachilla.

Representative specimens. COLOMBIA. Amazonas: 1 km E of Puerto Nariño, Río Loreto-Yacu, 100m, 2 Feb 1973, *Glenboski C-253* (US). Antioquia: Porce, Mun. Gómez Plata, 1 Oct 1940 (fr), *Ranghel Galindo* 7, 23 (COL.). Caquetá: Florencia, Cerros La Estrella, 400 m, 30 Mar 1940, *Cuatrecasas 8871* (COL.); Hetuchá, Río Orteguaza, 21 Jul 1926 (fl, fr), *Woronow 6106* (LE). Chocó: 7 km W of Totenendo, on road to Quibdó, ca. 100 m, 12 Aug 1976 (yfr), *Gentry & Fallen 17601* (BH); junction of Río Condoto and Río San Juan 100-150 m, seedling, 20 Apr 1939, *Killip 35673* (BH, COL, US); Environs of Las Animais, roadside entrance to Panamerican Highway, 2 km from Las Animais on the road to Quibdó, 15 Jan 1985 (fl) *King et al. 660* (JAUM, NY, TULV); Cabo Marzo, 13 Sep 1970, *Moore 9872* (BH). Meta: Llanos Orientales, Caño Quenane, 400 m, 22-23 Feb 1941 (fl, fr), *Dugand & Jaramillo 2897* (COL); *Llano* de San Martín, 250 m, 1851-1857, *Triana 716* (P). Norte de Santander: Petrolea, beginning of pipeline, ca. 60 m, 26 Sep 1946 (fr), *Foster & Foster 1789* (BH). Vaupés: Mitú, 200 m, 18 Oct 1939 (fl), *Cuatrecasas 7266* (BH, photo, COL, US); Río Caraparaná, between Las Bocas and El Encanto, 150 m, 22-28 May 1942, *Schultes 3864* (BH); Río Apaporis, Jinogojé, at mouth of Río Piraparaná, ca. 230 m, 18 Jun 1952, *Schultes & Cabrera 16754* (BH); Río Kubiyu, 30 Jun 1976 (fl, fr), *Zarucchi & Balick 1793* (ECON), 1 Jul 1976 (fr), *1805* (ECON); Río Vaupés, nr. stream across from Mitú, 3 Jul 1976 (fr), *Zarucchi & Balick 1809* (ECON); along road S of Mitú, 5 Jul 1976 (fr), *Zarucchi et al. 1811* (ECON); Tukunaray, below Mitú on Río Vaupés, 6 Jul 1976 (fr), *Zarucchi et al. 1813* (ECON); Río Vaupés, La Makarena Village upriver from Mitú, 9 Jul 1976 (fr), *Zarucchi et al. 1814*

FIGURE 6. *Jessenia bataua* in the Chocó.

(ECON); Río Kubiyú, 12 Jul 1976 (fr), *Zarucchi et al. 1838* (HUA, ECON), 12 Jul 1976 (fr), *1840* (COL, ECON), 12 Jul 1976 (fr), *1842* (ECON), 15 Jul 1976 (fr), *1850* (ECON); Río Vaupés, La Makarena Village upriver from Mitú, 17 Jul 1976 (fl, fr), *Zarucchi et al. 1851* (COL, ECON); Río Vaupés, on trail that leads to Santa Lucía on Río Querari, 7 Aug. 1976 (fr), *Zarucchi et al. 1874* (ECON). Valle: Buenaventura, 3 May 1926, *Cook 73* (US), 5 May 1926 (fr), *79* (US), seedling, 7 May 1926, *93* (US), 23 May 1926, *135* (US), 30 May 1926 (fl), *178* (US); Río Naya, Puerto Merizalde, 5-20 m, 20-23 Feb 1943 (fl, fr), *Cuatrecasas 13962* (COL, F, MO); Río Calima, La Trojita, 5-50 m, 19 Feb-10 Mar 1944, *Cuatrecasas 16319* (COL); Río Cajambre, 5-80 m, 5-15 May 1944 (fr), *Cuatrecasas 17379* (COL, F); 18 km E of Buenaventura, ca. 50 m, 14 Feb 1939 (yfr), *Killip & García-Barriga 33255* (BH, US); Buenaventura, 9 Feb 1967, *Moore et al. 9454* (BH); Agua Dulce, an island in Buenaventura Bay, 12 Feb 1967, Moore et al. 9476 (BH); Río Calima, Quebrada de La Brea, 30-40 m, 19 May 1946, *Schultes & Vallarreal 7377* (BH). Vichada: Las Gaviotas, Topochera, 25 Jul 1976 (fl, yfr). *Balick & Hoyos 76-18* (ECON); Guacamayas, 26 Jul 1976 (fr); *Balick & Hoyos 76-20* (ECON); Las Gaviotas, 27 Jul 1976, *Balick & Hoyos 76-22* (ECON). Santander: 20 km S of Barrancas Bermeja, ca. 100 m, Jul 1966 (fr), *Schultz & Rodrigues P. 509* (U).

ACKNOWLEDGMENTS

I am very grateful to the many individuals and institutions in Colombia who assisted my studies. At the onset, the Centro de Desarrollo Integrado "Las Gaviotas" provided logistical and financial support. Staff and facilities of the Instituto de Ciencias Naturales of the Universidad Nacional, Bogotá, Jardín Botánico "Joaquín Antonio Uribe" in Medellín, Universidad Tecnológica del Chocó "Diego Luis Córdoba", the Universidad de Antioquia and the Instituto Vallecaucano de Investigaciones Científicas (INCIVA) all provided invaluable assistance. Permission of the Instituto Nacional de los Recursos Naturales Renovables y del Ambiente (INDERENA) to conduct fieldwork in Colombia is gratefully acknowledged. The opportunity to undertake botanical fieldwork in Colombia since 1976 has given me the chance to make many personal friendships and professional relationships in this country, which has become a source of great pleasure for me. I am grateful for the help of many of these people in my past and continuing studies. Above all, this small paper is offered as part of a tribute to Professor Richard Evans Schultes, who has been to me both a teacher and friend.

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A FRUITFUL FRIENDSHIP BETWEEN AN ETHNOBOTANIST AND A PHYTOCHEMIST

By *Albert Hofmann*

After several years of scientific correspondence I met Dr. Richard Evans Schultes personally at a meeting of the Gesellschaft für Arzneipflanzenforschung (Society for Medicinal Plant Research) in Berlin. An inscription in my copy of Dr. Schultes' monograph "A Contribution of our Knowledge of *Rivea corymbosa:* The Narcotic Ololiuqui of the Aztecs" (Botanical Museum of Harvard University, Cambridge, 1941) reminds me of that meeting. It reads as follows: "To Dr. Albert Hofmann. May 22, 1964, Berlin. With great pleasure in finally meeting you personally, Richard Evans Schultes".

We became close friends. Dick's Oldbostonian humor, his realism, his custom to work hard, his reliability made me think of similar Swiss characteristics and he liked to explain that his ancestors were descendents of the in Zürich long established Swiss family Schulthess. When ever in the States I visited the Schultes family in the beautiful home in Melrose and we spent vacation in common on Sutton Island in Maine. In turn the Schultes visited us in our house on the Jura mountain at Burg in Switzerland.

One of the many sympathetic characteristics of Dr. Schultes is his deep connection with Harvard University. His enthusiasm for his university and its tradition made him urge me to participate at the Commencement Day Ceremonies, —as a disguised Harvard professor—. Which was indeed an extraordinary experience for me.

I had also the opportunity to test personally Dr. Schultes' fame as an outstanding ethnobotanical explorer. On a trip to Oaxaca in Southern Mexico we were, in company of a young phytochemist, in search of a rare tree, *Quararibea funebris,* its fragrant flowers being used by the Indias as an admixture to chocolate. My nose willguide me, said Dick. We went to the big market hall, central meeting place of the town of Oaxaca, passed through all the rich displays with fruits, vegetables, flowers, spices, etc., Dick always sniffling in the air. Suddenly he stopt at an old Indian woman, who had on her display dried flowers of *Quararibea funebris.* From her he got the information where such a tree would grow. We found it near a smal settlement some miles outside of the town, a beautiful big three belonging to a Zapotec family who lived on it, selling its white fragrant flowers to a chocolate producer. Our young colleague could collect here all the botanical documentation he needed for the book on chocolate he was writing.

Before we met personally I had been working on two research projects based on ethnobotanical findings of Dr. Schultes.

One was the chemical analysis of the "sacred mushrooms" of the Mexican Indians. It was Dr. Schultes who had initiated the botanical identification of these mushrooms by two articles in 1939 and 1940 (1). The investigations on "teonanacatl", the Aztec name of these mushrooms, was concluded in the latefiftieth by the isolation and chemical identification of the hallucinogenic principles, the alkaloids psilocybin and psilocin, by myself and my coworkers in the pharmaceutical research laboratories Sandoz, Basel, Switzerland (2).

The already mentioned publication of Dr. Schultes, "A Contribution of our Knowledge of *Rivea corymbosa:* The Narcotic Ololiuqui of the Aztecs", has served as ethnobotanical basis of our investigation on ololiuqui, an ancient magic drug of the Mexican Indians like the mushroom teonanacatl. The riddle of ololiuqui was solved when we found ergot alkaloids, i.e. lysergic acid amide and lysergic acid hydroxyethylamide, closely related to LSD (lysergic acid diethylamide) to be the hallucinogenic constituents of the convolvulaceous seeds (3).

My friendship with Dr. Schultes provided me with the privilege to coauther two of this books, namely "The Botany and Chemistry of Hallucinogens" a text book, and "Plants of the Gods" a large size, richly with colored pictures illustrated volume for a general public. (4-5).

Dick convinced me of the need that he, an ethnobotanist and I, a phytochemist, should write this textbook, considering that all research in the field of psychoactive drugs of natural origin begins with botany and chemistry and that therefore we should provide investigators in this field with this basic knowledge.

The title "Plants of the Gods" refers to the important role which psychoactive, especially hallucinogenic plants play in the history of religion and magic. These plants were used and are still used in our day in tribal cultures in religious ceremonies and in magical healing procedures. This is not mere superstition because phytochemists could isolate from many of these plants psychoactive substances which became useful tools in biological research and medicaments in psychiatry. This broad spectrum of cultural and scientific aspects presented by "Plants of the Gods" accounts for the widespread interest for this book which already appeared in a second edition and which has been tranlated in several languages.

When scientific collaboration is combined with friendship it becomes more fruitful and more pleasurable. My relation with Dr. Schultes is an example of such an experience.

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OLD AND NEW WORLD HALLUCINOGENS: A statistical Query and an Ethnological Reply

By *Weston La Barre* [1]

In the Spring of 1935, a Harvard undergraduate wrote me at the Yale Graduate School: could he go with me on an American Museum of Natural History fieldtrip (his first, my second) to the Kiowa Indians? And so we did, the following summer. Thus began more than a half-century of interdisciplinary cooperation and professional friendship. I take considerable pride in the event, though it is hardly necessary to point out that on his own, Richard Evans Schultes later became undoubtedly the most distinguished ethnobotanical fieldworker of his generation. The benefit was mutual and we learned from one another.

When, two years later as Sterling Fellow, I went to South America, I made a large (but, botanically, woefully inadequate) collection of Aymara Indian *materia medica,* mostly botanical. From my fragmentary specimens collected directly from Indians, Schultes made spectacular identifications which enabled publication.[2] The ethnologist was not a botanist. Thus, at his expense, I gained some belated notion of what constitutes a properly ethnobotanical collection. And the botanist was not an ethnologist: I chided him for evidencing an ethnocentric connotation of "medicine" which, for American Indians, means a supernaturally —not pharmacologically-operating substance— the sometimes subtle distinction between a native (emic) and a scientifically objective (etic) conceptualization.[3] I had maintained that *Lophophora williamsii* was claimed as a "medicine" in strictly Indian terms. I was doubtless right ethnographically. Yet, ironically, it transpired later that some of the *Lophophora* alkaloids, now about thirty in number, *were* pharmacologically medicinal. I was right emically, but Schultes was equally right etically. I think the latter counts for more, in the long run, though Schultes has profited enormously from his respect for native emic cues: a native pharmacopoeia is certainly richer for etic purposes than a random sampling.[4]

On a larger question —that of native areas of probably greatest knowledge and use of botanical hallucinogens— the botanist and the ethnologist saw eye to eye from the beginning. The Aztec area had obviously been the most studied, yet once the significance of Andean (Aymara) botanical *materia medica* had been established, then ethnographic logic would argue that the intervening Chibchan-Colombian area should have been stimulated diffusionally by both flanking Aztec and Andean. Thus when on the grounds of ethnobotanical fieldwork Schultes ventured the judgment that Colombia was probably that area of greatest native knowledge of hallucinogens[5], I agreed with him immediately[6]. Though on different grounds, we came to the same conclusion.

The mutual respect of botanist and ethnologist is thus fully understandable. I daresay no informed person will disagree with my judgment that whereas Schultes and Hofmann's *Botany and Chemistry of Hallucinogens* is the standard scientific authority in the field, their *Plants of the Gods: Origin of Hallucinogens* is surely the finest book for the general reader, along with Schultes' elegant summary in *Hallucinogenic Plants*[7]. Schultes has been reciprocally appreciative of La Barre[8].

The peak of our collaboration was reached in our pondering over a puzzling statistical discrepancy. As early as 1963, Schultes wrote:

> It is of interest that the New World is very much richer in narcotic plants than the Old and that the New

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World boasts at least 40 species of hallucinogenic or phantastica narcotics[9] as opposed to half a dozen species native to the Old World[10].

The reason for this marked discrepancy is by no means immediately evident. In fact, one might reasonably suppose the reverse to be true.

That is, the Old World has a far greater land mass than the New, and certainly as varied climates and ecologies –and hence the apparent possibility of a greater number and variety of plants. Furthermore, men and proto-men who might have discovered the properties of those plants that are narcotic have existed for an incomparably longer period (from the Australopithecines and *Homo habilis* onward) in the Old World than in the New (only from the late Paleolithic and Mesolithic onward). Thus, on geographic-ecological and botanical as well as anthropological grounds, the Old World *prima facie* should hold more psychotropic plant species than the New–which is quite contrary to the apparent facts.

On returning to the problem in 1955, Schultes cited the statistics again but continued:

> the foregoing statistics relate merely to those plants the narcotic properties of which man has discovered in his trial and error experimentation during human history. Is there any reason to presume that man in a primitive state of culture possesses any peculiar intuition enabling him to uncover more efficiently than his more civilized counterpart those plants that Nature has endowed with physiologically active principles?[11]

There is, I think, an answer in this. But not to our question. It may well be that Paleolithic hunters and gatherers of plants were oftener under hunger pressures to experiment with potential foodstuffs than are their Neolithic descendants more abundantly supplied both with their staple cultigens and their domesticated animals. But as to plant knowledge, are not later folk the cultural heirs of earlier ones? And for both food and narcotic plants, the Old World has contained primitive men questing to find them for a longer period than the New.

The value of Schultes' caution on the limited scope of trial and error as opposed to systematic enquiry is plain, for the one is old and the other quite new. It leaves open the possibility that, were human knowledge not grossly incomplete, then the Old World might in fact contain an appropriately larger number of psychotropic plants. But Schultes would be unwilling to hold that trial-and-error would be likely to result in the statistical discrepancy he points out, whatever a longer systematic enquiry might discover.

Be that as it may, his thinking contains, in my opinion, the germ of understanding –the differential factor is perhaps human, *viz.* at whatever level, one of human knowledge– if only we dichotomize not primitive and civilized man but rather discriminate among some (primitive) men and others ethnographically. We already have small-scale evidence of the possibility. Thus even in the same ecological region or "culture area", contiguous tribes may differ markedly in their folk-knowledge of plants. For example, the Cherokee of North Carolina retain much of their rich *materia medica* of plant origin, but the Catawba of South Carolina are culturally impoverished in this respect. Cherokee consequently call the Catawba "ignorant", and Catawba call the Cherokee "superstitious" in the use of folk simples.

Schultes returned still again to the problem in 1967:

> It may likewise be of significance that, whether because of cultural differences or of floristic peculiarities or of some other as yet unappreciated reason, the New World is much richer in narcotic plants than the Old. These statistics, naturally, relate merely to those plants the narcotic properties of which man has discovered in his trial and error experimentation during the course of human history. The longer I consider this question, the more I am convinced that there may exist in the world flora an appreciable number of such plants not yet discovered by the experimentating natives and still to be found by the enquiring phytochemist[12].

The number of narcotics yet to be found may be fewer perhaps than we anticipate, however, if we are right in supposing that over long epochs hunting-and-gathering natives repeatedly explore flora randomly for food. Indeed, Schultes himself has repeatedly stated his respect for the ethnobotanic experience of primitive peoples. Though he is the ranking authority on New World narcotics, Schultes is not content either to explain the matter easily in terms of objective floristic peculiarities.

Of the perhaps 800,000 plant species, Schultes[13] points out that among the 200,000-500,000 Angiosperms only about 3,000 are known ever to have been used directly as human food; that of these, only about 150 are important enough to have entered world commerce; and that of these last only about 12-13, all of them cultivated, really stand between man and starvation. Small as this number is, the provenience of the major food plants is reasonably balanced between those of Old World and New World origin[14]. Thus, given the discrepancy in provenience of narcotics, Schultes, following the Americanist ethnographer La Barre[15], would accede to the proposition that there exists a "narcotic complex" of New World peoples.

The matter of narcotics may be seen in biochemical perspective with some objectivity, since.

> We find, likewise, that the number of species providing man with narcotic agents is very small. Between four and five thousand species are now known to be alkaloid (*apud* R. F. Raffauf), and we must realize that constituents other than alkaloids –glucosides, resins, essential oils, and others– may be responsible for narcotic activity. Probably no more than 60 species, including Cryptogams and Phanerogams, are

employed in primitive and advanced cultures for their intoxicating effects. Of these, only about 20 may be considered of major importance[16].

Only four or five narcotic cultigens are commercially important, and they are unknown in the wild state, indicating long association with man. Surely, there is no massive selective ecological difference between the Old World and the New to account for great discrepancies in plants producing alkaloids, glucosides, resins, and essential oils in every case! We are, therefore, again forced afield beyond the probabilities of "natural occurrence" in order to explain the discrepancy in narcotics between the Old World and the New.

More ethnologist than ethnobotanist, and certainly than botanist, I believe that the statistical discrepancy may perhaps be explained on two levels: (1) our *human* ignorance (i.e. that of primitive folk-botanists as well as that of scientific ethnobotanists) of the total facts of local and world distribution; and (2) the *relatively greater knowledge* by New World natives of psychotropic plants, which is based on identifiable "cultural differences as yet unappreciated". It would be difficult to maintain, despite Schultes' brilliant and protracted fieldwork and that of his distinguished predecessora, that New World plant species are *better known* botanically –the many new species he discovered would alone tend to discredit the supposition– than those of the long-researched Old World in general and hence *more narcotics are known* from the Americas. The critical point is that these were *already known to natives.* Furthermore, any "narcotic complex" would necessarily embrace North, Middle and South America alike ethnographically, and especially their contiguous meridional portions, say 40° N. Lat, to 20°S. Lat. – a region ethnographically, but hardly botanically significant.

Since, significantly, this *larger number* of narcotics were already known to the American Indians, is it possible that they were *culturally motivated* to seek out psychotropic plant substances, as implied in Schultes' shrewd surmise? I believe that this is demonstrably the case. To show this requires a brief summarizing excursus into pan-Americana paleo-Indian basic culture.

Though certain essentially Asiatic paleo-Siberians (e.g. the Akmak people)[17] early hunted in interior Alaska and on the tundra of "Beringia" at the height of the last glaciation 20-18,000 years ago –when so much water was tied up in glacial ice that the continents were connected by this 1,300-mile-wide, dry-land corridor –the rest of the New World was blocked to man by an all-Canadian glacier that began to gap only about 14,000 years ago. Most authorities now date the first massive invasion of proto-Indians to the late-Paleolithic "Big Game Hunters" of the interior North American Plains, whose culture can be traced through the "Magdalenian" of Lake Baikal sites in Siberia westward to the classic Magdalenian of western Eurasia*.

On the basis of culture traits universal or near-universal from Alaska to Patagonia (e.g. the bow, spear-thrower, dog), it is evident that the trickling southward of paleo-Siberian hunters continued on into the Mesolithic period (witness the sporadic and distantly scattered occurrence of Mesolithic-period pottery in the Americas), at which time, many authorities believe, the Sibero-American Eskimo blocked further incursions of Asiatic peoples and cultures. It need hardly be noted that this picture is fully confirmed *archeologically* e.g. Asiatic-American semi-subterranean houses from Siberia to Alaska and the American Southwest), *linguistically* (e.g. tone-languages such as Apache and Navaho have been linked through starred-form proto-Athapaskan and proto-Sinitic to the Tibeto-Chinese tone languages of Asia), *physical-anthropologically* (serologically, etc.), *culturally* (the conical tipi-wigwam extends from western Asia across Siberia to the central Algonkians of the Great Lakes, snow vehicles from Finland to Maine, the circumboreal "bear ceremonialism", the Tungus olonism[18] and Indian vision-quest complex, etc.), *folkloristically)* (the Eurastic-American lightning-eagle, the "magic flight" myth-motif, the Orpheus legend), and even ethnobotanically (the ritual use both in Siberia and among Great Lakes Algonkins of the same *Amanita muscaria.*

All the invaders from Siberia were simple hunters and gatherers. All American agriculture and domestication (save for the Mesolithic dog) were local developments wholly independent of Asia. No later animal domesticates and no cultivated plants were intercontinentally-shared in pre-Columbian times (the Chinese peanut and Oceanic "yam" to the contrary notwithstanding)**

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* Charred baby mammoth bones in California imply in date a Neanderthal phase of man in America that has never been found and few authorities believe in. Certainly the American Indian is only an unspecialized (e.g., lacking epicanthic fold) paleo-Mongoloid version of modern *Homo sapiens.*

** The more romantic "Kon-tiki" fantasy of Polynesian settlement from Peru is scientifically irresponsible and lacks the integrated and consistent evidence from all the anthropological sciences that the Sibero-American thesis does (the Polynesians were not Indian in race; their languages are Malayo-Polynesian; the Polynesians were great Oceanic voyagers, which Indians were not; Polynesian religion, political systems, mythology, and plant cultigens are wholly different from American Indian equivalents). That boatloads of the great "Vikings of the Pacific" might have reached the conspicuously "barn-door" west coast of the Americas is a more probable hypothesis and one accepted by most Americanists to account for all the Pacific-American sporadic similarities (Nordenskiold); there are no "Indian" cultures pin-pointed from non-seagoing Americans into Pacific islands. The exclusively proximate-to-Asia presence of body-armor, and perhaps the distinctive Northwest Coast art –Asiatic similarities visible as late as the first Chinese Bronze-Age Shang dynasty have been convincingly argued– are late exceptions, but by the same Silvero-American route. The generic American culture-horizon consequently remains incontestably the Upper Paleolithic-Mesolithic from Siberia.

Basic religion in both Americas was the visionary shamanism of hunters, with animal familiars and animal "owners" quite like and in fact culture-historically continuous with paleo-Siberian shamanism and the shamanism of Mesolithic Eurasiatic hunting peoples*. As ecstatic-shamanists they valued the psychedelic state; as simple hunters and gatherers they were under pressure continuously to explore their plant environment for food –and accidental new narcotics.

The ethos of the American Indians was and essentially remained that of hunters. For one basic example, economic organization and social status everywhere –even to the *potlach* give-away feasts of the wealthy Northwest Coast fishermen, even to the economic give-and-take focused on the "great house" chiefs of Amazonia, and even to the stored tax-hoards of the royal Inca communal state– all were ultimately based on the invidious ability of hunters to provide shared largesse for their dependents**.

In this male-oriented hunting society, curiously, *quite like food,* a boy's manhood and manly prowess in hunting and war and sexuality *all came as gifts from the outside,* from the stronger ones, that is as "medicine power" from the outer generalized supernatural (Siouan *wakan,* Algonkian *manitou,* Iroquoian *orenda,* etc.), and not from any endogenous endocrine entelechy within[19]. At adolescence this power was *acquired,* or struck in like lightning, or imbibed by the individual whether in the individual vision quest, the shamanic spirit-possessed ecstasy, or in the invariably, therefore, *sacred* eating, drinking, snuffing, or smoking of psychotropic plants.

This power-concept is pervasive. Even in the advanced hierarchic agricultural societies of the Aztec of Mexico and the Chibcha of Colombia, with the vague generalized supernatural now become personalized gods (e.g. the Aztec god of war whom, before sacrifice, the bravest war-captive impersonated for a year), these gods still needed to be fed spirit-power like food from the human-sacrificial victims; the Aztec captured these victims in war, the Chibcha bought them in a lively trade with neighbors. Quite as Andeans brought tribute to the Inca, and as young Amazonian hunters perforce brought their game to the greathouse chief to distribute, so also in religion hierarchic Aztec and Chibcha brought human-spirit food to their gods. Farther north scalping, and farther south head-hunting had the same motive, the acquisition of spirit-power from scalp or skull, whether for the individual or for the tribe. *Mos saecula, mos religiosa:* men need "power" for success in all male activities, gods need power to remain gods.

It strikes us as strange that the shamanic "doctor" himself takes the "medicine" in the whole area of the American narcotic complex, rather than the sick patient. But this is entirely logical in native terms, since it is the shaman who needs the supernatural "power" to effect a cure, i.e. to diagnose the human or physical cause (often a crystal, a feather, a claw, etc., to be sucked out), to contest a rival's malevolent magic causing the illness, to prognosticate, for clairvoyance, to control the weather, and the like. Moreover, even more widely than in the narcotic-complex area, the shaman-visionary has power over the illness, manifestly because with supernatural power he himself has recovered from it. Likewise, any patient whom he cures characteristically joins the "medicine society" of the shaman, cure being much like initiation into a ritual secret one witnesses and learns, so that all members of the Bear Society, for example, share the "bear power" of the shaman. It is a psychic sodality much like Alcoholics Anonymous.

For the American Indian, the presence of any psychotropic effect in a plant was plain evidence of its containment of supernatural "medicine" or spirit-shaking "power". One introjected the power exactly as he ate food.

The principle was true of even so mildly psychotropic a drug as tobacco. Aboriginally tobacco was *always* used in a sacred magico-religious context, and never for mere secular-indulgent enjoyment. Thus when the post-adolescent Amazonian boy licked from his dipped spatula the tobacco infusion from the men's palaver-pot, the act signified and sealed his yea-vote (by convention all Indian votes are "unnanimous"), which he must hereafter religiously honor under the potent supernatural sanc-

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* Even the famed prestige-warfare of the Plains (which was certainly no Marxian class warfare struggles over the means of production, etc.) may have derived ultimately from the hunting ethos. When strictly individious prestige could no longer be based on hunting of animals as fantastically plentiful and easily accessible as the Plains buffalo, then the more difficult hunting of men preserved the invidious prestige basis of aboriginal American society.

** From the *Philosophes,* encyclopedists and other Eighteenth-century utopians down to the early Nineteenth-century Romantic Movement, the image of the American Indian (with obvious tendentiousness in then-contemporary Europe) has been that of open-handed communalist generosity. But this ethnographic truth neglects the obverse of the coin, the inveterate and deep-seated psychological *dependency* of the rest of the band on the great hunter and band chief –not all James Fenimore Cooper's Indians were the deer-slayers!– a dependency early transferred to the trader as source of goods, then to the Indian agent, and now on reservations to the Indian Office bureaucracy. The proud hunters and warriors without weapons are now, sadly, a rural proletariat of the psychologically (and culturally) most dependent kind. It is no accident that peyotism, based on the psychotropic *Lophophora,* has since 1890 diffused almost universally among the Plains tribes. It might even be argued that the notorious Indian vulnerability to alcohol is consistent with their inveterate quest for "medicine power" *from outside* and their deep cultural dependence on the psychedelic experience. Any attempt to "better" the plight of the Indian must realistically take into account, beyond romanticizing, the culturally built-in psychological dependency of the American Indian.

tion of the manifest "power" in the tobacco liquor. And when in the Woodlands or Plains, Indian chiefs in a grave intertribal pow-wow smoked the sacred calumet or peace pipe, the rite meant the invoking of the power of tobacco upon their sacred oath. An Iroquois visionary made the appropriate gift to a tobacco-begging supernatural he was lucky enough to encounter in the woods, whereupon he carved the face of the supernatural on a living basswood tree and possessed the supernatural's power when he wore the cut-off mask in any subsequent dance of the False Face Society. A Plains Indian peyotist censes himself in the smoke of the shavings the Cedar Chief casts into the fire; he rubs the sweet smell of *Artemesia* on his joints to preserve his body from aches and pains; but he is "praying" when he smokes a blackjack oakleaf –or a cornhusk– wrapped cigarette in a peyote meeting. The abundant evidence would suggest, in fact, that tobacco was *the* supernatural plant *par excellence* of the American Indian, for tobacco was aboriginally used everywhere that it would grow in the New World, that is from middle Canada southward to Patagonia.

In similar fashion, no Andean communicant would think of approaching the supernatural without being intoxicated with the chewed *Erythroxylon coca* leaf; more exactly, the psychotropic effect *is* the supernatural. In Mexico, even into historic times, alcoholic intoxication occurred in a sacred religious context[20] and the same was true in tribal fiestas from the non-Pueblo Southwest to the Andean plateau and Amazonia[21]. The Virginian "huskinawing" with the *Ilex* "black drink" was a puberty ritual magically making boys into men. *Datura* intoxication was part of a puberty ordeal or of shamanistic possession in southern California, and in any other uŝe of daturas in South America a similar magico-religious context should be sought. The same should be done with respect to the *Virola* snuffs and *Anadenanthera peregrina.* Aboriginal Aztecan and modern Mazatecan use of the *teonanacatl* mushroom (literally, eating the "flesh of the god") has very ancient cognates in the paleo-Siberian use of *Amanita* fly-agaric in shamanled group-intoxications; the alleged "mushroom stones" of the Maya represent probably just that. The Red Bean *Sophora secundiflora* had supernatural power whether laced on a moccasin-fringe, hidden in a medicine bundle, or worn as a necklace, because it obviously had "medicine power" when eaten; it was also used in an aboriginal Red Bean cult spreading from prehistoric Texas (the evidence is archeological) to the southern Siouans[22]. And with all specific tribal cultures now largely gone, residual generic Plains culture still regards the hallucinations produced by eating peyote, *Lophophora williamsii,* as visionary proof of the presence of the supernatural[23]. Whether shaman alone, or shaman and communicants, or communicants alone imbibe or ingest the black drink, datura infusions, tobacco in whatever form, native beers and wines, peyote cactus, ololiuhqui seeds, mushrooms, narcotic mint leaves, or coca, ayahuasca *(Banisteriopsis caapi)* or "death vine" –or any of the vast array[24] of Amerindian psychotropics– the principle is the same. *These plants contain spirit power.*

Although the earlier Indian use of psychotropic drugs in shamanistic hunting societies is still thoroughly visible in the advanced Aztec use of many in their more codified rites to individuated gods, and to a degree also in the use of coca in similarly advanced agricultural-herding states of the Andes such as the Aymara[25] and the Inca, it has been repeatedly remarked by ethnologists that the intensively agricultural Pueblos, with their more tightly organized politico-religious theocracies, manifest almost a clear repugnance to alcohol and other psychotropic substances. Nearer geographically than Plains Indians to the natural area of *Lophophora williamsii,* Pueblos are yet not peyotists, even though they have been longer exposed to Mexican-Southwestern peyotism –save for Taos, most Plains-like of the Pueblos, with its centuries-long battle over peyotism. In the midst of Athapaskan and Yuman tribes with their typical ritual use of many native wines and beers, the Pueblos shun alcohol. They also lack *Sophora* cults and for the most part any use of datura; and though they border on Mexican tribes that use narcotic mushrooms, mints, ololiuhqui, etc., the Pueblos use none of these agents. Among Pueblo agriculturalists, erstwhile shamans have become primarily rain-priests, emphasizing almost exclusively the old ability of shamans to control the weather. Religions change ecologically too.

Is it possible that agriculturalists have different anxieties from those of hunters? Is a "technology" of rain-making more needed than animal helpers in hunting? Does religion itself become more bureaucratized with denser town-living? And do religions of town-living people become more routinized than those of individualistic hunters, naively content to rely on similarly-individualistic religion, i e. the direct mystical experience?

These are large questions. But some of these trends may be discerned in our own cultural tradition. Behind the Olympian king of the gods himself (an image significantly consistent with the *tyrannos* of the early Greek city-state) lurks the old Indo-European, indeed ancient Eurasiatic, shaman. Northern Zeus, who in Greece married local Hera of the "clear sky", still remained the weather-shaman and rain-king. The father of gods and men was still a fertility-figure, like the masked sorcerer of the Trois Freres cave and the central shaman in the Paleolithic wall-painting of the Cogul Dance. Zeus could still, like the shaman, metamorphose into many Ovidian animals. In fact, he and his brother Poseidon still held the sacred trident symbolic of the old Eurasian shaman. Many a Greek god retained as "attribute" his original shamanic animal-familiar (Apollo's wolf, Artemis' stag, Athena's owl and snake, Zeus' thunderbird and so on). Behind the ubiquitous rain-bull of Neolithic agriculturalists in Asia Minor and Egypt, too, was the mighty wild aurochs of late Paleolithic hunters. In this region also were many an ancient "Mistress of the Animals" as old in prototype perhaps as the Magdalenian mother-goddesses. And even the two gods most characteristically Greek of all still had their ecstatic shamanistic oracles, Zeus at Olympus and Apollo at Delphi, some say intoxicated with laurel leaves. Indeed, the Hellenistic Mysteries and even later cults drank immortality with the blood of the vine-god and ate it in the flesh of the divine animal or the seed-cake of Ceres (which Wasson has conjectured contained an LSD-like hallucinogen from grain smut)[26].

The possession of ritual psychotropics is surprisingly tenacious culturally. It has been plausibly argued that the Indo-European gods were "divine" in directly shamanistic terms: they drank alcoholic mead from fermented honey-water nectar (that may be as old as Mesolithic art showing honey-gatherers, though the pan-Indo-European term for *mead* is only as old as the Chalcolithic or Bronze Ages); and they ate odorous ambrosia (*Amanita muscaria,* the narcotic mushroom of paleo-Asiatic shamanism). The shamanism of ancient hunters seems never to have been lost, only transformed (into the wine-blood and Host-wafer flesh of the god). And perhaps the Greek nature-gods are so naively man-like simply because they were once merely the shamanic nature-mages and rain-kings.

What is the tenor of these speculations? Briefly: hunters have supernaturals appropriate to their needs and shaped projectively by their socio-economic ecology and secular anxieties about finding game. These figures are not lost with the "Neolithic Revolution" of agriculture and husbandry, but are only masked and changed into socio-politically more relevant gods. The personal magic of ecstatic shamans, borrowing supernatural forces directly from nature, evolves into religious worship and placation of cosmic gods in whom the power now permanently resides. (And when the anthropomorphic God dies, we are left the impersonal forces of science).

American Indians, in ethos essentially still hunters (with late local high cultures in Mexico, Chibchan Colombia, and Andes still preserving shamanistic traits) and still kept in religion also the fundamental shamanism of hunters. American Indians still actively sought the mystic visionary experience; their epistemological touchstone for reality was direct psychic experience of the forces in nature, not a sophisticated critique that seeks to rid experience of subjective elements; and they still sought, under this religio-cultural inspiration, the actively psychotropic drugs to attain this state. Their cognitive map was that of the mystic perhaps, but it as also pharmacodynamically pragmatic: *some plants house spirit-powers and psychedelic forces.*

American Indians of the ethnographic present still have the knowledge of psychotropic plant substances consistent with the characteristics shamanism of hunting societies. The Old World may once have known more such plants, but with socio-cultural changes these have now faded into desuetude and myth. (What did the Lotus - Eater ingest? and why was the lotus sacred both in Buddhist India and in Egypt? What was the Odyssean *moly?* What were Circe's drugs?) Meanwhile the Old World in objective botanical fact may contain as many psychotropic plants as by chance we would expect them to have from our knowledge of the vivid and still discernible "narcotic complex" of the New. The ethnobotanist and the paleo-ethnologist need only learn over again what earlier men once knew.

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NOTES ON THE TOXICITY OF *Sphenoclea zeylanica*

By *Robert F. Raffauf*[1] *and Akifumi Higurashi*[2]

The genus *Sphenoclea* was described by Gaertner in 1788 (15). Its affinities and family placement have continued ever since to be a source of taxonomic uncertainty, as a few randomly chosen botanical references –from monographic, floristic, general studies and dictionaries– would indicate.

In 1835, von Martius included *Sphenoclea* in the Sphenocleaceae (37), and a year later Lindley placed it in the Campanulaceae as a "Sub-order", Sphenocleaceae. He wrote that "this remarkable plant is very much like a campanulaceous genus in structure; but its exalbuminous seeds, the absence of collecting hairs from its styles, and the round sub-sessile anthers seem to indicate the type of a different order; and the peculiar habit of the only known species seems to confirm the propriety of the separation" (22). Bentham and Hooker assigned it in 1873 to the Campanulaceae (7), as did Engler and Diels in 1936 (13). In 1959 and 1973 Hutchinson maintained the genus in the Campanulaceae (19, 20) although the floristic works of Hutchinson and Dalziel in 1931 and 1963 retained it as a member of the Sphenocleaceae (21, 22). Cronquist in 1968 (10) and Takhtajan in 1969 (27) recognized the Sphenocleaceae, assigning the family to the Campanulales. Later, in 1981 Cronquist wrote: "*Sphenoclea* is embryologically and palynologically much like the Campanulaceae, and its relationship here seems reasonably certain" (11).

A number of floristic works have likewise differed as to the placement of *Sphenoclea*. Examples of this opinion over the past century are shown by several references: Blanco (8) in 1837, Danguey (12) in 1930 and Wright in 1850 (31) maintained the genus in the Sphenocleaceae. Wagenitz, however, as late as 1954, while assigning it to the Campanulaceae, expressed the opinion that its position in this family is uncertain and that apparently it may not even belong in the Campanulales (30).

In 1948, the late Airy-Shaw (3) placed the genus in the Sphenocleaceae stating that this family "ought to be positioned as a 'half-way house' between the Phytolaccaceae and the Primulaceae. Usually, however, it is treated as a genus of the Campanulaceae or as a closely related distinct family. The last possibility is maintained here". In 1960, he treated the genus as a tribe of the Campanulaceae (4); and in 1966, in his edition of Willis' *Dictionary of Flowering Plants and Ferns,* he qualified *Sphenoclea* as a "peripheral Centrosperm group with possible connections to Phytolaccaceae (*cf.* habit, anatomy) and even the Lythraceae (*cf.* Peplis, etc.)... the widely assumed connection with Campanulaceae is probably illusory".

Two years later (5), he characterized the Sphenocleaceae as "an isolated group, probably marginally related to the Centrospermae, e.g., Phytolacca (*cf.* habit, anatomy) and perhaps the Primulaceae (*cf.* capsule). Included by Bentham and Hooker and Engler and Prantl in the Campanulaceae probably due to convergence of superficial technical characters".

It was Agardh (2) who, as early as 1958, suggested that *Sphenoclea* might be related to the Lyth-

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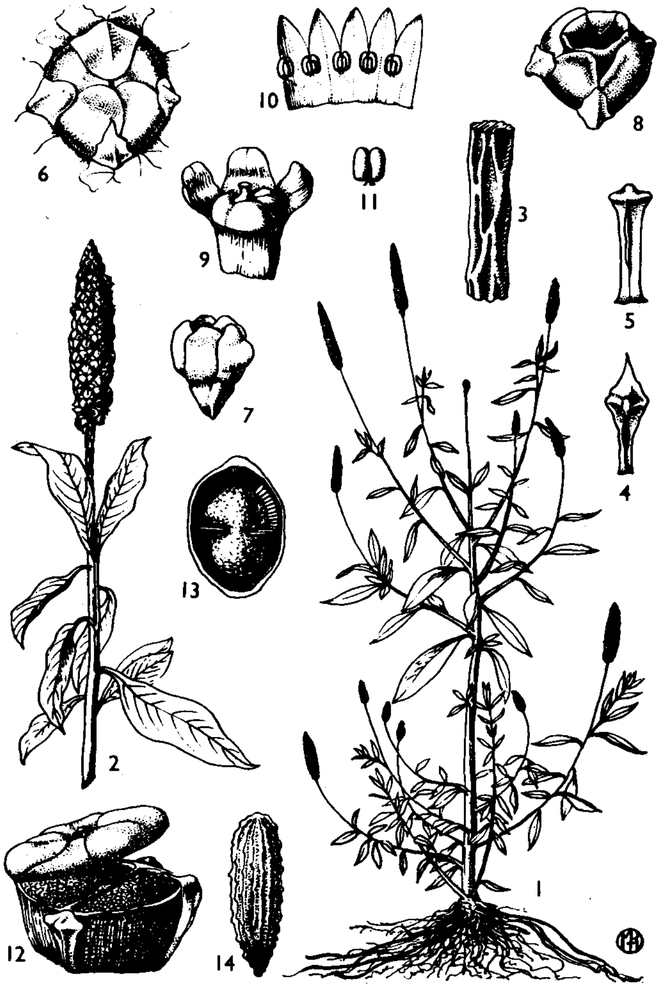

Sphenoclea zeylanica. 1) Habit; 2) part of flowering branch; 3) rhachis of inflorescence, showing scars left by fallen capsules; 4) bract; 5) bracteole; 6) flower bud, apical view; 7) bud beginning to open, side view; 8) flower, showing opening corolla, oblique view; 9) gynoecium and calyx, with two sepals removed, showing cuneate base; 10) corolla opened; 11) stamen; 12) fruit, partially dehisced; 13) transverse section of fruit; 14) seed. Courtesy Crown Agents for Oversea Governments and Administrations (Published in *Flora of Tropical East* Africa: Airy Shaw – *Sphenocleaceae,* 1968).

raceae, a concept that has subsequently been intimated. Heywood (18), for example, recently has felt that *Sphenoclea* is so aberrant that it should not be included in the Campanulaceae in the restricted sense and has assigned it to the Sphenocleaceae with the annotation that "certain characters suggest affinity with the Lythraceae".

On the basis of anatomical studies, Metcalf and Chalk (24) in 1950 allocated *Sphenoclea* to the Campanulaceae but indicated that "there are ample reasons for restoring the family Sphenocleaceae to include the genus".

Since almost nothing is known of the chemistry of *Sphenoclea,* chemotaxonomy cannot as yet be of help. In 1964, Hegnauer (17) placed the genus –probably on the basis of morphology– in the Campanulaceae, but he emphasized that its position in the family is doubtful and pointed out that the complete lack of chemical data made it impossible to assist in defining its affinities. Gibbs (16) in 1974 could add only that *Sphenoclea* "does not accumulate aluminum" and that it "probably lacks raphides".

We are accepting Sphenocleaceae as a distinct monotypic family related to the Campanulaceae.

Sphenoclea zeylanica Gaertn., Fruct. Sem. Pl. 1 (1788) 113, pl. 24, fig. 5.

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Only one other species of *Sphenoclea* has been recognized: *S. Dalzielli* N.E. Brown of West Africa from Senegal to the Central African Republic.

Sphenoclea zeylanica has spread throughout the humid tropics of both hemispheres. It is widely distributed in Colombia, as indicated by the following collections in the Economic Herbarium of Oakes Ames and the Gray Herbarium, both at Harvard University, and the Herbario Nacional de Colombia in Bogotá.

Sphenoclea zeylanica, a weedy annual, grows abundantly on the sandy banks of islands in the upper Amazon in the vicinity of sand bars or sandy edges of the low islands; this weed takes over in some areas to the exclusion of almost all other plants.

In 1946, in the Leticia area of Colombian Amazonia, cattle were being poisoned. At that time, Dr. Richard Evans Schultes was engaged in botanical research in the region, and the Ministerio de Economía Nacional in Bogotá requested that he look into the problem. The cattle lost the use of their legs; the head could not be held upright; there was excessive salivation and sometimes swelling of the tongue; the animals eventually died.

Because of poor pasturage on the higher land in the Leticia area, owners of cattle in the area usually drove their animals through the water, or carried them over on barges to the flat parts of the islands to fatten up on the lush grasses that normally cover the sandy banks. The cattle were returned to the poorer pastures when the rivers rose and flooded the low islands.

There are in the vicinity of Leticia two types of islands: 1) older islands, some parts of which are annually flooded along very narrow strands and 2) younger islands –some only several years old– which are low, fully flooded and with wide strands. *Sphenoclea zeylanica* does not grow on the narrow strands of the older islands; the younger islands usually have dense stands of grasses on the wide strands, but peripheral to the grasses and immediately adjacent to the water's edge, *Sphenoclea* takes over in dense stands. It was soon discovered that only the cattle driven to the younger islands that had this plant were affected.

When the report that the cattle not be put on the islands where *Sphenoclea zeylanica* grew was implemented, the deaths ceased.

In Leticia, the plant is known as *borrachero* ("intoxicant") or *borrachito* ("little intoxicant"), indicating that the local people realized that it had toxic properties, even though they did not associate the plant with the intoxication of the cattle.

In Indonesia, *Sphenoclea zeylanica,* known in Java by the native name *goonda,* or *goenda,* is valued as a pot herb (9). Ochse (25) is very explicit about its edibility: "In 'Tropische Groenten', I warned against eating *Sphenoclea* but wrongly so. Afterwards it appeared that it is frequently eaten as *lalab,* that it is very fit for this purpose and is sold as food in the native markets. At first I did not dare to share the opinion of Sphenoclea expressed by Heyne[3], ... but now I am better informed. The truth was here best served by the interchange of ideas". He reports that "young plants of *Sphenoclea* are eaten whole, whilst of old plants the young shoots are consumed, always, however, steamed or at least immersed for a moment in boiling water. They serve as *lalab* with the rice table. This *lalab* is slightly bitter but otherwise rather savoury and tender".

In distinguishing between the two plants known as *goonda* (*Sphenoclea zeylanica* and *Hydrolea zeylanica* (L.) Vahl.), he further states: "I warned against the use of *Sphenoclea zeylanica* Gaertn. This warning has appeared to be unfounded. Both kinds of *goonda* are harmless, at least when steamed or cooked". This statement would seem to leave some uncertainty that these plants were harmless in the fresh condition.

It is perhaps of interest, insofar as the toxic effects are concerned, that, for human consumption,

3 *Cf.* Heyne, K. *Nuttige Planten van Nederlandsch Indie.* Dept. van Landboruv, Nijverheid en Handel, Batavia. 2 (1927) 1428.

Sphenoclea zeylanica. Solid growth on bank of island at lowest water. Habitat from which *Schultes, Raffauf et Soejarto 24046* was collected: Island 8 miles above Leticia, Río Amazonas, Colombia. Photograph Richard Evans Schultes.

Inflorescence of *Sphenoclea zeylanica.* Leticia, Río Amazonas, Comisaría del Amazonas, Colombia. Photograph: R. F. Raffauf.

this plant is always steamed or subjected to boiling water, whereas its poisoning of animals seems to be associated with the ingestion of fresh, uncooked material. In this connection, however, it should be pointed out that an herbarium collection from Texas states that *Sphenoclea zeylanica* is eaten by cattle. If this observation be correct, might not the toxic properties of the plant in the Leticia area of the Amazon possibly be due to the selective concentration of a minor element present in the sands or waters and not found in many other localities? This one reference to the ingestion by cattle is found on an herbarium specimen in the Gray Herbarium of Harvard University: *V.L. Cory 50767,* Texas, Hardin County, 2 miles southeast of Saratoga, November 13, 1945 –"Leaf green plant, 3-4 dm. tall, growing in shallow water in roadside ditch, a favorite forage plant of cattle".

Airy-Shaw of the Royal Botanic Gardens, Kew, was kind enough to search through the specimens of that institution and, in a letter dated November 11, 1968, he wrote the following information concerning the toxicity of *Sphenoclea zeylanica.*

"I have now looked at every sheet of *Sphenoclea* present in our herbarium, and on only one is there a definitive statement on toxicity. This is an old collection of Mann from the River Cameroon, N. Nigeria, in January 1861 (*Mann 749),* where he has the note: 'Plant poisonous'. On a sheet from N. Rhodesia (*Vesey-Fitzgerald 4313*) there is a statement 'Not grazed', and one from Zambia (*B. L. Mitchell 2792*) bears the statement 'Not eaten'. My colleague Peter Taylor tells me that, when he was in East Africa with Edgar Milne-Redhead some years ago, he noticed that hippopotami would not eat *Sphenoclea.*

"Apart from these scanty indications we have been unable to trace any relevant information. These conflicting statements are very curious. As of course you will know, *Sphenoclea* is regularly eaten as a pot-herb, with rice, in Indonesia. Can it be that the plant is only toxic to cattle when eaten *with* some other plant? It would perhaps be interesting to discover what else is growing with it in those parts of the upper Amazon where trouble occurs. I may add that when looking through our material I found no statement of *Sphenoclea* being relished by cattle, such as the one you quote from Texas".

In view of this discrepancy –the use of the plant as food in Southeast Asia and its toxicity in the Amazon region– we undertook to determine wheter or not extracts of *Sphenoclea zeylanica*

Sphenoclea zeylanica, showing the complex root system of the plant. Isla de Ronda, Río Amazonas, Comisaría del Amazonas, Colombia. Photograph: R. E. Schultes.

Dense stands of *Sphenoclea zeylanica* line the strands of the younger "islands" in the upper Amazon region. Isla de Ronda, Río Amazonas, Comisaría del Amazonas, Colombia. Photograph: R. F. Raffauf.

Sphenoclea zeylanica in a deeply flooded area of Isla de Ronda, Río Amazonas, Comisaría del Amazonas, Colombia. Photograph: R. E. Schultes.

Sphenoclea zeylanica grows in the Amazon in areas subjected to three or four months of deep flooding. Isla de Ronda, Río Amazonas, Comisaría del Amazonas, Colombia. Photograph: R. E. Schultes.

produced any overt biological effects that could be construed as toxicity to animals.

Two different samples of plant material were available for chemical and pharmacological study. Colombian material was collected by R.E. Schultes in April 1969 from an island in the Amazon River about eight miles west of Leticia; a sample from Louisiana was made available through Prof. J.W. Thieret, then at the University of Southeastern Louisiana, Lafayette, Louisiana, whose assistance is gratefully acknowledged. Vocher specimens representative of both collections have been deposited in the herbarium of Economic Botany in the Botanical Museum of Harvard University.

Pharmacological evaluation. Lyophilized 50% aqueous alcoholic extracts of the ground, whole plants were suspended in gum acacia and administered to mice by both the intraperitoneal and oral routes. Observations were made on general behavior, appearance, response to pain stimulation (tail pinch), evidence of neurological deficit (roller bar) and, finally, death, using equivalent groups (n = 10) of normal animals as controls. No significant gross pharmacological effects were observed after oral administration of either the Colombian or the Louisiana plant extracts at dose levels of 1000 and 2000 mg/Kg respectively. On the other hand, intraperitoneal administration of these extracts at levels of 1000, 500 and 250 mg/Kg produced marked evidence, within 5-10 min., of irriation and toxicity which included writhing, hind leg paralysis, depression, analgesia, ptosis, piloerection, neurological deficit and abnormal defecation and urination. The severity of the symptoms decreased with time, persisting for as long as 24 hours at the highest dose; all (10/10) animals died within 48 hours at 1000 mg/Kg, 2/5 at 500 and none at 250 mg/Kg.

Preliminary Chemical Notes. Positive tests for alkaloids, albeit in small amounts, were obtained on both fresh material in the field and on dried plant in the laboratory by methods described earlier (26). Tests for free sterols and triterpenes were done according to Arthur (6); tests for tannins were based on the methods reviewed by Farnsworth (14); methods for the detection of saponins, cardenolides and bound sugars were based on those of Abisch and Reichstein (1). The results indicated the presence in *Sphenoclea* of small amounts of alkaloids, triterpene saponins, and minor amounts of free triterpenes. These results are not inconsistent with those previously published on the constituents of the few genera of Campanulaceae which have been examined (28). No major differences were obserbed in the responses to the chemical tests by the two samples of the plant.

The isolation and characterization of the major constituents of *Sphenoclea zeylanica* and a more definitive study of the pharmacological properties of these substances will be reported at a later date.

ACKNOWLEDGEMENT

We wish to express our gratitude to Professor Richard Evans Schultes, the Botanical Museum, Harvard University, for bringing this problem to our attention, for assistance in consulting some of the earlier botanical literature, and for permission to include three of his illustrations in this report.

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EDIBLE ARRACACHAS OF THE SIBUNDOY

By *Melvin Lee Bristol*

The arracacha, *Arracacia xanthorrhiza* Bancroft (Umbelliferae), is an important edible root crop in the northern Andes. It was brought to my attention by Richard E. Schultes in southern Colombia in mid-1962 while on a botanical collecting trip in the company of Alvaro Fernández Pérez and Leslie Garay. We encountered the plant in cultivated fields in the highlands around Pasto, Departamento de Nariño, and around El Encano and the Valley of Sibundoy in the mountainous part of the Comisaría del Putumayo. Sibundoy lies at an elevation of 2200 meters just north of the Equator in a region of extremely high rainfall, about 5 meters annually.

Richard Schultes had first learned of some of the unique plants of the Sibundoy people through the 1935 plant collections of Hernán García-Barriga. Schultes had visited the Sibundoy in 1942, in 1946 with Villarreal, and in 1953 with Angel Cabrera, and had found several of their endemic *Arracacia* and *Datura* (Brugmansia) cultivars. One of the latter had such an extraordinary floral morphology that in 1955 he proposed for it the endemic genus *Methysticodendron* (6). Schultes' notes on the Sibundoy arracacha cultivars were shared with Walter Hodge who published a series of cultivar names (cf. below) in 1949 (5).

In 1962-63 I returned to the Valley of Sibundoy for 13 months to investigate the ethnobotany of the Sibundoy people and to write a doctoral dissertation to complete my studies in the Department of Biology at Harvard University. The endemic cultivars of tree Datura were a focal point of my fieldwork and their morphology, cytology, taxonomy and ethnobotany were described in 1969 (4). The complex vegetation of the Sibundoy planting fields also occupied my attention, especially in terms of the process of plant domestication in a primitive agroforestry setting (3). Among the 240 plant species and cultivars integrated into the Sibundoy agroecosystem in 1963 there were at least 13 clones of *Arracacia xanthorrhiza*, most of them known only from this valley.

The genus *Arracacia* consists of 45 species of coarse herbs and subshrubs in the American tropics and subtropics, especially in mountainous regions. *Neonelsonia* is a closely allied genus of two species; and one, *N. acuminata* Coult. & Rose ex Drude is called 'wild Arracacha' by the Sibundoy (cf. below) (1).

The arracacha is an acaulescent herb with many long-petioled, ternately decompound leaves and several conical, edible roots 10 to 15 cms. long and 3 to 5 cms. in width at the upper end. The plants rarely flower. The species is cultivated in moderate climates from Venezuela to southern Peru and also somewhat in the Caribbean region. In Colombia, where its cultivation is most intensive, it ranges in elevation from 1500 to 2700 meters.

CULTIVARS

Hodge, in a noteworthy review on the arracacha, cites eleven cultivar names in Kamsá, the Sibundoy language, together with approximate Spanish equivalents, information furnished to him by Schultes (5). I was able to locate and cultivate five of the cultivars recorded by Schultes as well as six others. The following key distinguishes the eleven cultivars grown by the writer both at Sibundoy and at the Arnold Arboretum in Jamaica Plain, Massachusetts, USA.

VEGETATIVE KEY TO CULTIVARS OF *Arracacia xanthorrhiza* BANCR.

I. Leaves entirely green (some with slight purple striae), margins slightly purple . . . . . 'Mantequillishá.'

II. Leaves more or less purple.

A. Petioles deep red-purple, pigment reaching smallest veins of lamina.

1. Petiole bases red-purple, root vascular cylinder not colored.

a) Root cortex white . . . 'Uatub(f)tseng-uatshe-isha'

b) Root cortex light yellow . . . Collection no. 18.

2. Petiole bases white or pinkish, root cortex yellow.

a) Root vascular cylinder blue-purple . . 'Uatshe-ce-lesteshą.

b) Root vascular cylinder not colored. . . Collection no. 17.

B. Petioles more or less red-purple, lamina and veins (except leaflet midribs from above) green.

1. Petiole bases white.

a) Petioles deep red-purple, root cortex yellow. 'Uatsase-ishą.'

b) Petioles light or dull red-purple, root ortex white... 'Uabshajans-uabajateshą.'

2. Petiole bases colored.

a) Root cortex white; petiole slightly glaucous, root vascular cylinder blue. . . . 'Uatshe-uachoros-shą.'

b) Root cortex light yellow.

(1) Petiole base pink, petiole heavily glaucous (gray appearing); root vascular cylinder blue-purple 'Bolador-celesteshą.'

(2) Petiole base red-purple, petiole slightly glaucous (not gray appearing).

(a) Root vascular cylinder blue-purple. Collection no. 21.

(b) Root vascular cylinder not blue-purple. Collection No. 20.

Because the cultivation of a large number of arracacha cultivars had been declining for several decades, many of them were uncommon in 1963. Most Sibundoy knew the names of only two or three cultivars, and for some, no name was encountered. Preliminary botanical and linguistic investigations suggest the presence of eighteen distinct clones of which the Sibundoy recognize fourteen.

HISTORY

While the arracacha is cultivated in the West Indies, Central America and the Andean region south to southern Peru, its cultivation by both European and native peoples is most intensive in Colombia (5). Because the Sibundoy grow a much larger number of cultivars than is known elsewhere in the New World, it seems likely that the Valley of Sibundoy has been a geographical center in the selection, development and maintenance of cultivars of this species. Sufficient time for the process to have occurred within the valley is indicated by the presence of ancient agricultural terraces now in ruins. Indeed, the arracachas, more than any other starch sources now grown in the valley, give the greatest indication of cultivation in antiquity and perhaps were the basis of subsistence for that culture which was associated with the terraces. The cultivar 'uatsengelesteshą'is thought to be one of the oldest in the valley. Several of the cultivars, such as 'Uatsase-ishą' and 'Mantequillishą', are seldom cultivated today and an unusual one with round roots, 'Uashatsequeshą, is thought to be extinct. The loss of a cultivar in a particular garden occurs quickly —within one month after harvest— unless it is deliberately replanted. With so few natives growing the rarer cultivars, it is likely that these, too, will become extinct in the valley. In 1963, I attempted to preserve these remnants of ancient cultivation by sending eleven clones (those in the key above) to the Instituto Tecnológico Agrícola, Pasto, Nariño, Colombia, and to the University of Puerto Rico Agricultural Experiment Station, Rio Piedras, Puerto Rico, for further study. Unfortunately, not all the clones have survived outside the Valley of Sibundoy.

The reason for the decrease in cultivation of several clones during recent decades is their moderate yield and the limited possibilities of marketing them to the large European population arriving in this century. The immigrants prefer the white cultivars and especially one they brought with them, perhaps about 1950, 'Shcungvę' (Kamsa: 'foreign'), which probably has the highest yield of all. It is similar to 'Uabshajans-uabajateshą', but has larger foliage and larger roots. It was much cultivated by the Sibundoy soon after its introduction, both for their own consumption and to sell to the European population.

COMMON NAMES

1. General terms.

Kamsá: *Iengǫ, ingǫ, ingoshą.* (see below under descriptive terms for the distinction here.)

Spanish: *Arracacha,* from Quechua *racacha.*

2. Cultivar terms.

The following names of cultivars are those given by Schultes in Hodge (5) and confirmed by the writer's investigations as well as several additional ones encountered in use by the Sibundoy in 1962-63. Only an approximate idea of their meaning is given here.

boladorŭshą – very white

btsi-ishą – large

jojoashą – tender

mantequillishą – butter

shcungvę – foreign

tsŭshi-ingǫ – yellow

uabshająns-quetoquenseshą – cotton

uabshająns-uabajateshą – gray-petioled, white root

uabshajants-shą – white

uaselest-morądsha – purple-ringed

uashatsequeshą –

uashetsecacashą–

uatatųtubjans-shą –

uatsase-ishą – yellow

uatsengelesteshą – blue-ringed

uątshe-celesteshą – blue-ringed

uątshe-uabajateshą – gray-petioled

uątshe-uachǫros-shą – coarse

uatub (f) tsęng-uatshe-ishą – purple petiole, yellow root

The Sibundoy language, Kamsá, is written here according to the system of notation devised by the writer in 1962 (2). Efforts at pronunciation will be most successful within the framework of the Spanish language.

The number of these cultivar names does not indicate the number of cultivars known to the Sibundoy, since some cultivars have more than one name, while others may have none.

3. Descriptive terms.

These Kamsá words apply to parts of the plant and are applicable to all cultivars.

Iengǫ, ingǫ – 'the food of *A. xanthorrhiza,'* i.e. the several swollen roots (Spanish: *guaguas* 'babies') and the central, enlarged caudex (Spanish: *madre* 'mother').

Ingoshą – 'the plant', as a whole; also 'arracacha cutting' used in planting.

Jenashą, jenavią -- 'arracacha cutting' for planting the crop. (Spanish: *colino,* or *malqui* from Quechua).

Ingoshąche – 'arracacha leaf.' *–ąche* is the combining form of *tsubuanąche* 'leaf'.

The cutting, with its enlarged base and green petioles, not only has the potential to become a new plant *(ingoshą),* but is symbolic of it as seen in the extension to the cutting of the term *ingoshą*

CULTIVATION AND HARVEST

Planting procedures begin at harvest time. The plant is pulled up with both hands and all the leaves (about 80 per plant) are quickly removed with a machete leaving 10-15 cms. of the petioles. The 25 or so cuttings *(jenashą),* which are technically branches, are broken off and tossed into a pile. The three to five engorged roots are broken from the enlarged caudex and thrown into another pile. The caudex itself is scraped free of dirt with the machete and thrown with the roots. When several plants have been taken up in this fashion, attention is turned to the pile of *jenashą* The larger ones are removed and loose soil and any rotting leaf bases are carefully scraped off with the machete. These *jenashą* are left in a separate pile for later planting. During the drier months of December-February such a pile is covered with weeds to prevent drying. Thus, the preparation for planting is accomplished, and the harvest is completed by loading the edible roots and caudices into one of the open-weave baskets *(svarůco)* and carrying it to the house using a tumpline. If pigs are being fattened, as is usually the case, the smaller *jenashą,* those not selected for planting another crop, are also brought in from the garden in a basket.

The problem of storage is largely avoided by making small plantings throughout the year and harvesting a few plants at a time as desired. If necessary, the harvested roots may be buried for two to three weks but they cannot be stored in this way for much longer.

The time of planting is determined by the stage of the moon, the fifth day of the first quarter being the optimal date. It is thought that the roots will not enlarge if the *jenashą* are planted during the other quarters. Because of this restriction on the time of planting, harvest time must be one to three weeks earlier ("before the new moon") in order to privide the desired latent period for the *jenashą.* During this period the more vigorous cuttings send out a new leaf, and the few wihich do not are not planted.

The preferred planting site for arracachas is one with very sandy soil, and if possible one near where *Neonelsonia acuminata* C. & R. is growing. However, there are so few specimens of this species *(ingoshąjůsn)* growing in the Sibundoy agricultural area that this companionship seldom occurs. Usually the *jenashą* are planted in patches among maize and other plants or in rough rows alternating with rows of maize. They are spaced a meter or more apart.

The planting procedure is to loosen the soil either with a machete or with a pointed stick, in this case called *jenanų(p)fta.* Weeds are removed from an area about 40 cms. in diameter and this is done very carefully if the troublesome weed *kikuyu (Pennisetum clandestinum* Hochst.) is growing there. One *jenashą* is thrust diagonally into the loosened soil at each spot.

During the first two months one or two weedings may be required, but there is no further care of the plantings until the arracachas are ready to be harvested in five or six months. As harvest time approaches, the plantings are inspected to determine the degree of maturity, and if any plants have begun to flower — a rare occurrence — the young flower stalks are removed. (If photoperiodicity is involved in the failure of the species to flower in the Valley of Sibundoy, it should be noted that daylength here close to the equator is constant throughout the year.)

UTILIZATION

Most of the arracacha eaten by the Sibundoy is prepared simply by boiling both the roots and the caudices cut into chunks. Many say it is best when eaten with meat of the guinea pig, *tsǎjąna (Cavia porcellus* L.). Among the various edible tubers grown by the Sibundoy, arracachas are preferred for their excellent taste.

The cultivar 'Uatub(f)tsęng-uatshe-ishą', with a yellow root, was formerly much eaten during the old holidays, now abolished by the Christian authorities. It was also ground and fermented to make *chicha* on such occasions.

The cultivar 'Shcungvę' ('foreign'), recently introduced in the valley, is much cultivated by the natives for sale to the European population.

A single medicinal use was reported, the hollow leaf petioles being boiled to make an infusion for bathing feet afflicted with "savañones, a microbe between the toes".

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A CONTRIBUTION TO THE ETHNOPHARMACOLOGY OF THE LOWLAND QUICHUA PEOPLE OF AMAZONIAN ECUADOR

By *Robin J. Marles*[1], *David A. Neill*[2], *and Norman R. Farnsworth*[1]

"The Indian tribes [of the Amazon] possess an extensive pharmacopoeia of presumed medicinal plants. Most, if not all, of these species are biodynamic, but we know the active principles in only a few; in a few more we may guess from chemotaxonomic relationships what the active constituents might be. How great a challenge! There is no way of calculating how many new chemical structures - some of possibly great importance to human life and health - lurk yet undiscovered in the flora of the Amazon. It would seem that this potentiality alone might suffice to preserve from extinction the Amazon forests as well as the indigenous cultures privy to deep knowledge of the properties of their ambient vegetation (Schultes 1979)".

Dr. Schultes' challenge is one that must be accepted with urgency. The World Health Organization has estimated that approximately 80% of the population of developing countries still rely on traditional medicines for their primary health care (Farnsworth et al. 1985). Most of these traditional medicines have never been studied scientifically to establish their efficacy and safety, and undoubtedly most national medical associations would like to be able to provide their people with modern, clinically proven drugs within a proffessional health care system. Unfortunately, for many developing countries the cost would be prohibitive to import sufficient pure synthetic drugs or construct a home-based synthetic drug industry adequate to care for the entire population.

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One answer to this dilemma is to take advantage of the natural resources at hand: indigenous plants and the accumulated knowledge and experience of traditional healers. Some medical professionals are quick to discount the value of herbal remedies, yet in the United States, for example, 25% of all prescriptions dispensed from community pharmacies in 1980 contained plant extracts or active principles prepared from higher plants, such as digitoxin and vincristine. In 1980 plant-derived drugs represented an eight billion dollar industry (Farnsworth et al. 1985).

It is also true that some advocates of traditional medicines place too much faith in them. Some plants famous in Europe and North America, with centuries of traditional usage, such as pennyroyal (*Hedeoma pulegioides* (L.) Pers., Labiatae) and sassafras (*Sassafras albidum* (Nutt.) Nees, Lauraceae), are now known to contain toxic constituents which, when taken in excessive amounts, have caused serious injury. Other plants, such as comfrey (*Symphytum officinale* L., Boraginaceae), have chemical races, some of which are safe and some of which contain toxic amounts of certain constituents, in this case pyrrolizidine alkaloids (Tyler 1982). Thus a rational, scientific approach is necessary to provide reliable, standardized preparations of traditional medicines with proven efficacy and safety.

The ethnopharmacological approach to developing new medicines is not just a theory. There are currently at least 119 plant-derived drugs in professional use throughout the world. Of these, 88 (74%) were discovered as a result of chemical and pharmacological investigations to isolate the active principle(s) responsible for the reputed benefits of the plant's traditional use (Farnsworth et al. 1985).

OBJECTIVES

The first objective of this ethnopharmacological investigation was to inventory the plants used as traditional medicines by the Quijos Quichua, a group of Ecuadorean Lowland Quichua people whose ethnopharmacology is poorly known. The details of medicinal plant collection, preparation, and use had to be clearly documented with plant voucher specimens, in addition to notes and photographs, to ensure accuracy.

This work was needed urgently because, as in most developing countries, the primary rainforest of Ecuador is rapidly disappearing under the plow and bulldozer, as agriculture expands to feed a growing population, and as plantations, mines, and factories expand to feed the nation's exportation requirements.Simultaneously, as the people of the Amazonian lowlands of eastern Ecuador shift from a subsistence economy and traditional lifestyle to a cash economy and modern lifestyle, the human resource of traditional healers with an intimate knowledge of the local flora and fauna is diminishing. In fact, one of the traditional healers who contributed his time and knowledge to this study has since died, without passing on most of his traditional medical lore to his children, who are much more acculturated than he and consequently have more modern, materialistic interests.

Once a base of information on the indigenous medicinal plants of these Lowland Quichua people was established, the second objective was to conduct extensive library research to establish the current extent of knowledge about the chemistry and pharmacology of those plants collected in Ecuador. In this way time and effort could be saved in setting priorities for research on traditional medicines: some medicines' efficacy and safety may already have been established, certain others may show exceptional promise due to a correlation between preliminary chemical or pharmacological research and a long history of traditional use, and some may already have been found to be ineffective or toxic.

These first two objectives have been accomplished, and the results will be summarized below. A third objective, toward which work is in progress at this time, is to perform biological assays of selected Lowland Quichua medicinal plants. Bioassay-guided fractionation is being used to isolate the chemical principle(s) responsible for the observed activities, which can then be related back to the traditional use of the plant. Once the active principles have been isolated and identified, a solid basis will have been established for the decision to recommend plants for more extensive pharmacological and toxicological evaluation, and for the determination of appropriate formulations and dosage.

The final objective of this project will be to communicate specific recommendations to the providers of primary health care in Ecuador. Interviews with medical doctors practicing at government clinics in Ecuador's eastern lowlands revealed their frustration at not being able to do enough to help the people because of the lack of adequate drugs, equipment and facilities. The doctor at the clinic in Puerto Misahuallí stated that, if he knew that a local plant was both effective and safe, and if he knew the correct preparation and dosage, he would be happy to incorporate in into his practice (E. Reinoso, pers. comm.).

Some of the traditional healers also expressed great interest in learning what modern science could discover in their traditional medicines. They know that the value of a traditional medicine in its proper cultural context lies both in the intrinsic properties of the plant and in the psychological effects of their ministrations. However, they are also aware of the pressures to modernize, and know that to successfully adapt they must find a way to combine the old and the new. A traditional healer who contributed to this study is now collaborating in an educational and research program with Ecuadorean and American college students.

BACKGROUND

1. *Quijos Quichua Cultural Background*

Of Ecuador's indigenous population of three million people, about 60,000 live in the tropical lowlands on the eastern side of the Andes. Approximately 25,000 of these people speak Quichua. The Lowland Quichua-speaking people living along the upper Napo River and its tributaries, especially the Arajuno, Misahuallí, and Huambuno rivers, who were visited for this research project, speak a dialect known as Quijos Quichua or Tena Quichua (Orr and Wrisley 1965, Stark n.d., Whitten 1976). Within the study area they inhabit the villages of Puerto Misahuallí and Ahuano on the Napo River, settlements at Pusuno, Campana Cocha and Gusano Llacta, and farms lining the banks of the rivers.

The Quijos Quichua are descendents of intermarriage between Quichua of the Ecuadorian highlands who migrated to the lowlands, Quijos of the Andean foothills, and the Záparo, an original rainforest people (Steward and Métraux 1948, Stark n.d.). Quijos Quichua culture is thus a product of the melding of diverse highland and lowland cultures, and four and half centuries of contact with European culture. That contact, started in 1536 with the explorations of Gonzalo Días de Pineda and Francisco de Orellana (1538), became permanent with the establishment of the Dominican mission of Canelos in 1581 near Puyo (Steward and Métraux 1948). Acculturation has been accelerated by the construction of the town of Puerto Misahuallí in the 1960's at the end of a road built to bring modern economic development to the

Oriente. Today that road has passed Puerto Misahuallí and is penetrating ever further into the heart of the primary rain forest and its indigenous cultures.

The Quijos Quichua live by subsistence farming of sweet manioc, several varieties of plantain and bananas, and sweet potatoes. Various fruits, especially papayas, breadfruit, oranges, lemons, limes, peach-palm, and pineapple are also cultivated. Corn, cacao, bananas and coffee are grown as cash crops. Farms operated by extended families line both sides of the rivers, but generally extend back only 500 m to 1 km, then giving way to primary rain forest disturbed only by foot-paths. Protein in the diet comes from small mammals and birds snared or shot with muzzle-loading shotguns, and very small fish obtained by throw-nets and dynamiting. People still possess blowguns and fish poisons, but they are rarely if ever used.

2. *Napo Valley Ecological Background*

The Quijos Quichua live in the western-most reaches of the tropical Amazonian rain forest, within sight of the Andes. The life zone is "Very Humid Tropical Forest", with an annual rainfall of approximately 6,000 mm making it the wettest zone of the entire Amazon region (Neill and Baker 1985).

The terrain consists of east-west oriented ridges bearing highly leached red latosol soils, which rise up to 50 m above the rich alluvial soil of the Napo River flood plain. During the wet season, the banks of the river are flooded almost on a weekly basis, due to runoff from the nearby Andean foothills. The river level often will rise two to three meters overnight, depositing some of its load of alluvium and thus enriching the soil. There is no dry season, only a "less-wet" season.

The floristic diversity of the region is very high, there being an estimated 40,000 species. Composition of the flora is significantly different from zones of less rainfall within the Amazon Basin (Neill and Baker 1985). Recent botanical investigations in the Misahuallí area have discovered that 70% of the tree species collected had not been previously recorded from Amazonian Ecuador, and 10% were species new to science, indicating the prior lack of information and botanical richness of the region (Baker et al. 1987).

3. *Ethnobotanical Literature Background*

Ethnobotanical studies on the Napo Quichua, who live to the east of the Quijos Quichua on the Napo river from Coca to Iquitos, have been conducted by Orr and Wrisley (1965), Alarcon Galegas (1984) and Iglesias (1985), but the first reference provides no scientific names, the second has not been published, and the third provides often misspelled scientific names for only about 50% of the medicinal plants discussed. Kvist and Holm-Nielsen (1987) have done extensive ethnobotanical research in all the lowland regions of Ecuador, but to date have only published a limited amount of their information, which includes the Napo Quichua. Irvine (pers. comm.) has been studying Napo Quichua ethnoecology in the Payamino river area, but is just now writing her dissertation. Karsten (1935) describes some medicinal plants of the Canelos Quichua, who live to the southwest of the Quijos Quichua near Puyo and Canelos, but he provides only a few scientific names. Krukoff and Smith (1939) wrote about the arrow poisons of the Canelos Quichua. There is a small amount of ethnobotanical information on the Canelos Quichua in Whitten (1976, 1985). Shemluck (pers. comm.) made a brief study of Canelos Quichua ethnobotany, but has not published it.

For neighbouring cultures the literature is quite comprehensive. Pinkley (1973) wrote his Ph.D. dissertation on the ethnoecology of the Cofán. Vickers and Plowman (1984) published the ethnobotany of the Siona Secoya. Davis and Yost (1983a, 1983b) studied the ethnobotany of the Waorani. Karsten (1935) provides a limited amount of ethnobotanical information on the Shuar, and Kvist and Holm-Nielsen (1987) provide some information on all the neighboring groups. Lowell (pers. comm.) is studying the ethnopharmacology of the Shuar and Ashuar of Ecuador as part of the same project as the study reported here. There is also literature available on the Shuar of nearby Peru (Ayala Flores 1984, Lewis and Elvin-Lewis 1984), and Amazonian natives of Colombia (e g. Schultes 1985a and 1985b).

METHODS

This research is part of a collaborative project between the Program for Collaborative Research in the Pharmaceutical Sciences (PCRPS) at the University of Illinois at Chicago College of Pharmacy, the Missouri Botanical Garden in St. Louis, the New York Botanical Garden, the United States Agency for International Development, and Ecuador's Dirección Nacional Forestal, Ministerio de Agricultura y Ganadería (National Forest Service, Ministry of Agriculture and Animal Husbandry), Quito.

1. *Study Site Selection*

Ethnopharmacological field work was conducted in the Napo province of eastern Ecuador from September 15, 1985 to November 30, 1985. Preliminary trips were made to two areas to evaluate their potential for obtaining information about medicinal plants from Lowland Quichua-speaking people living in the most traditional setting of the primary rain forest.

The region of La Joya de los Sachas ("The Jewel of the Jungles"), 0° 10'S, 76° 50'W, 350 m alt., near the Coca river, while inhabited by some Quichua people, proved to be an area undergoing rapid development. Both petroleum oil exploration and African oil palm plantations have destroyed much of the primary rain forest, and there is extensive cultivation of the land by a recent influx of government-sponsored colonists from the coast and sierra of Ecuador. Knowledge of medicinal plants appeared in most people interviewed to be limited to common weedy species with a wide distribution in Ecuador, thus not reflecting the traditional Quichua pharmacopoeia.

The region of Misahuallí on the Napo river, 1°S, 77°30'W, 450 m alt., also shows the impact of the modern world: western clothing, portable radios, and Yamaha outboard motors for the dugout canoes, but most of the Quijos Quichua people are still living in a fairly traditional setting of subsistance farms on the floodplains, with access to primary rainforest on ridges above the floodplains for hunting and gathering of wild foods and medicines. Two study sites were therefore established in the Misahuallí area. One study site was a farm on the Arajuno River, two and a half hours by motor-canoe or four hours by canoe and foot, from the town of Misahuallí. The second major study site was a farm at the junction of the Napo and Huambuno Rivers, two hours downstream from Misahuallí.

2. *Collection of Information and Samples*

Introduction to the medicine men was accomplished through the location of relatives of the medicine men, who would guide us to their farms. An initial short visit was made to establish whether or not the medicine man would be willing to share his knowledge with us. Once our welcome was established, several visits of three to four days were made, staying with the family of the medicine man.

Daily trips into the rainforest with the medicine man and sometimes other family members were made to collect medicinal plants. Their preparation and use was recorded in writing, on audio tape, and on slide film, and administration of traditional medicines was observed as opportunity presented itself.

Voucher specimens of every medicinal plant were collected at least in triplicate, pressed in the evenings, and fully dried at the base camp over a kerosene heater. Bulk samples (with separate voucher specimens) for pharmacognostic analysis were collected in volumes sufficient to give a dry weight of 5 - 10 kg, and were dried on tarpaulins, in partial shade, with frequent turning to prevent spoilage. Samples that molded were discarded. The dried samples were packed in woven corn sacks that would allow air circulation and thus lessen the chance of spoilage, until ready for final shipment to our laboratory in the United States.

Voucher specimens of each medicinal plant have been labelled with the collection data and a summary of their ethnopharmacological uses, and deposited with the John G. Searle Herbarium of the Field Museum of Natural History in Chicago. Duplicate sets are at the National Herbarium of Ecuador, Quito, and at the Missouri Botanical Garden, St. Louis. Botanical determination of the vouchers was done by the staff of the Field Museum herbarium, the Missouri Botanical Garden, and specialists elsewhere.

Literature information on the plants collected in Ecuador was obtained mainly from NAPRALERT, the Natural Products ALERT computer database at PCRPS, University of Illinois at Chicago. An extensive review of the literature was made to obtain information on the ethnomedical uses, biological activities, chemical constituents, and toxicity of the Quichua traditional medicines. Since particular species of plants often have a limited distribution range and in many cases other members of the same genus have similar chemical constituents, any literature information obtained for a genus has here been extrapolated to the species. This will undoubtedly be inaccurate in some cases, but in general should provide more useful information than a strict species level literature search.

RESULTS AND DISCUSSION

During ten weeks of field work in Ecuador 140 voucher specimens of traditional Quichua medicines were collected. These represent about 120 species (105 genera in 63 families). To date 138 (99%) of the voucher specimens have been identified to the family level, 132 (95%) to genus and 115 (82%) to the species, which is encouraging when it is known that most of the voucher specimens are sterile. The short time in the field made it impossible to find fertile material in most cases. Unlike professional botanists, the medicine men seldom need flowers and fruit to identify the plant. The results of the field work are summarized in Table 1.

At least 80 different therapeutic uses are distinguished by the Quijos Quichua, but by far the most common uses are for treating symptoms suggestive of parasitic infections, e.g. anthelmintic, antimyiasis, antifungal, antiinflammatory, antidiarrheal, and febrifuge remedies: 64 spp. (53%). Other common uses are for pain management: 32 spp. (27%), female fertility and its regulation: 30 spp. (25%), and as antivenoms (snake, spider, conga-ant, stingray): 12 spp. (10%).

From extensive literature research it was learned that, of the 120 species collected for this study, corroborating ethnobotanical information was obtained for at least 71 genera/species (59%): of these the information came from other South American cultures for 66 (55%), and from other regions of the world for 19 (16%). Corroboration of traditional uses by published pharmacological studies were found for 42 genera/species (35%). Information on chemical constituents that appeared to be relevant to the traditional use was found for 36 genera/species (30%). Combined pharmacological and chemical information supporting tradi-

TABLE 1

Preliminary Results of Lowland Quichua Ethnopharmacological Field Research and Corroborating Information from the Literature

FAMILY	SCIENTIFIC NAME[a]	TRADITIONAL USE	ETHNO[b]	PHARM[c]	CHEM[d]	TOXIC[e]
Acanthaceae	not identified yet (#25)	sprains				
Actinidiaceae	Saurauia prainiana	myiasis	F	Y	Y	N
Amaranthaceae	Alternanthera of. brasiliana	stomach "fever"	L, F	Y		Y/N
Amaranthaceae	Alternathera lanceolata	liver pain	L			Y/N
Anonaceae	Xylopia sp.	diarrhea	L, F	Y	Y	N
Anonaceae	Xylopia sp.	postpartum hemorrhage	L, F			N
Anonaceae	Xylopia sp.	tonic for strength				N
Apocynaceae	Aspidosperma sp.	menorrhagia	L	N	N	Y/N
Apocynaceae	Himatanthus cf. sucuuba	hernia				Y
Apocynaceae	Himatanthus cf. sucuuba	malaria				Y
Apocynaceae	Tabernaemontana cf. sananho	contraceptive	F	Y	Y	Y
Apocynaceae	Tabernaemontana cf. sananho	sterilant	F	Y	Y	Y
Aquifoliaceae	Ilex guayusa	mouthwash	L			N
Aquifoliaceae	Ilex guayusa	polio myelitis		N		N
Aquifoliaceae	Ilex guayusa	tonic	L	Y?	Y?	N
Araceae	Anthurium loretense	body tremors				N
Araceae	Anthurium loretense	foot cramps				N
Araceae	Dracontium loretense	snakebite	L			Y
Araceae	Monstera spruceana	skin sores	L	Y	Y	Y
Araceae	Philodendron sp.	hepatitis				Y
Araceae	Philodendron sp.	yellow fever				Y
Aristolochiaceae	Aristolochia cf. cornuta	"erysipelas"	L, F	Y	Y	Y
Aristolochiaceae?	not identified yet (#89)	cough				
Aristolochiaceae?	not identified yet (#89)	tuberculosis				
Bignoniaceae	Crescentia cujete	abortifacient	L			
Bignoniaceae	Crescentia cujete	sedative				
Bignoniaceae	Jacaranda glabra	pimples	L	N	Y	Y
Bignoniaceae	Mansoa alliacea	colds	L	Y	Y	
Bignoniaceae	Mansoa alliacea	pain	L			
Bignoniaceae	Mansoa alliacea	stomachache	L			
Bignoniaceae	Tynnanthus cf. panurensis	hair growth promoter				
Boraginaceae	Cordia nodosa	snakebite	L, F			Y/N
Boraginaceae	Cordia nodosa	spiderbite	L			Y/N
Boraginaceae	Cordia nodosa	sting of conga ant				Y/N
Boraginaceae	Cordia nodosa	sting of stingray				Y/N
Burseraceae	not identified yet (#144)	menorrhagia				
Cactaceae	Epiphyllum phyllanthus	cuts			Y	
Capparaceae	Capparis sola	abortifacient	L, F			N
Capparaceae	Capparis sola	colds	F	Y	Y	N
Capparaceae	Capparis sola	contraceptive	L, F			N
Capparaceae	Capparis sola	pain	F			N
Capparaceae	Capparis sola	sore throat	F	Y	Y	N
Capparaceae	Capparis sola	tonic for strength				N
Celastraceae	Maytenus krukovii	abortifacient	L			Y/N
Celastraceae	Maytenus krukovii	anemia				Y/N
Celastraceae	Maytenus krukovii	cancer	L, F	Y	Y	Y/N
Celastraceae	Maytenus krukovii	contraceptive	L	N		Y/N
Celastraceae	Maytenus krukovii	pain	L	Y	Y	Y/N
Celastraceae	Maytenus krukovii	rheumatism	L	Y	Y	Y/N
Celastraceae	Maytenus krukovii	stomachache	L			Y/N
Compositae	Clibadium asperum	fish poison	L	Y	Y	Y
Convolvulaceae	Ipomoea batatas	viral conjunctivitis	F	Y	Y	Y/N
Cucurbitaceae	Gurania spinulosa	itching pimples		Y		
Dichapetalaceae	Tapura peruviana	stomachache (severe)				
Dioscoreaceae	Dioscorea cf. polygonoides	fungus on foot		Y	Y	Y/N
Dioscoreaceae	Dioscorea samydea	boils		N		Y/N
Dioscoreaceae	Dioscorea samydea	pimples		N		Y/N
Elaeocarpaceae	Sloanea fragrans	diarrhea				Y?
Elaeocarpaceae	Sloanea cf. robusta	bloody feces, vomiting				Y?
Erythroxylaceae	Erythroxylum gracilipes	jaundice				N?
Euphorbiaceae	Caryodendron orinocense	cauterize navel				

TABLE 1

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FAMILY	SCIENTIFIC NAME[a]	TRADITIONAL USE	ETHNO[b]	PHARM[c]	CHEM[d]	TOXIC[e]
Euphorbiaceae	Croton cf. lechleri	cuts	L, F	Y	Y	Y/N
Euphorbiaceae	Croton cf. lechleri	toothache; gingivitis	L	Y	Y	Y/N
Euphorbiaceae?	Croton? (#141)	cuts	L, F	Y	Y	Y/N
Euphorbiaceae?	Croton? (#141)	diarrhea	L, F	Y	Y	Y/N
Euphorbiaceae	Manihot brachyloba	rheumatism				N?
Euphorbiaceae	Phyllanthus anisolobus	fish poison	L	Y	Y	Y/N
Euphorbiaceae?	not identified yet (#72)	epilepsy				
Euphorbiaceae?	not identified yet (#72)	heart attack				
Euphorbiaceae?	not identified yet (#72)	seizures				
Flacourtiaceae	Mayna odorata	cold sores				
Flacourtiaceae	Mayna odorata	tonic for dogs				
Gesneriaceae	Besleria barbata	stabbing muscle pain				
Gesneriaceae	Columnea ciliata	oral candidiasis				
Gesneriaceae	Columnea ericae	menorrhagia	L			
Gesneriaceae	Columnea ericae	postpartum hemorrhage	L			
Gleicheniaceae	Dicranopteris cf. pectinata	"mal aire"	L			
Gleicheniaceae	Dicranopteris cf. pectinata	neuromuscular disorder?				
Gramineae	Pariana sp.	curing ceremony fan	L			
Graminae	Zea mays	curing ceremony fan				
Guttiferae	Vismia cf. tomentosa	stop fear of water				
Hernandiaceae	Sparattanthelium glabrum	fever	L	Y?	Y?	
Hernandiaceae	Sparattanthelium glabrum	pain		Y?	Y?	
Hernandiaceae	Sparattanthelium glabrum	stomachache	L	Y?	Y?	
Icacinaceae	Calatola venezuelana	anticarie	L			
Labiatae	Hyptis pectinata	menorrhagia	L, F	Y	Y	Y/N
Labiatae	Hyptis pectinata	postpartum hemorrhage	L, F	Y	Y	Y/N
Lauraceae	Cinnamomum? (#77)	painful urination		Y	Y	N
Lecythidaceae	Couroupita guianensis	infected wounds	L		Y	
Lecythidaceae	Grias neuberthii	emetic	L			
Lecythidaceae	Grias neuberthii	swellings				
Lecythidaceae	Gustavia macarenensis	fungus of crotch itch				
Leguminosae	Brownea ariza	cold sores				
Leguminosae	Brownea ariza	cuts	L		Y	
Leguminosae	Brownea ariza	oral candidiasis				
Leguminosae	Lonchocarpus cf. nicou	fish poison	L	Y	Y	Y
Leguminosae	Macrolobium cf. stenocladum	tonic for lung strength				
Leguminosae	Macrolobium cf. stenocladum	pain				
Leguminosae	Macrolobium cf. stenocladum	stomachache				
Leguminosae	Macrolobium cf. stenocladum	tonic to strengthen baby				
Leguminosae	Myroxylon sp.	fever	L, F	Y	Y	N
Leguminosae	Parkia nitida	myiasis	L			
Leguminosae	Piptadenia cf. flava	vomiting			Y	N
Leguminosae	Pithecellobium macrophyllum	boils				
Leguminosae	Pithecellobium macrophyllum	myiasis	F	Y	Y	Y
Leguminosae	Swartzia simplex	abortifacient	L			Y
Leguminosae	Swartzia simplex	colds				Y
Leguminosae	Swartzia simplex	contraceptive	L			Y
Leguminosae	Swartzia simplex	pain				Y
Leguminosae	Swartzia simplex	sore throat				Y
Leguminosae	Swartzia simplex	stomachache	L, F			Y
Leguminosae	Swartzia simplex	tonic for strength				Y
Leguminosae	Vigna caracalla	skin blemishes	F	Y		
Loganiaceae	Potalia amara	snakebite	L			
Loganiaceae	Sanango racemosum	bath before hunting				
Loganiaceae	Strychnos cf. peckii	"erysipelas"	F	Y	Y	Y
Malpighiaceae	Banisteriopsis caapi	hallucinogen	L	Y	Y	
Malpighiaceae	Diplopterys cabrerana	hallucinogen	L	Y	Y	
Malvaceae	Hibiscus abelmoschus	anuria	L, F	Y		N
Malvaceae	Hibiscus abelmoschus	sting of conga ant	L			N
Malvaceae	Pavonia fruticosa	magically cause malaria				
Melastomataceae	Clidemia heterophylla	cough	L			

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FAMILY	SCIENTIFIC NAME[a]	TRADITIONAL USE	ETHNO[b]	PHARM[c]	CHEM[d]	TOXIC[e]
Meliaceae	Cedrela odorata	diarrhea	L		Y	N
Meliaceae	Cedrela odorata	intestinal parasites	L	Y	Y	N
Menispermaceae	Abuta grandifolia	diarrhea	L			Y
Menispermaceae	Abuta grandifolia	fever	L	Y	Y	Y
Menispermaceae	Abuta grandifolia	pain	L	Y	Y	Y
Menispermaceae	Abuta grandifolia	stomachache	L			Y
Menispermaceae	Abuta grandifolia	tonic for strength	L			Y
Menispermaceae	Abuta rufescens	fever	L	Y	Y	Y
Monimiaceae	Siparuna eriocalyx	"mal aire"	L		Y?	N
Monimiaceae	Siparuna sp. (#128)	"mal aire"	L		Y?	N
Monimiaceae	Siparuna sp. (#15)	colds	L		Y?	N
Monimiaceae	Siparuna sp. (#15)	fever	L		Y?	N
Monimiaceae	Siparuna sp. (#15)	pain	L		Y?	N
Moraceae	Artocarpus altilis	abscesses		Y		Y/N
Moraceae	Artocarpus altilis	boils	L	Y		Y/N
Moraceae	Artocarpus altilis	cuts		Y		Y/N
Moraceae	Artocarpus altilis	diabetes	L			Y/N
Moraceae	Brosimum sp.	cuts				N
Moraceae	Brosimum sp.	tonic	L			N
Moraceae	Brosimum utile	diarrhea	L			N
Moraceae	Brosimum utile	tonic for strength				N
Moraceae	Ficus cf. insipida	intestinal parasites	L	Y	Y	N
Myristicaceae	Otoba parvifolia	cuts	L			
Myristicaceae	Otoba parvifolia	diarrhea				
Myristicaceae	Otoba parvifolia	intestinal parasites				
Myrtaceae	Psidium guajava	diarrhea	L, F		Y	Y
Myrtaceae	Psidium guajava	fever	L, F	N		Y
Myrtaceae	Psidium guajava	stomachache	L, F			Y
Ochnaceae	Cespedesia spathulata	abortifacient				
Ochnaceae	Cespedesia spathulata	contraceptive				
Ochnaceae	Cespedesia spathulata	diarrhea				
Ochnaceae	Cespedesia spathulata	stomachache				
Ochnaceae	Cespedesia spathulata	tonic to strengthen baby				
Ochnaceae	Ouratea cf. williamsii	fever				
Ochnaceae	Ouratea cf. williamsii	stomachache	L, F			
Ochnaceae	Ouratea cf. williamsii	tonic for strength	L, F			
Olacaceae	Heisteria acuminata	contraceptive				
Olacaceae	Heisteria acuminata	sterilant				
Olacaceae	Minquartia guianensis	intestinal parasites	L			
Olacaceae	Minquartia guianensis	pain in kidneys	L			
Olacaceae	Minquartia guianensis	pain in muscles				
Olacaceae	Minquartia guianensis	skin irritations	L			
Onagraceae	Ludwigia hyssopifolia	toothache, abscess		Y		N
Orchidaceae	Maxillaria rufescens	hernia				
Orchidaceae	Schomburgkia crispa	hernia				
Palmae	Bactris gasipaes	diarrhea	L			
Palmae	Desmoncus cf. vacivus	boils				
Palmae	Desmoncus cf. vacivus	hernia				
Phytolaccaceae	Petiveria alliacea	colds	L	Y	Y	
Piperaceae	Peperomia sp. (#84)	"purple spot sickness"				
Piperaceae	Peperomia sp. (#91)	snakebite	L			Y
Piperaceae	Pothomorphe peltata	bite of insects				
Piperaceae	Pothomorphe peltata	cuts	L			
Piperaceae	Pothomorphe peltata	swellings	L			
Polypodiaceae	Lomariopsis japurensis	menorrhagia				
Polypodiaceae	Lomariopsis japurensis	postpartum hemorrhage				
Polyporaceae	Ganoderma sp.	fungus on skin		Y?	Y?	N
Ranidae	small frog - not identified	stuttering				
Rubiaceae	Duroia hirsuta	diarrhea				
Rubiaceae	Duroia hirsuta	fever				
Rubiaceae	Duroia hirsuta	snakebite				
Rubiaceae	Duroia hirsuta	tonic for strength	L			

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FAMILY	SCIENTIFIC NAME[a]	TRADITIONAL USE	ETHNO[b]	PHARM[c]	CHEM[d]	TOXIC[e]
Rubiaceae	Psychotria sp.	anticarie				
Rubiaceae	Psychotria viridis	hallucinogen	L	Y	Y	N
Rubiaceae	Sickingia sp.	emetic	L		Y	
Rubiaceae	Sickingia sp.	headache	L			
Rubiaceae	Sickingia sp.	hepatitis				
Rubiaceae	Sickingia sp.	stomachache	L			
Rubiaceae	Simira sp.? (#23)	abortifacient				
Rubiaceae	Simira sp.? (#23)	contraceptive				
Rubiaceae	Simira sp.? (#23)	fever				
Rubiaceae	Simira sp.? (#23)	pain				
Rubiaceae	Simira sp.? (#23)	stomachache				
Rubiaceae?	not identified yet (#111)	arrow poison				
Rubiaceae?	not identified yet (#111)	infected wounds				
Sapindaceae	Serjania inflata	intestinal parasites	L	Y	Y	Y/N
Selaginelaceae	Selaginella sp.	mosquito repellant				
Solanaceae	Brugmansia sp.	hallucinogen	L	Y	Y	Y
Solanaceae	Brunfelsis grandiflora	cough				
Solanaceae	Brunfelsia grandiflora	fever	L	Y	Y	
Solanaceae	Brunfelsia grandiflora	pain	L	Y	Y	
Solanaceae	Brunfelsia cf. grandiflora	severe fatigue	L			
Solanaceae	Lycianthes cf. amatitlanensis	rheumatism				
Solanaceae	Solanum tuberosum	accelerate parturition	L			Y
Solanaceae	Witheringia solanacea	cancer of the lungs		Y	Y	
Solanaceae	Witheringia solanacea	cough				
Solanaceae	Witheringia solanacea	fever				
Solanaceae	Witheringia solanacea	sore throat				
Sterculiaceae	Theobroma cacao	cuts			Y	N
Sterculiaceae	Theobroma cacao	fever				N
Sterculiaceae	Theobroma cacao	malaria				N
Sterculiaceae	Theobroma subincana	breast eruption				N
Sterculiaceae	Theobroma subincana	fungus on skin				N
Steculiaceae	Theobroma subincana	malaria				N
Sterculiaceae	Theobroma subincana	yellow fever				N
Urticaceae	Urera caracasana	diarrhea	L			
Urticaceae	Urea laciniata	pain in back	L	Y	Y	
Urticaceae	Urera laciniata	pain in kidneys	L	Y	Y	
Urticaceae	Urera laciniata	pain in muscles	L	Y	Y	
Usneaceae	Usnea sp.	contraceptive	L			
Usneaceae	Usnea sp.	sterilant				
Verbenaceae	Petrea maynensis	contraceptive	L			
Verbenaceae	Petrea maynensis	sterilant				
Verbenaceae	Verbena litoralis	tuberculosis	L, F	Y	Y?	N
Vitaceae	Cissus erosa	"erysipelas"	L, F	Y		N
Zingiberaceae	Renealmia thyrsoidea	snakebite	L		Y	
not identified yet	not identified yet (#74)	boils				
not identified yet	not identified yet (#74)	cancer				
not identified yet	not identified yet (#74)	tuberculosis				
not identified yet	not identified yet (#75)	snakebite				
not identified yet	not identified yet (#132)	tonic for lung strength				
---------------	grey pot-clay	stop spontaneous abortion				
---------------	soil from cicada nest	mineral deficiency				

a) Numbers in parentheses are voucher specimen numbers, included to avoid confusion where specimen identification has not been completed.

b) ETHNO = Ethnopharmacological reports in the literature on the genus, where "L" indicates "Local" corroboration, i.e. from other South and Central American cultures, "F" indicates "Foreign" corroboration, i.e. from cultures on other continentes.

c) PHARM = Pharmacological information in the literature on the genus, where "Y" indicates "Yes", the studies reported do seem to support the traditional Lowland Quichua use, "Y?" indicates possible corroboration, "N" indicates "No", the studies reported seem to conflict with the traditional use.

tional uses was found for 34 genera/species (28%). Toxicological information was found for 58 genera/species (48%), of which 35 (29%) showed some evidence of toxicity. Support from ethnobotanical, pharmacological and chemical literature combined was found for 29 genera/species (24%). For more than 30% of the traditional Quichua medicinal uses no relevant literature could be found.

The above figures give some indication of the tremendous potential of Quijos Quichua traditional medicines to provide new therapeutic agents or new locally-available sources for therapeutic agents. The probability of random correlation between any given plant and a particular biological activity may be approximately 10%, based on the findings of antitumor activity in a random screening of over 20,500 species (Spjut and Perdue 1976). Thus the above rates of correlation between Quijos Quichua traditional medicines and supportive chemical and pharmacological literature are two to three time the probability of coincidence. This reaffirms the value of studying traditional remedies to discover new medicines.

Information in the literature apparently contradictory to the Quijos Quichua traditional use, or indicating the toxicity of certain plants used in their traditional medicine, provides an important cautionary note. In no case can it be assumed that, based on currently available information, a particular medicinal plant is both safe and effective for the traditional therapeutic use. Rather, this information should be used to set priorities for the thorough chemical, pharmacological and toxicological evaluation of those plants which appear most promising as new sources of therapeutic agents.

Once the safety and efficacy of particular medicinal plants of the Quijos Quichua have been established, particular attention should be paid to their formulation for modern therapeutic use. In most cases the pharmaceutical companies of highly industrialized nations formulate their products as pure active compounds, or simple mixtures of pure active compounds, in tablet or injectable form. This sort of expensive processing would result in a product far beyond the means of most of the people whose traditional healers discovered the medicine and who are in the greatest need of safe, effective, readily available, inexpensive drugs. Simple galenical preparations which could be done on location, and have been standardized for potency, dosage, and stability, would be of much greater benefit to the majority of the people. A good example of this method is provided by Hansson et al. (1986), who describe a proven preparation of *Ficus glabrata* (Moraceae) latex for the treatment of intestinal helminthiasis.

Finally, it will be essential to disseminate the information on proven remedies and ineffective or toxic remedies as widely as possible among the providers of primary health care, whether they are doctors, nurses, missionaries, or traditional healers. Since the traditional healers are still respected and relied upon by the majority of the population of third world countries, their cooperation must be enlisted. The enlightened exchange of information between modern medical practitioners and traditional healers will clearly result in better health care for all people.

CONCLUSIONS

In the short period of ten weeks, field work with the Quijos Quichua of the Amazonian lowlands of Ecuador provided information on the medicinal uses of approximately 120 species of plants. A review of ethnobotanical, chemical, pharmacological, and toxicological literature provided substational corroboration of the Quijos Quichua traditional medicines, and also indications of possibly hazardous uses of some species. The fact that correlations between the literature and the field results were much higher than could be reasonably attributed to random chance confirms the value of examining traditional medicines in order to discover new therapeutic agents or new locally-available sources for therapeutic agents.

The type of information provided by studies such as the present one can serve to set priorities for the thorough evaluation of the chemistry, pharmacology and toxicology of promising medicinal plants. Those with proven safety and efficacy could then be incorporated, with suitably simple instructions for formulation and prescription, into the pharmacopoeia of their native countries, and into the practice of modern and traditional providers of primary health care. Also, the use of those plants with demonstrated toxicity or lack of efficacy could be discouraged. Thus we could significantly improve the level of health care for the majority of the population of developing countries, who still depend on traditional medicines, without the investment of large sums of hard currency for the importation or manufacture of modern pharmaceuticals.

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d) **CHEM = Chemical information in the literature on the genus, where "Y" indicates "Yes", the studies reported do seem to support the traditional Lowland Quichua use, "Y?" indicates possible corroboration, "N" indicates "No", the studies reported seem to conflict with the traditional use.**

e) **TOXIC = Toxicological information in the literature on the genus. It must be noted that most acute toxicity studies are performed by intraperitoneal injection of extracts into rodents, and therefore do not necessarily relate to human oral toxicity. Toxicity is influenced by the plant part, method of preparation, and route of administration. Here "Y" indicates "Yes", the plant is known to be toxic to animals (LD50 $<$500 mg/kg), "N" indicates "No", the plant does not appear to be toxic to animals, "Y/N" indicates conflicting reports from different assays, extracts, or species in the same genus..**

ACKNOWLEDGEMENTS

We would like to express our gratitude to L. Grefa and the family of D. Aguinda for the cheerful sharing of their knowledge of traditional medicines and their hospitality while we learned from them. The generous hospitality and assistance of A. Suárez, W. Palacios, and P. Gómez in Ecuador is also gratefully acknowledged. The staff of the Herbarium, Field Museum of Natural History, Chicago, and of the Missouri Botanical Garden, St. Louis, are thanked for their assistance in identifying the voucher specimens. Financial support from the University of Illinois at Chicago, the Missouri Botanical Garden, and the U.S. Agency for International Development is also gratefully acknowledged.

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CULTURAL CHANGE AND ENVIRONMENTAL AWARENESS: A CASE STUDY OF THE SIERRA NEVADA DE SANTA MARTA, COLOMBIA

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INTRODUCTION

The present-day native population of the mountain flanks of the Colombian section of the Northern Andes is characterized by its adaptation to sloping terrains which offer a wide variety of subsistence resources. The principal Indian groups in this particular situation are, from south to north, the Kwaiker of the southwestern ranges of the Nariño district, the Sibundoy and Kamsa of the Putumayo headwaters, the Paez and Guambiano of the Andean Massif, the Tunebo of the eastern slopes of the Nevado del Cocuy, the Yuko of the Sierra de Perijá, and the Kogi, Ika, and Sanha of the Sierra Nevada de Santa Marta. In all cases the ecological adaptation of these tribal and peasant societies to an extremely rugged topography seems to have been remarkably successful; in fact, effective slope adaptation appears to have been practised in prehistoric times (Reichel-Dolmatoff, 1961, 1978a).

NOTA DEL AUTOR

El presente artículo se escribió originalmente en inglés y fue publicado en la Revista *Mountain Research and Development,* Vol. 2, No. 3, pp. 289-197, (1982), por la United Nations University, bajo el patrocinio de UNESCO. Posteriormente la oficina de UNESCO en Montevideo (ROSTLA) tradujo el artículo al castellano y, sin haber sido aprobado por el autor, se publicó en 1985 en: *Informe sobre los conocimientos actuales de los ecosistemas andinos: Vol. 3: Los Andes Septentrionales: Cambios ambientales y culturales,* pp. 81-96, Montevideo. La traducción al castellano es del todo errónea y por consiguiente dicha publicación de ROSTLA fue desautorizada por el autor, debido a que los lectores de habla castellana quedaron desinformados sobre el tema del artículo el cual perdió toda su validez y sentido. Lo transcribo en su forma original en testimonio de mi vieja amistad con el Profesor Richard Evans Schultes, cuyos estudios etnobotánicos han sido para mí un estímulo permanente.

Nevertheless, few detailed studies have been carried out in Colombia on native land use, be it historic or modern. Some archaeological reports contain information on terracing and irrigation; Donkin (1979) provides a general overview; Eidt (1959) and Broadbent (1964, 1968) describe terraces and ancient field systems in Muiska territory; Mason (1931-1939), Reichel-Dolmatoff (1950-1951, 1953, 1954), and others describe terraces and irrigation channels in the Sierra Nevada de Santa Marta; Parsons and Bowen (1966) refer to extensive ridged fields on the north coast, and West (1959) writes of ridged and "era" cultivation in the Central Cordillera. But none of these publications provides a detailed analysis of agricultural practices; few measurements are given and no pollen diagrams are presented. The engineering features are not placed within a wider context of prehistoric developments and hardly any excavations have been carried out. Historial information on ecological adaptation and agricultural practices during the colonial period, when far-reaching changes were introduced by the Spaniards, is scattered throughout the literature concerned with the *encomienda* system, land tenure, and similar topics, but lacks quantitative data and demographic correlations. An important source is Colmenares (1975, 1978); Reichel-Dolmatoff (1961) has published on slope adaptation of the sub-Andean chiefdoms; on the Chibcha (Muiska), Hernández (1949), Eidt (1954), and Friede (1974) provide some information.

RESEARCH ON CONTEMPORARY INDIAN GROUPS

Research studies on the modern Indian groups of the Andean slopes of Colombia are only sligtly more numerous. Exceptional in scope and depth of analysis is the study of Ortiz (1973) which describes the productive strategy of the Paez Indians and discusses decision-making processes. A previous study of Paez economy by Bernal (1954) deserves mention; Schwarz (1973) has studied culture change and stability among the neighbouring Guambiano and has published a short section on agricultural activities; Schorr (1968), in a brief study of land tenure in the adjacent Cauca Valley, uses early colonial ethnographic data in his discussion of *minifundio* structure. Farther to the south, Bristol (1958) describes the agricultural plants of the Sibundoy and Ingano Indians of the upper reaches of the Putumayo River. A study of shifting cultivation among the slope-dwelling Yuko of the Sierra de Perijá has been made by Ruddle (1974) and constitutes a valuable source. Beckerman (1975), following Leslie White's theoretical approach, has studied energy flow among the Barí Indians of the southwestern Maracaibo Basin bordering on Yuko territory; the study provides general data on food resources and concentrates on human energy expenditures.

Although this paper is not concerned with native ecological adaptation to rain-forest environments the following studies may be mentioned here: Isacson (1976) on Chocó slash-mulch cultivation; Reichel-Dolmatoff (1976) on ecological concepts of the Tukano Indians of the Northwest Amazon, and Von Hildebrand (1975) on land use and shifting cultivation among the Indians of the Miritiparaná River, also in the Northwest Amazon. Some additional data are contained in Friedemann (1976).

STUDIES ON THE SIERRA NEVADA DE SANTA MARTA

In the extreme north of Colombia the slopes and foothills of the Sierra Nevada de Santa Marta have been described by many travellers but very few of them refer in any detail to ecological problems or to native adaptative strategies. A historical outline has been presented by Reichel-Dolmatoff (1951, 1953); geographical studies of altitudinal levels, settlements, and soil degradation have been made by Taylor (1931), Seifriz (1934), Schultze (1937), Krogzemis (1967), Bartels (1970), Amaya (1975), Guhl (1975), and others, but no systematic work on the landscape history of the Sierra Nevada has been undertaken. Specific climatological data are found in Hermann (n.d.), Wilhelmy (1954), and Raasveldt (1957). Ethnological data referring to slope adaptation are mentioned in Reichel-Dolmatoff (1950-1951).

A summary evaluation of the existing literature on native adaptation to the northern Andean environment of Colombia indicates a lack of intensive studies on slope-dwelling societies. In fact, the study of indigenous man-land relationships has been grossly neglected. So far, concepts such as vertical control (Murra, 1972), partial system theory (Conklin, 1954, 1963), niche theory (Hardesty, 1975), micro-environments in prehistory (Coe and Flannery, 1964), and others, have not yet been applied and tested in the study of aboriginal agricultural systems in Colombia. Also the theoretical contributions of authors such as Conklin (1957), Flannery (1968), Rappaport (1969), Janzen (1973), and Brush (1976), to mention only a few, have not been appreciated.

THE KOGI INDIANS AND THEIR ENVIRONMENT

This paper is concerned with the analysis of a specific case of adaptation and change: that of the Kogi Indians of the Sierra Nevada de Santa Marta. The Kogi, a Chibcha-speaking tribe of about 6,000 individuals, are among the very few surviving native groups whose social, political, and religious institutions still contain many elements characteristic of the ranked societies of the ancient chiefdoms of northwestern South America. A study of their highly efficient agro-ecosystem, developed in the course of major periods of change, therefore, is of interest to the assessment of the wider northern Andean scene.

The Sierra Nevada de Santa Marta is an isolated, domeshaped massif separated from the neighbouring ranges by low-lying alluvial plains. It is the highest (5,775 m) coastal mountain in the world, and its narrow base is roughly triangular in outline, each side measuring about 150 km. A large number of fast-flowing streams, fed from the snowfields of the high sierra, drain in all directions, descending toward the coastal flats. Temperature depends not only on altitude but also on the proximity of snow-fields, on cold air currents descending the valleys, and on the geographical orientation of the respective slope. Two rainy and two dry seasons occur during the year; the main dry season lasts from December until the end of March and is followed by a rainy season lasting until the end of June when a minor dry season, with showers at noon, sets in. This is followed by another rainy season lasting from late September to December. Although this overall seasonal pattern is fairly predictable, local rainfall is often unpredictable, depending upon many regional factors. During the main dry season the eastern slopes, together with the northern and northwestern foothills, are exposed to strong northeast trade winds while some east-west trending valleys on the northern slopes, such as the Palomino and the lower Piedras and Manzanares river valleys, are known for foehnlike wind storms. The southeastern slopes lie in the tradewind belt and in the mountain's rain-shadow and are driest; the northern slopes are considerably wetter owing to longer rainy seasons and orographic precipitation. The entire mountain massif can be divided into a series of thermic belts which range from the tropical coastal plain to subtropical, temperate, cold, and paramo belts. The characteristic dense cloud forest begins at about 2,000 m; the snowline is at 5,000 m.

SETTLEMENT OF THE SIERRA NEVADA DE SANTA MARTA

The Sierra Nevada de Santa Marta and the surrounding lowlands have been inhabited for thousands of years. On the arrival of the Spaniards in the early sixteenth century, the region of Santa Marta (founded in 1526) and the northern foothills and ascending slopes of the massif were occupied by the Tairona Indians who formed a major chiefdom. They lived in nucleated settlements consisting of a large number of houses built on stone foundations on terraced sites containing architectural and engineering features such as retaining walls, stairs, slab-paved roads, drainage channels, and other structures. The economic basis of the dense population consisted of intensive maize cultivation combined with many other crops, cultivated fruit trees, marine resources, and trade relations (Reichel-Dolmatoff, 1951) Tairona irrigation engenerring was openly admired by the Spaniards. From archaeological and ethnographical comparisons it seems that the Tairona originally came from Central America, more precisely from the Atlantic slopes of what is today Costa Rica, and that they first arrived in the tenth or eleventh century A.D. (Dussan, 1967; Aguilar, 1972; Reichel-Dolmatoff, 1975, 1978a; Fonseca, 1979). The year 1600 marks the final defeat of the Tairona at the hand of Spanish troops; their remnants, together with survivors from other tribes, fled into the mountain fastnesses while Spanish colonizing interests turned to other regions of the country.

From the seventeenth century to present times this mixed Indian population became known under the generic name of Aruacos; in present-day ethnographic literature three tribes are distinguished: the Kogi, living mainly on the northern slopes of the Palomino, San Miguel, and San Francisco valleys; the Ika of the southern slopes; and the Sanha of the eastern slopes. The Kogi claim to be the direct descendants of the ancient Tairona, a belief that is supported by considerable evidence (Reichel-Dolmatoff, 1953, 1965); at present they are the least-acculturated tribe.

The roughly pyramidal shape of the Sierra Nevada, with its narrow base and its radiating drainage pattern is characterized by deeply-cut valleys which broaden only in their lower courses where they erode downward to the coastal plain. The edaphic and climatic characteristics of these valleys vary widely and form a complex mosaic of micro-environments which are particularly notable in the temperature belt; it is this wide climatic belt that is occupied by the Kogi.

KOGI AGRICULTURAL SYSTEMS

Kogi villages, consisting of up to one hundred circular straw-thatched, single-family houses, are not permanently inhabited but are social and ritual centres where people gather only at certain times of the year; people spend most of the time on their scattered homesteads spread over the mountain flanks at different altitudes. An individual family may own up to five or more houses, each one located in a small one-half to one hectare field clinging to a steep slope or nestling in a narrow valley bottom. Each family will also own a house in the next village but this will be used only on rare occasions. Because of fluctuating rainfall patterns the carrying capacity of each field, or of a cluster of neighbouring fields, varies from one year to another and from one region to another; moreover, certain crops thrive in a slighty warmer or cooler environment, and for these reasons Kogi families frequently move from one field to another, spending at each plot the time necessary for harvesting, weeding, and otherwise attending to the crops. The entire population is actively engaged in agricultural pursuits and this transhumance pattern is the main characteristic of Kogi subsistence.

Much of Kogi territory bears the lasting marks of age-old previous human occupations. Centuries of burnings have produced a landscape of barren mountains covered with coarse grass and fire-blackened boulders. The treeless slopes are badly eroded and only along the creeks and rivers do some stands of trees survive; at some spots primary or secondary forest is present. Although some Kogi fields are found on the limited valley floors and on small alluvial terraces some 20 or 30 m above the river bed, most are located on slopes where they occupy at most 2 ha of mixed crops. Kogi agriculture is based on the following crops: at about 1,000 m, which is approximately the lower limit of the habitat, there are plantains, bananas, sweet manioc, some maize, squash, sapote, pineapple, together with coffee and sugar-cane as cash crops. At about 1,500 m beans are added to this complex but fewer fruit trees are present; above 1,500 m some maize, beans, arracacha, and sweet potatoes are grown while higher up potatoes and onions are planted.

The standard procedure consists in clearing a field in December and January and in firing it by late February or early March. But there is no definite harvest season; harvesting is a year-round activity because of the variety of crops planted and because of variations in soil quality, and diversity in the altitudes of fields. Under these conditions it would be misleading to say that the Kogi practise shifting cultivation. In fact, they do not "shift"; a field may be cultivated for some five years and then left to fallow for ten years, but it is never completely abandoned during this period; even after the soil is fairly exhausted there will always be some food plants, such as curcurbits, peppers, beans, or a fruit tree, left in some corner. Since a family's fields are in different stages of production, there are no clear-cut harvesting or fallowing seasons. Plantain gardens and sugar-cane fields have been observed under production with hardly any change in over 30 years. A comparison between cropping and fallowing frequencies is therefore useless; some fields are practically perennial. This type of escalated cultivation on mountain flanks differs from true shifting cultivation in a flat rain-forest environment in that it provides more spatial and temporal crop variety, an interlinking of growth cycles, and has less dependence on rainfall, since it is likely that even during an unexpected drought some rain will fall at some spot in the mountains. The effective variety of Kogi crops varies throughout the year and must always be supplemented from other levels and environments, but the overall system is that of a very stable subsistence agriculture.

ARCHAEOLOGICAL TERRACES

In order to put this agricultural system into perspective, one must look back in time. In many parts of the present Kogi habitat one can see extensive archaeological terraces the structural details of which are very similar to those of the ancient Tairona territory in the Santa Marta region. These linear sloping terraces are built of rows of boulders and rocks of varying sizes which not only collect eroded top soil, but also collect runoff water behind the embankments; this water is then drained off by a slight lateral sloping of the embankment. Occasionally the prehistoric Indians dug long narrow drainage channels obliquely across a slope. A contoured pattern of terraces can be observed at some points on hillsides varying in slope from a few degrees to 45° and more; but in other regions the pattern formed by the stone rows is rather one of imbrications, of an all-over crescentic pattern of semi-circular terraces. Associated traits are small stone platforms and dressed slabs or markers set upright in the ground. These traces of former terracing activity indicate that the Tairona or other ancient tribes were quite aware of the necessity to minimize soil erosion and provide drainage. And so are the present-day Kogi; they know the benefits of soil conservation and irrigation, but use them only in a limited way. Field debris (rocks, small pebbles, branches, old tree trunks) are sometimes located at points where they might serve as small soil traps, and minor garden plots are sometimes irrigated, or narrow drainage channels are dug obliquely on a slope; but intensive irrigation is lacking although the necessary technological knowledge is plainly present.

It is a striking fact that the archaeological terraces, so prominent on the barren slopes of the Kogi habitat, are not integrated with the present agricultural work organization, nor with the prevailing settlement pattern. In the prehistoric past, when they accompanied large nucleated settlements, they probably constituted artificial ecosystems, but at present they are hardly in use. They contain good soils but sometimes are distant from settlements; and then the Kogi shy away from them because, in a sense, the terraces are sacred spots that belong to the ancestors. In sum, while the Tairona reworked the natural environment and thereby increased its yield, the Kogi maintain their natural environment by planting their scattered fields and gardens with a mixture of subsistence crops.

CURRENT FOOD PRODUCTION

Random finds of archaeological grinding stones suggest that the relic terraces had been used for maize cultivation, as was stated by the early Spanish chroniclers. At present, however, maize, although still surrounded by many ritual observances, is of little importance as a dietary item. The staple food of the Kogi throughout the year consists of cooking plantains, a fruit which can be harvested almost perennially; it is also clear that the important subsistence items are plants most of which are of post-Columbian origin, such a plantains, bananas, yams, potatoes (post-Conquest in the Sierra Nevada), pigeon peas, sugar-cane, mango, and others. Autochthonous American plants such as maize, manioc, sweet potatoes, and beans, although distinguished by the Kogi as "belonging", are of less importance. This indicates that, to a large degree, the Kogi have had to reorientate their agricultural production and with it many other aspects of their traditional life-style, such as their settlement patterns. According to the Indians, maize cultivation is not profitable in their present environment and their preference is for starchy foods such as plantains, tubers, and squash, with tree crops being of considerable importance. The use of animal resources is limited both by environmental factors and by cultural mechanisms, for most animal proteins are thought to be dangerous to health and unclean in ritual contexts. Game is very scarce and there is little garden-hunting. River crabs and beetles are occasionally consumed. Oxen, acquired in the lowlands, are used exclusively as animals of burden and to operate the primitive sugar mills; chicken is an emergency food. It should be mentioned here that the Kogi and their neighbours are avid consumers of coca, the toasted leaves of which they chew with the addition of lime obtained from burning marine shells.

The change in subsistence patterns, from intensive irrigation agriculture to mixed starchy crops, from seashore and tropical resources to subtropical and highland products, was made possible mainly by the adoption of cash crops, oxen, and subsequent trade relationships with neighbouring creole peasants. Agricultural practices not only regressed in technical complexity but became completely reoriented when foreign crops were adopted. By colonial times the Kogi had adopted sugar-cane, potatoes, onions, and more recently, coffee, to exchange or sell in the lowlands. Trade relations have been going on for centuries. Dietary supplements obtained at present in this manner are dried fish and salt, but most of the proceeds of this trade are spent on bush-knives, axes, cast-iron vessels, needles, and similar items. The Kogi weave their own cotton cloth and steadfastly refuse all other manufactured goods. There is no market system, and even among families hardly any exchange is carried out.

This reorientation has developed over the last three centuries and its success must be measured by the biological and cultural survival of thousands of Indians who, although exposed to strong acculturational pressures, have been able to retain their cultural autonomy. Present-day agricultural practices, therefore, are not a carry-over from the Tairona but differ significantly from those of the prehistoric and early historic tribes. The period of disintegration of Tairona communal life was thus overcome by adaptive mechanisms of great efficiency.

MECHANISMS OF CULTURAL CHANGE

Two main aspects must be taken into account here: first, the prevailing agro-ecosystem must be analysed in detail and second, the intellectual premises formulated by the Kogi leadership, which initially made this ecological adaptation possible, must be described.

The overall gradient of the Sierra Nevada is not steep, except where it approaches the snow-covered peaks, but the radiating rivers form V-shaped valleys with steep slopes on which an entire range of life-zones can be observed. A single valley or mountain flank may offer a range of different climatic belts spanning hundreds and even several thousand metres of altitude, and in deep valleys insolation may be severely limited. But the lower one descends, the wider become the valleys, and their slopes are less steeply inclined. The lowlands, however, are avoided and no Kogi settlements are found in the tropical thorn woodlands of xerophytic vegetation which is characteristic of the base of the Sierra Nevada. The principal valleys of the Kogi habitat have two or more nucleated villages located at different altitudes and thus they provide convenient stopping places for people moving between fields. Most valleys are about 30 km long and an entire valley, from the coast up to the paramo can be walked in three days. Since altitudinal belts are often very compressed, a large number of different resources are available within a day's walking distance from any village. To walk up or down a valley is easy enough because of the gentle gradient, but to cross from one valley –however small– to another, requires a major effort because of the very steep slopes and rocky trails. There is no seasonal migration but people move according to their needs which might vary from one family to another according to the location of their fields and kinds of crops they contain. People continuously move up and down the rivers and cross from one valley to the next in a pattern which is sometimes described by them as an almost sacred network, a huge textile in which warp and woof come to symbolize life (Reichel-Dolmatoff, 1978b). To see entire families walking through wind and rain over steep mountain trails, carrying heavy loads of field fruits, small children, raw sugar cakes, and firewood, may easily create in the observer an image of abject poverty and call to mind the plight of an impoverished people trying to wrest a living from a degraded environment. This image, however, is erroneous; neither do the Indians think of their part-time nomadism as a heavy task, nor are the resources of the environment as scarce as might appear to the outsider. In reality, what one is witnessing here are the normal workings of a system of effective adaptation developed over long time periods and maintained by precise rules and prescriptions.

Under the distinctive ecological circumstances here described, the Kogi have made their choice from these resource environments and each settlement has worked out its own particular mode of adaptation. In exploiting a series of horizontally and vertically different microenvironments the Kogi have achieved a workable balance. In the course of centuries of being forced higher and higher into the mountains by encroaching settlers, the Indians' ecological awareness has been sharpened to a point where a precise knowledge of soil characteristics, temperature, plant cover, rainfall, drainage, slope exposure, and winds has begun to form a coherent body of procedures and expectancies. In their sloping fields the Kogi will plant a variety of species but a relatively small number of individuals, thus creating a generalized ecosystem, but on terraced or level ground near villages or on valley floors, they will do the contrary and create a specialized system by planting a small number of species, such as plantains, pigeon peas, sugar-cane, or coca. To sum up, the Kogi practise a sustained-yield, non-expanding economy within the carrying capacity of their environment (Janzen, 1973). Fluctuations in annual productivity, resulting from prolonged dry seasons for example, are not disastrous because of this resource variety; there is always some spot where food can be found. It should be pointed out here that, in their daily food procurement, the Kogi do not attempt to produce a surplus; there is no storage of food beyond a few days and only some sun-dried plantains may be kept for emergency use.

When discussing their semi-nomadic migrations and the problem of available land resources most Indians will say that there is no real shortage of land; they will point out areas of primary and secondary forest, fallowed land, or even some unused level terrain in a valley bottom, all available for agricultural purposes. In fact, potential cultivable land is not as scarce as it would appear at first sight; by having a large number of fields at different stages of production and in different ecological niches, the Kogi have been able to accumulate certain reserves of agriculturally usable lands. One must also recognize the fact that, by not living in nucleated settlements, the Kogi preserve the lands adjacent to the villages from degradation and, at the same time, guarantee crop protection.

As seen from the outside one might suggest that the Indians could well live permanently in their villages and exploit a limited range of neighbouring lands; their agricultural tradition and technological knowledge of watercontrol engineering would make this possible. But no Kogi would ever accept this alternative; their life-style is to occupy their scattered homesteads, to roam over the mountain flanks, and only occasionally to gather in a village or a small ceremonial centre to celebrate some periodic rituals. The urban tradition of the Tairona (if there ever was one) has disappeared among their modern descendants. It seems, then, that the reasons for their present, diffused agricultural pattern must be sought in another dimension of tribal tradition.

KOGI LEADERSHIP AND ECOLOGICAL ADAPTATION

The Kogi live in a complex, ranked society in which priestly and lordly lineages continue to play a major role. However, none of these lineages, membership in which is determined by the principle of parallel descent, are privileged in any way by landholdings, better housing, or other physical advantage. Even the highest-ranking Kogi shares in the subsistence level, wears the same threadbare clothes, and lives in the same small hut as his lower-ranking compatriot. The difference consists in traditional power, in authority, and in the ability to establish rules of correct procedure. Although most Kogi villages have a headman who nominally represents civil authority, the true power of decision in personal and community affairs is concentrated in the hands of the native priesthood. These men, many of whom possess a profound knowledge of astronomy, meteorology, and ecology (Reichel-Dolmatoff, 1977), base their authority, in part, on their continuous intelligent leaderhip, in part on strong religious principles. Perhaps the most important religious mechanism is confession. Public confession of misbehaviour and offences –in action or intent– constitutes a periodic ritual and the truthfulness of the confessants is guaranteed by priestly threats of illness and impending death. Kogi priests believe that between man and nature exists an equilibrium which might easily be disturbed by irresponsible human action. Although this equilibrium refers not only to subsistence resources, water management, and forest conservation, but also to a spiritual and moral balance of the indivual, nevertheless, agricultural rituals occupy a very prominent place in Kogi religion. The repetitive sequence of the major collective rituals is timed according to astronomically determined seasons; that is, the ritual calendar corresponds to the agricultural cycle. Individual agricultural practices are subject to many ritual rules. It is believed that all native food plants have their other-worldly "fathers" and "mothers" and that crop fertility has to be insured by frequent offerings to these spirit-beings. Soil Types (humus, clay, sand, and so on) are ritually named, as are categories of rains, winds, lagoons, and the different cardinal directions with which they are associated. The planting or harvesting of any crop needs a specific "permit" *(sewa)* which only a priest can give and similar permits are required to fell a tree, fire a field, or dig a drainage ditch. These permits consist of small stone beads or other talisman-like objects and their acquisition may be costly, protracted, or may be withheld altogether. The possession of these *sewa* depends, in part, upon the user's lineage, and in part, upon priestly approval; each member of a lineage is the "owner" of certain *sewa,* while the principal priestly lineages are associated with fertility symbols such as water, rain, lagoons, rock crystals, semen, or similar concepts.

Kogi priests and, indeed, most adult men are aware of the relationship between population size and carrying capacity, and are greatly concerned about undesirable population pressure. Kogi society is sexually very repressed; sex is sinful and women are said to constitute a dangerous element in society, bent upon disturbing its precarious balance. Large families are criticized and complex birthcontrol calendars are in use. A moral tenet which is repeated over and over by priests and elders states that people should not multiply like ants, but that their model should be a squash plant which produces only here and there a single clearly traceable fruit. The ant-hill/squash antithesis not only emphasizes the necessity for population control, but also tries to keep the population from disorderly dispersal and attempts to orient it toward the maintenance of interdependent social and economic units. This native statement on a basic ecological principle is only one example of the prevalent Kogi world view. Kogi religion and philosophy are extremely severe and demanding, being based upon a harsh discipline of frugality, continence, obedience to a moral code, and meditation upon ultimate realities.

The principal cultural mechanism for any economic, social, or religious activity is priestly divination. Divinatory techniques are many and consist of simple yes-or-no alternatives, but often take the form of complex interpretations of signs and symbols, such as the reading of cloud formations, animal voices, or the shape and number of air bubbles rising from a tubular necklace bead which has been submerged in water. Other mechanisms are muscle twitching, deep meditation, and the listening to sudden sounds or voices from within. Divination is practised mainly to ascertain whether or not a certain action is feasible. The decision may concern the planting of a crop, the clearing of a field, or any aspect of a wide range of major or minor alternatives of resource management, housing, family affairs, travel, trade, or other activities. People must continually consult these priestly oracles in order to have their actions guided by divination; should they disregard these rules, symptoms of illness will soon come to express the displeasure of the divine forces and the priests will impose penalties which, occasionally, can be very harsh. Priestly divination undoubtedly introduces a random element (Moore, 1965) but much of it appears to be manipulated and the final decision most often represents a personal choice made by the priest. This is almost always the case in matters of mate selection; in agricultural and general subsistence decision making, divination is an effective device in ecological planning because the priest's practical environmental knowledge is truly outstanding. Priestly divinations provide guidance not only for small-scale decisions in daily life but may determine major strategies such as the foundation or relocation of settlements, the intensification of a certain crop, or the nature of trade relationships with neighbouring creole settlers. The effectiveness of this, to a large degree, ritually controlled agroecosystem (Rappaport, 1969) is recognized by most Kogi Indians. In fact, the underlying reason why Kogi culture has been able to resist harmful change, is that it gives a strong backing to priestly authority.

In all these planning activities Kogi priests are concerned with two aims: to keep population density below the carrying capacity limit of the fields and their associated technology; and to maintain areas of undegraded environment which might constitute reserves in times of need. A case in point are the relic terraces and other archaeological sites which are tabooed for all immediate purposes, but whose untapped resources can be exploited at any given time if need be; a priest might simply "divine" that a certain extension can be used for cultivation. In most cases observed, permission was granted to plant single crops of high-protein yielding plants such as pigeon peas; on other occasions, when a local food shortage was arising, the usually restricted consumption of a tree fruit *(Metteniusa edulis)* with high protein content was relaxed and its use widely recommended. All kinds of ritual food restrictions, which are very common among the Kogi, may thus be removed when the priests see fit to do so after due divination.

This kind of resource control provides power; it determines the elite which administers the many "permits", but what in other societies would be grossly exploited, among the Kogi is being handled with great social responsibility. Kogi priests will never put themselves outside this chain and will always form part of it. They obtain no material benefit whatsoever and have no special resource rights; on the contrary, by their living conditions they always exemplify the austere ideals of Kogi life. It is true that the priests command the support of their followers by threatening them with illness, but at the same time they alleviate stress and provide experienced leadership.

The agricultural system by which the Kogi tend to occupy somewhat more land than is actually necessary for subsistence, has its beginnings in several traditional aspects of Kogi culture. On the one hand, from historical experience the Indians know that any forced movement farther into the mountains would seriously reduce the choices of resources; indeed, there is a critical ecological threshold at about 2,000 m, a level beyond which they would be deprived of their staple food of plantains. The upper limit of plantain cultivation constitutes an effective check to expansion into the high-altitude areas. The possession of a large number of fields in the temperate belt, many of them almost inaccessible to the creoles, thus constitutes a reserve in times of future encroachments. On the other hand, the widely scattered field system is a means by which tribal territorial rights are being upheld. The Kogi have not forgotten the past when their Tairona ancestors dominated these regions and at present, by thinly spreading their settlements and fields over the mountain flanks, they continue to lay claim to these traditional lands. The entire headwater region of the San Miguel River above about 800 m is considered to be a sacred legacy from the ancients and the innumerable fields, houses, trails, stone markers, or ritually named landmarks express symbolic property rights to these lands. In any event, the Kogi declare they would never migrate to the lowlands and become wage labourers; their tendency would always be one of retreat into the highland regions, even if such a movement would severely reduce their present ecological diversity.

TRADITION VERSUS EXTERIOR FORCES

The situation described above does not present any truly pressing problems as long as conditions continue to evolve at the slow pace of past developments, and as long as the Sierra Nevada remains an island whose inhabitants can retain their tribal identities. But this is a hypothetical situation. The fact is that the period of isolation is coming to an end; the Sierra Nevada has ceased to be an out-of-the way mountain retreat and it is necessary to evaluate its physical resources and human problems in the context of international developments. The real problems of change and adaptation, if not of physical survival, are threatening from the outside. A realistic assessment of the present situation (1981) of the Sierra Nevada de Santa Marta and its Indian population must take into account a number of stark facts which become evident as soon as one places this small area of the world into its evolving national and international context. In the first place, a broad climatic belt, located mainly on the northern flanks where it party overlaps with the lower limits of Indian territory, is occupied by widespread illegal marihuana crops which form part of the international narcotics trade. Although governmental controls are active, the trade is spreading and its inevitable consequences of violence and corruption are beginning to be strongly felt in the tribal territories. In the second place, owing to its particular geographical position and its favourable climatic conditions, the Sierra Nevada is of potential strategic value, especially as a base for modern communication systems. A third aspect is this: not only the Sierra Nevada but also other isolated mountainous regions are potential strongholds of political insurgence. The Northern Andes constitute a natural link between the Andean core lands and the Caribbean sphere and, in the future, political and military action may be expected to affect some regions presently inhabited by aboriginal groups or subsistence farmers. Another, even more striking, fact is that directly at the base of the Sierra Nevada, between the massif and the Venezuelan border, one of the hemisphere's largest coal deposits at El Cerrejón has been discovered and large-scale strip mining will begin in the near future. There is no need to elaborate on the eventual impact of all these developments upon the Sierra Nevada. Modernization, with the worst effects of cultural decline, wage labour, debt bondage, alcoholism, disease, and violence will take its toll and, since there exist no refuge areas for the native peoples, they are likely to be left at the mercy of modern industrialization and all its consequences. There is but little consolation in the fact that the spectacular beauty of the mountain landscape will eventually lead to the development of the international tourist trade, another prospect of doubtful benefit for the local scene. In any event, the Sierra Nevada is already well on the way to becoming connected with the world market, whatever its promises and demands.

It would be unrealistic to ignore these facts and to propose instead the usual local agricultural programmes, health services, and the like. Territorial encroachment, marihuana, violence, and large-scale industrialization are not mere problems of acculturation but are bound to have destructive aspects which, in the case of the Sierra Nevada, are likely to lead to serious problems. There can be no easy solutions; future directions must be based upon a clear awareness of the increasing threats and must attempt to prepare the native peoples for a time of far-reaching, accelerated change.

CONCLUSION

Two aspects deserve immediate attention: one concerns scientific interst in Kogi adaptive strategies; the particular agro-ecosystem should be studied in detail, preferably in one of the larger valleys such as that of the San Miguel River. The study should attempt to provide a coherent picture of land tenure and land use in different ecological niches, crop diversity, and seasonal variations. Soil analyses and meteorological data should be obtained and case studies of the semi-nomadic pattern of individual families should be made. The nutritional and general health status of the Indians should be assessed and demographic data should be analysed. This body of qualitative and quantitative information should be related to Kogi social organization, power structure, and their overall religious and philosophical world view. The value of such a study would lie in its analysis of a native strategy of zero-growth development, and in its comparability with other, similar adaptive strategies elsewhere in the Northern Andes. The other aspect that deserves priority treatment refers to the urgent need for establishing a biosphere reserve, as envisaged by the Man and the Biosphere (MAB) Programme, where Kogi culture would be protected against destructive influences while long-term research could be carried on by teams of specialists in ecology, plant geography, hydrology, geomorphology, and many other disciplines. The physical characteristics of the Sierra Nevada provide ideal laboratory conditions for this kind of research.

In conclusion, the Sierra Nevada de Santa Marta is not an isolated case; many other regions of the Northern Andes present similar patterns of ecological adaptation and find themselves exposed to similar impending changes. It is evident that development of proper resource management practices to anticipate and diminish the impacts of the oncoming changes remains a major problem; the biggest challenge will lie in providing the institutional mechanisms which will protect small traditional societies from disruptive changes imposed from the outside. In this respect, the resilience of their age-old ecological awarenees may contain important lessons. It is essential, then, that specialists in all spheres of planning, training, and research be made equally conscious of the cultural complexities of the material conditions for survival.

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WHAT WAS PALGRAVE'S PLANT?

By *Dorothy Kamen-Kaye, A.B., F.L.S.**

PALGRAVE'S DESCRIPTION OF AN UNFAMILIAR PLANT

"Here also, for the first time, I met with a narcotic plan very common farther south, and gifted with curious qualities. Its seeds, in which the deleterious principle seems chiefly to reside, when pounded and administered in a small dose, produce effects much like those ascribed to Sir Humphry Davy's laughing gas; the patient dances, sings, and performs a thousand extravagances, till after an hour of great excitement to himself and amusement to the bystanders, he falls asleep, and on awaking has lost all memory of what he did or said while under the influence of the drug. To put a pinch of this powder into the coffee of some unsuspecting individual is a not uncommon joke, nor did I hear that it was ever followed by serious consequences, though an over-quantity might perhaps be dangerous. I myself tried it on two individuals, but in proportions, if not absolutely homeopathic, still sufficiently minute to keep on the safe side of risk, and witnessed its operation, laughable enough, but very harmless. The plant that bears these berries hardly attains in Kaseem the height of six inches above the ground, but in 'Omân I have seen bushes of it three or four feet in growth, and wide-spreading. The stems are woody, and of a yellow tinge when barked; the leaf of a dark-green colour and pinnated, with about twenty leaflets on either side; the stalks smooth and shining; the flowers are yellow, and grow in tufts, the anthers numerous; the fruit is a capsule, stuffed with a greenish padding, in which lie embedded two or three black seeds, in size and shape much like French beans; their taste sweetish, but with a peculiar opiate flavour; the smell heavy and almost sickly. While at Shohar in 'Oman, where this plant abounds, I collected some specimens intended for botanical recognition at home, but they with much else were lost in my subsequent shipwreck, nor did I again meet with this curiosity for the rest of my journey, then, indeed, near its end".

Narrative... (1865)
vol. I, Ch. vi. pp. 254-255

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NARRATIVE

OF

A YEAR'S JOURNEY THROUGH

CENTRAL AND EASTERN

ARABIA

(1862–63)

BY

WILLIAM GIFFORD PALGRAVE

LATE OF THE EIGHTH REGIMENT BOMBAY N. I.

Not in vain the nation-strivings, nor by chance the currents flow;
Error-mazed, yet truth-directed, to their certain goal they go.
TEY'YEEYAT EL KOBRA', BY EBN-EL-FÁRID

فلا عبثاً والخلق لم يخلقوا سدى – وإن لم تكن افعالهم بالسديدة

IN TWO VOLUMES

VOL. I

London and Cambridge

MACMILLAN AND CO.

1865

Abstract. "Palgrave's plant" is part fact, part fable-and, in part, fate. His plant may be called "psychotomimetic" (Schultes and Hofmann, 1980) and its seeds may be assumed to contain certain alkaloids (see *Banisteriopsis,* S. and H.). This discussion considers primarily two plants: *Peganum Harmala* (Zygophyllaceae), native to dry areas from the Mediterranean to northern India, Mongolia and Manchuria, and *Papaver somniferum* (Papaveraceae), cultivated throughout the Mediterranean region and in Asia.

These two plants are mentioned in accounts of a drug that produces intoxication more or less similar to that witnessed by Palgrave on several occasions among Arabian men gathered at the coffee-hearth. Palgrave supplements his account with a description of the plant said to produce the seeds utilized in powdered form as an addition to coffee.

Since Palgrave's immediate family were close relatives of William Hooker and his son Joseph —both prominent in the history of the Royal Botanic Gardens, Kew— he had a close contact with these distinguished botanists. Palgrave himself has beer characterized not only as "something of a botanist" but also —as his writing show— as a "keen observer".

The plants discussed, while worthy of consideration, must be regarded in the Palgrave connection as possibly as much fable as fact, in consideration of circumstances that add up to "fate". On the whole, his is yet another among the many incomplete reports of ethnobotanical identification in the older literature.

William Gifford Palgrave (1826-1888)

After a brilliant career at Trinity College, Oxford, Palgrave went to India as a subaltern in the Eighth Regiment, Bombay N.I., in 1847. Following an illness, he left the army to join the Jesuit Order as a missionary. He had felt an attraction to the East for some years, and he had his father's linguistic aptitude. In Syria, where he made many converts and founded numerous schools, he acquired such familiarity with the Arabic language, manners and habits of life that he could, and did, pass easily for a native. He barely escaped alive in the massacre at Damascus in 1861, and in 1862-1863, he carried out a journey across central Arabia, partly with a view of possible missionary enterprise there and partly on a semi-political mission for Napoleon III. North and Central Arabia had been closed to Europeans for many years because it was under the control of the Wahhabi. This fanatic fundamentalist sect of Islam, named for a holy man, Mohammed ibn Wahhab, (a description and analysis of which Palgrave gives a lengthy account) was a significant influence in his time in the politics as well as the religion of Arabia. Believing it imprudent, even dangerous, to travel there as a Christian and a European, Palgrave posed as a Syrian physician, Saleem Abou Mahmoud-el-Eys, and was accompanied by a Greek Jesuit, Geraigiri, as his assistant Barakat-esh-Stanee. Both wore the dress of "middle-class travellers from Syria". They took along a camel-load of books, including a few medical books in good Arabic "intended for professional ostentation", a box of drugs and other medical supplies, and an assortment of trade goods, including two large sacks of coffee. Palgrave "doctored" by day and was received by friends and acquaintances at night along the length of a year's journey from Ma'an to the coast of Omān. Returning to London with the consent of his superiors, he severed his connection with the Society of Jesus and engaged in diplomatic work for the British government. He married in 1868 and left three sons at his death in 1888. Palgrave's account of his Arabian adventures, titled *Narrative of a Year's Journey through Central and Eastern Arabia,* published in 1865, was in such demand that Macmillan published a Second Edition in 1866.

(Principally from the *Dictionary of National Biography,* Vol. XV, with some details from Palgrave's *Narrative).*

Notes on two key phrases in Palgrave's account of "a narcotic plant" and his failure botanically to identify it.

"...a narcotic plant... gifted with curious qualities" which he met with for the first time in the lower Nejd and in Kaseem in central Arabia. Palgrave refers specifically to the seeds of this plant, which, pounded to powder and added to a cup of coffee and drunk by a guest at a coffee-hearth, causes him to "perform a thousand extravagances till after an hour... he falls asleep..." and a awaking remembers nothing that has happened.

Reference: One of the many students whom Linnaeus taught when he was a professor at the University of Uppsala —Olaf Reinhold Alander— presented a dissertation titled "Inebriantia" as a part of the required academic preparation for an initial medical degree; it was written in Latin and dated 1761. This thesis came to the attention of Professor Richard Evans Schultes of Harvard University and Professor Bo Holmstedt of the Karolinska Institutet, Stockholm. Suspecting that it was "probably the earliest interdisciplinary treatise on intoxicating plants in the Linnean era and possibly in European literature", they felt that it "ought to be made available to the English-speaking audience". They translated it, using both the original Latin and a Swedish version published in 1963. In their Foreword, the state that "it is believed that Linnaeus himself wrote wholly or in part, some of his students' theses".

Alander describes the effects of use of both opium and *Peganum Harmala.* He quotes Belon on *P. Harmala,* who stated that it was consumed as "seeds sold in the market", adding that "the emperor Soliman used to eat the seeds without knowing what they were, because they gave him increased sexual desire and blotted out the memory of unpleasant events". He mentions the possibility that these same seeds, eaten in Persia by Kaempfer, produced euphoria followed by hallucinations.

Comments

(Lewin 1964: pp. 38 and 239) Belon, a French naturalist who travelled through Asia Minor and Egypt, stated in 1546 that "They [the Turks] eat opium because they think that they thus become more daring and have less fear..." Lewin mentions Kaempfer, in connection with betel, as "a famous explorer".

(Font Quer 1962: p. 424) Speaking of the seeds of "alharma", he comments that "Linnaeus himself, in his 'Academic Amenities' speaks of this virtue [of producing 'a delicious intoxication'] when he tells us that in Turkey they sell them to obtain with them a state of mirthful euphoria and great joy. It seems to be similar to that which the Indians of America attain with yajé. In Morocco, these seeds constitute a kind of panacea with which they cure the most diverse illnesses".

(Lewis 1963: p. 32) quotes Ogier Ghiselin de Busbecq, the Turkish Ambassador to Vienna, in the Turkish Letters... 1694: "if you ask me, what manner of man Solyman was? I'l tell you..." [he refers to Süleyman (1520-1566) called "Kanuhi" ("the law-ordained") by the Turks and "the Magnificent" by the west]. After recounting the Sultan's virtues, he admits that his enemies faulted him as being too uxorious..., [and that his wife had] that Ascendent over him, by reason of her Inchantments and Amatory Potions...".

(Lewin 1964: pp. 34-35) quotes from the Odyssey: When Telemachus visits Menelaus in Sparta, they and the assembly, sharing memories of the slain, are sorrowful. "And Helen...poured into the wine...a drug, nepenthes, which gave forgetfulness of evil. [She] possessed this wonderful substance which Polydamna had given to her, [who was] the wife of Thos in Egypt..." Lewin adds, "There is only one substance...capable of acting in this way, and that is opium...Either the unripe seeds –the ripe one are useless– or the capsule of the poppy were employed".

By the time Palgrave, having been present at many gatherings at Arabian coffee-hearths, witnessed the action of certain seeds pounded to powder and added to spiced coffee, confusion as to the origin of so unusual a drug must have been general. It seems strange that he apparently never found out more at the time about the provenance of the seeds and the appearance of the plant from which they were harvested. Was there a reluctance to share what may have been a secret?

"...but they [the unidentified seeds] with much also were lost in my subsequent shipwreck...".

Palgrave tells the story:

"One of our sails was blown to rags, the others were with difficulty got in, and when night closed we were driving under bare poles before a fierce south-wester over a raging sea, while the sky, though unclouded, was veiled from view by a general haze, such as often accompanies a high storm. The passengers were frightened, but the sailors and I rather enjoyed the adventure, knowing that we were by this time far off the coast, clear of all rocks, and in short anticipating nothing worse than a day or two extra at sea before getting round to Mascat. The moon rose, she was in her third quarter, and showed us a weltering waste of waters, where we were scudding entirely alone; some other vessels which had been in sight at sunset had now totally disappeared. The passengers, and Yoosef-ebn-Khamees among the number, dismayed by the mad roll of the ship, no longer steadied by a stitch of canvas, by the dashing of the waves, and all the confusion of a storm, sat huddled below in the aft-cabin, while the helmsman, the captain, and myself, held on to the ropes of the quarter-deck, and so kept our places as best we might; the two Sonnees with the Nejdean recited verses out of the Coran; the 'Omānee sailors laughed, or tried to laugh, for some of them too began to think the matter serious; no one however anticipated the sudden catastrophe near at hand.

"It may have been, to judge by the height of the moon above the horizon, about ten of the night or a little earlier, when we remarked that the ship, instead of bounding and tossing over the waves as before, began to drive low in the water, with a heavy lurch of a peculiar character. One of the sailors approached the captain and whispered in his ear; in reply the captain directed him to sound the hold. Two men went to work and found the lower part of the vessel full of water. Hastily they removed some side boardings, and saw a large stream pouring into the hold from sternwards: a plank had started. ...'Ikhamoo', 'plunge for it', shouted the captain, and set the example by leaping himself amid the waves. All this passed in less than a minute; there was no time for deliberation or attempt to save anything.

"How to get clear of the whirl which must follow the ship's going down was my first thought. I clambered at once on the quarter-deck, which was yet some feet raised above the triumph of the lashing waves, invoked Him who can save by sea as well as by land, and dived head foremost as far as I could. After a few vigorous strokes out, I turned my face back towards the ship, whence a wail of despair had been the last sound I had heard. There I saw amid the raging waters the top of the mizen-mast just before it disappeared below with a spiral movement while I was yet looking at it. Six men –five passengers and one sailor– had gone down with the vessel. A minute later, and boards, mats, and spars were floating here and there amid the breakers, while the heads of the surviving swimmers now showed themselves, now disappeared, in the moongleam and shadow.

"So rapidly had all this taken place that I had not a moment for so much as to throw off a single article of dress; though the buffeting of the waves soon eased me of turban and girdle. Nor had I even leisure for a thought of deliberate fear; though I confess that an indescribable thrill of horror which had come over me when the blue glimmer of the water first rippled over the deck, though scarce noticed at the time, haunted me for months after. But at the actual moment the struggle for life left no freedom for backward-looking considerations, and I was already making for a piece of timber that floated not far off, when on looking around more carefully I descried at some distance the ship's boat; she had been dragged after us thus far at a long tow, Arab fashion, though who had cut her rope before the ship foundered was what no one of us could ever discover. She had now drifted some sixty yards off, and was dancing like an empty nutshell on the ocean... At last, after some minutes, long as hours, I touched land, and scrambled up the sandy beach, as though the avenger of blood had been behind me. One by one the rest came ashore—someja stark naked, having cast off of lost their remaining clothes in the whirling eddies; others yet retaining some part of their dress. Every one looked around to see whether his companions arrived; and when all nine stood together on the beach, all cast themselves prostrate on the sands, to thank God for a new lease of life granted after much danger and so many comrades lost.

"Then rising, they ran to embrace each other, laughed, cried, sobbed, danced. I never saw men so completely unnerved as they on this first moment of sudden safety... Yoosef has lost his last rag of dress; I had fortunately yet on two long shirts (one is still by me), reaching down to the feet, Arab fashion. I now gave my companion one, keeping the other for myself; my red scull-cap had also held firm on my head, so that I was as well off or better than any...

"Two of the sailors, with a curiosity nowise unnatural, made a return visit that very evening to the beach, where they found the broken planks of our boat, dashed to pieces by the surf. Of the ship we never heard or saw more—where she lay, not five but seventy or eighty fathoms deep, if the soundings of the Sowadah rocks be correct".

(Excerpts from Palgrave's *Narrative*, Vol. II, p. 342ff.).

Since Barakat was unwilling to continue to Omān, Palgrave's good friend, Aboo-'Eysa, sent with him Yoosef-ebn-Khamers, a young native of Hasa to whom he had been king and who was devoted to him. Before they set out for Omān, Palgrave entrusted all his notes and personal belongings not needed on the journey to Barakat, to be returned to him when he rejoined Barakat in Baghdad. So it was, that the seeds he had collected in Omān were lost forever, seventy or eighty fathoms deep off the Sowadah rocks. Thus did fate become the third factor in the story of "Palgrave's plant". On reaching Sohar, on the Gulf of Omān, Palgrave and Yoosef did not continue their journey on land, as they had planned. As Palgrave observes, "on the backgammon board of life, chance and circumstance decide no less than forethought and skill".

They continued by sea from Mascat instead —and ran into one of the fiercest of the storms for which the Gulf was famous. After the shipwreck near Seeb, the two walked barefoot to Matrah (on the coast, west of Mascat), where they presented themselves as "two shipwrecked individuals" and were given food and shelter. They proceeded by canoe to Mascat where a merchant from Hasa gave them not only food and shelter but also clothing of the kind worn in that region. There was an epidemic of fever (which Palgrave thought was typhoid) at Mascat, and when a sea-captain whom they met offered them free passage to Sohar, they decided to accept, and embarked on March 23, although Palgrave already felt ill. At Aboo-Shahr, he had to be carried on the shoulders of seamen to Aboo-'Eysa's house, where his welcome was all the warmer because he was thought to have perished in the shipwreck. He then travelled by river steamer, receiving medical attention on the way, to Baghdad, where Barakat awaited him, and now convalescent, was able to continue to Aleppo with Barakat. So concludes the story of Palgrave's year-long travels in Arabia in which fate played a decisive role.

Palgrave concludes his *Narrative:* "Much, how much, is left untold, reserved, I trust, for some more fortunate traveller than he who bids the reader a hearty "Farewell'."

Palgrave spoke truly; there remain questions unanswered. Why did he never find out more about the seeds of the coffee-hearth? He was on intimate terms with "Uncle and Aunt [William J.] Hooker" and their son Joseph Dalton Hooker, and visited them at Kew (Allan 1972, p. 151). Throughout his book, he mentions many (and describes some) plants, from herbs to trees. Surely he asked these two distinguished botanists about them. An approach to Kew (pers. comm.) elicited a suggestion that Palgrave's memory of the narcotic plant "was at fault" to account for his description of it. His omission of and failure to verify botanical observation is the more strange because in the interest of accuracy, he sent his manuscript to his brother Francis (who had published in 1861 his *Golden Treasury of the Best Song and Lyrical Poems in the English Language),* asking for a critical reading and possible corrections, and he went to Berlin to consult two prominent cartographers when he made a map of his travels.

Overall, Palgrave's attitude was that of the scientist. In his "Preface" he states that he will distinguish clearly between what is seen in person —what is inferred or conjecture— what is gathered at second hand. He explains that omissions and possible mistakes were due to his lack of "the customary requisites for verifying latitudes and longitudes or determination of heat and cold, of moisture and humidity". He adds that he was also handicapped by his disguise, which prevented his taking notes or making sketches in public. He naturally carried no photographic equipment.

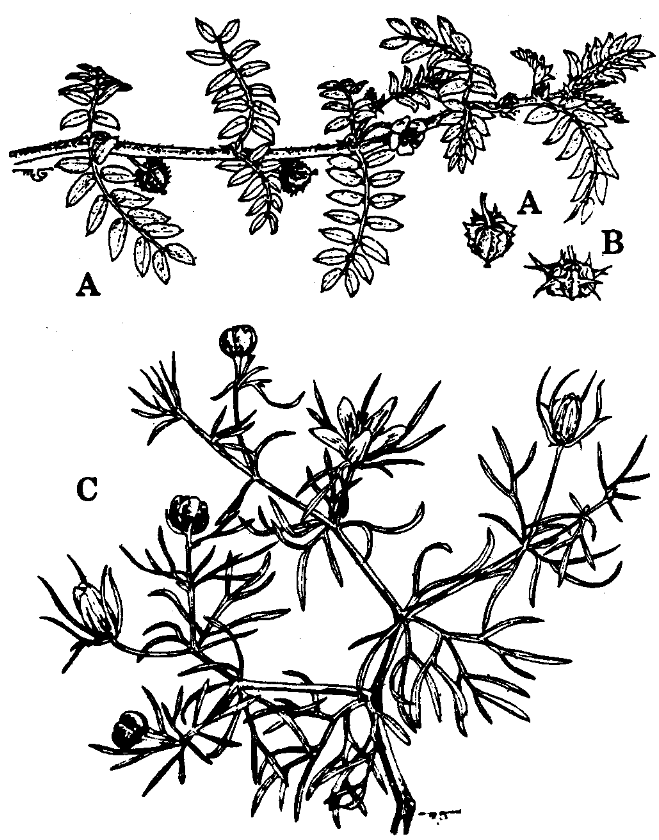
Perhaps the "not uncommon joke" of the surreptitious addition of a drug to coffee was not so general a joke as Palgrave thought. Accounts of the coffee-hearth and its etiquette in several studies of Arabian customs do not mention it. For example, two readings of Doughty's *Travels in Arabia Deserta,* in which he often mentions semi-ceremonial coffee-drinking as an almost universal custom between 1876 and 1878 in oasis settlements and cities, there is little reference to any "entertainment", aside from conversation or the recounting of experiences. In this classic among books on Arabia in the eighteen hundreds, Doughty does describe, as diversion, the exchanging of riddles. "The old man, Nejm", he writes, "propounded riddles...the Arabs...said theirs, and we guessed 'round; when the word fell to me, I set them the enigma of the Sphinx, saying that this was the most famous riddle in the world. When they could not unriddle [it] they were delighted with the homely interpretation. Twice again I have propounded my riddle..." (Vol. I, p. 237).

Perhaps it is forgivably in character to conclude these notes on facts, fables and fate with mention of riddles; actually, in sum, they add up to a riddle.

From a phytochemical evaluation of the confused and very limited account given by Palgrave, it appears that the psychoactive seeds to which he made reference must be referred to *Peganum Harmala* and not to *Papavar somniferum.* First: the part of the plant employed is reported to be "seed". The ripe seeds of *P. somniferum* contain no psychoactive principles and are commonly used in Western bakery products. Second: all of the sparse descriptions of the effects of these narcotic seeds used in the Orient agree with the effects of β-carboline alkaloids. The β-carboline alkaloids-harmine, harmaline and β-harmaline are known from *P. Harmala,* of the Zygophyllaceae (Hegnauer, 1973).

These same or related alkaloids are present also in the hallucinogenic drink known as ayahuasca, caapi, natema, pindé or yajé prepared for and used in the western Amazon as magico-religious adjuncts to aboriginal ceremonies (Schultes and Hofmann, 1980). This narcotic beverage is prepared from the malpighiaceous genus *Banisteriopsis,* a member of the *Malpighiaceae,* a family closest allied to the Zygophyllaceae. It is strange that peoples in opposite parts of the world would find different plants for psychoactive use which, although in different families and in plants of very different ecological situations, contain the same active principles.

Pl. 100 ZYGOPHYLLACEAE



A. Tribulus longipetalus B. Tribulus terrestris
C. Peganum harmala

Consequently, in view of the vague data presented in Palgrave's report and basing our evaluation on the available morphological and chemical information available, it is suggested that Palgrave's intoxicant was not the opium poppy but was *Peganum Harmala,* a plant common in the region and containing the chemical principles necessary to account for the activity described.

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BEHAVIORAL NOTES, BREEDING RECORDS, AND RANGE EXTENSIONS FOR COLOMBIAN BIRDS

By *Edwin O. Willis**

NEW COLOMBIAN BIRD RECORDS

Publication of a detailed field guide to Colombian birds (*Hilty & Brown* 1986; hereafter, *"HB"*) has stimulated me to publish certain ornithological notes from trips to that country in 1962, 1965, and 1966. I was mainly looking for ant-following species in forests, but took careful notes on many of the other species seen, checking them later in museums (American Museum of Natural History, New York; National Museum of Natural History, Washington; Museo de la Universidad de Bogotá; Museo de la Universidad del Valle).

Ten species were new for Colombia *(Neomorphus pucherani, Phlogophilus hemileucurus, Heliodoxa schreibersii, Lepidocolaptes albolineatus, Myrmotherula spodionota, Rhegmatorhina melanosticta, Pipreola chlorolepidota, Lipaugus subalaris, Elaenia strepera, Turdus lawrencei).* Others were in areas far from previous records, or at unrecorded elevations; and breeding information was obtained for 100 species in Colombia or nearby regions. The present report considers those species for which my notes may provide information useful in future Colombian field guides. Some other records cannot be included yet, usually because of uncertainty as to the species involved. Records included in *HB* have also been omitted, in general. I have not attempted to report on behavior or nests of Colombian species from locations distant from Colombia, as this would extend the length of the present report greatly.

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ITINERARY

In 1962, I arrived in Medellín on 19 February and left the same city on 23 June, having learned rudiments of Spanish and traveled well around Colombia under primitive conditions in the interim. On 20 February, I walked out to farmland in the afternoon. On 21 February, one of seven to a bench on an open-sided bus, I rode across the Bolembolo bridge on the Cauca, heard *Habia cristata* in a roadside ravine about 1300 m elevation on the mostly denuded western slope of the Andes above El Carmen when the bus broke down (*Willis* 1966 a), and was shocked by my first primitive hotel in Quibdó. On 22 February, I got a launch up the swollen Atrato River to a juvenile detention farm directed by Sr. Didimo Chitiva R. at Tanandó, observing some birds in a woodlot west across the river that afternoon and the next. Away from the natural river levee, mostly planted to bananas and other crops, there was only mud and second growth.

On 24 February, I got a crowded launch upriver to Yuto, a few houses on the west bank. I walked the road past swampy river woods and then forested hills 12-4 pm, before returning for the bus to Istmina on the Río San Juan. The next day, I got a outboard dugout downriver to the headquarters of the "Compañía Minera Chocó-Pacífico" at Andagoya, and 26 February a launch to El Tigre, their gold-dredge operation up the Río Tamaná between Nóvita and Juntas. Until 7 March, I walked the famous El Camino Real of Spanish days, still forested or in second growth. Moss growing over green leaves, rain even in the dry season, but mine-company luxury made the hilly rain forest easy to work, to some 500 m elevation on a ridge a few kilometers up river (near Quebrada La Piedra).

March 8 I flew from Andagoya to Cali and March 9 took the train up over the Western Andes to Bitaco, 9 km past La Cumbre and at 120 km from Buenaventura. My host, Mr. William Kyburz, kindly took me to secondary and logged-over ridgetop woods to nearly 2000 m off east, until 12 March. Finding no *Habia cristata,* I moved to Queremal on 13 March, taking a corduroyed trail through pastures up into mossy forest on the ridge to the west. The next day I took a bus to the Anchicayá dam, climbing to the top of a mossy wet forested ridge at perhaps 1000 m above. I tried the moss forest west of Queremal on 15 March, then a rotting suspension bridge to ravine forests at kilometer 49 below town, where I finally found *H. cristata* (16-29 March; see *Willis* 1966 a). Some days I circled to distant forest edges, up the Río Queremal to the base of the Farallones de Cali, to pastures and woodlots around town, and to 1250 m above La Elsa at Km 60 (also crossing the river at 660 m and up to 800 m in a woodlot). One bus trip to Cali, I obtained the necessary altimeter.

Dr. F. Carlos Lehmann V. now helped me, taking me 30 March to the family pheasant ranch at the forest edge up on the Farallones near San Antonio, about 1800 m, and to his collection at the Universidad del Valle, where finally I could identify some of the birds I had been naming things like "Flame-colored Warbler" (*Erythrothlypis salmoni*). On 31 March I took an afternoon bus trip to dry bush near Yumbo, on 1 April hiked to second-growth woods in pastures up to 2250 m at the tower atop the Western Andes (I got the bus back from Km 12 on the Buenaventura Road). Dr. Lehmann took me to the family farm near the Río Palacé at Popayán, dry second-growth in pastures, where I birded 3-6 pm on 4 April, and to Tijeras (Moscopán) 2400 m on 5 April. On 6 April I visited Finca Santa Teresa, clearings and forests at 2100 m in the river San Jorge just north; 7 April took the bus to the Chaparral and páramos of the Parque Nacional de Puracé, walking back down 10 km through forests to 2900 m, 3-6 pm; and 8 April returned to Tijeras and climbed to forest edges at 2600 m.

On 9 April I got buses across the Magdalena River and Eastern Andes to Florencia, and on 10 April flew to Tres Esquinas and stayed at the Colombian Air Force base at visitor rates until 22 April. The airport bushy scrub and clearings extended 2 km out into sandy and low woodlands, and huge clearings off south toward Puerto Solano further reduced my chances of finding army ants in forest. A visiting general took me up the Río Orteguaza to oxbow lakes, 21 April.

On 22 and 23 April I found ants in a little hilltop woodlot near Florencia, but the countryside was too cleared for ant-following birds. I grabbed a crowded bus and descended at a primitive inn at El Paraíso 700 m, up the Neiva road. Forest still remained on an incredibly steep ridge to 1150 m just east of the tiny village. The steep forest trail produced only one ant colony 24 to 27 April, when I gave up-even though it later turned out that several birds were new for Colombia or for the state of Caquetá, and that further study of these lower subtropical forests was needed.

On 27 April I birded briefly in the afternoon on dry plains and at a pond near Altamira, then spent 28 April in the second growth of the Parque Arqueológico of San Agustín. Via slow buses to Neiva, Bogotá, and Medellín and flight to Remédios, I worked tall forests and second growth a half-hour walk north of town 2 to 9 and 11 to 14 May. At Cali I had my first hot shower in six weeks, flew to Pasto and renewed my tourist card in Ipiales, with visits to local wheat and corn fields 16 May.

Via group-taxi to Pasto and a perilous bus trip off the Andes, I visited forests and clearings at the tiny town of Puerto Umbría 18 March to 2 June. Even with frequent rains and getting lost on forest traverses, the hill forests produced ant-following Amazonian species and the patchy woods along the Río Guineo other birds. Pouring rains and landslides blocked the bus overnight 3-4 June at 2450 m near San Francisco, forcing me to walk 5 kilometers to town the next morning with my 18 kg of baggage.

By plane from Pasto to Medellín and Caucasia, I started searches for *Habia gutturalis* west of the Cauca River. Woodlots, pastures, and marshes 7 June produced none, but patches at 700 to 900 m on the west side of the Cauca gorge at Puerto Valdivia had some 8 June. A downpour and raging gulches trapped me uphill without a flashlight, the local family were wary, and I finally had to find my way down the steep trail by lightning flashes. I checked dawn-songs of *H. gutturalis* in the drizzle the next morning, then took a bus to Puerto Bélgica and checked forests woodlots and pastures in the afternoon and on 10-11 June.

I went by bus through the cleared lowlands to Montería, by plane up the Sinú River to Tierralta, on foot 13-14 June on 3-hour dawn and eve walks across deforested plains to and from forests on northern spurs of the Sierra de Murrucucú (up to 700 m elevation). With the mixture of savanna and forest birds, I saw 160 species in a day, including a Harpy Eagle on a 500 m ridge, but was not able to locate ant-following birds. I took and outboard dugout upriver to Tucurá, where clearings went only a kilometer from town and there were army ants in tall forests 16-18 June. Back by dugout to Tierralta, I checked patches of second-growth 19 June morning, and finally got a plane to Montería and a bus that arrived 9 hours late to Caucasia on 20 June. I collected hybrid *Manacus* and watched marsh and woodlot birds 21 June, took a bus to Medellín on 22 June, and left the next day.

In 1965, I tried again to locate possible sympatry of *Habia gutturalis* and *H. fuscicauda* in the smoke and fires of land clearing in northwestern

Colombia, now with *Meyer de Schauensee* (1964) in hand. From Medellín, I flew to Turbo, took an open-sided bus to Apartadó, and checked forests into slopes back of the pastures of Hacienda Chinito 8-9 March. I checked forests back of Chigorodó on 10 March, and beaches and mangroves at Turbo later that day and early on 11 March. I flew to San Pedro on the Río San Juan, where the clearings and dry forest had ants but no anttanagers, 11-16 March (with a visit to Finca Las Mendozas off a few km N on 15 March, as guest of Dr. J. Berrocal). A dusty standee bus trip to Tierralta and flight to Tucurá showed that forests had been destroyed in both areas.

I started a long walk upriver, to the farm of Sr. Jesús Ortiz at the mouth of the Río Verde (Mr. Gordon Horton, missionary at Tierralta, had kindly given me letters of introduction to church members up the river). The forests were patchy and smoke filled the air from new clearings everywhere, despite screeches of macaws. I was rafted across the Río Verde at Caño Fino, and soon forded the river to the farm of Sr. Jesús Flores, just above Caño Remolina and across from Caño Jarupiá. I visited forests and clearings at both on 21-23 March, then recrossed the river and took the trail upstream, past a few forested low ridges ("Las Pulgas") and many clearings, past the playa and little Spanish and Indian hamlet of Chocó, to the town of Saisa at the Quebradas Saisa and Saisita. On 24 March I Hiked up. Q. Saisita, over a 750 m ridge in forests and clearings to Q. Nutria, and returned to town. At 4:30 I started up Q. Saisa and by flashlight got a justifiably suspicious family to let me sling my hammock with them where the trail turns across the Filo de Abibe. On 25 March I walked up to wet forests at 700 m on the Pacific slope of the Filo, and down to 500 m in the upper Río Carepa drainage. I returned to Q. Saisa at 370 m, and turned southwest to the house of Sr. Ramón Gutiérrez at 525 m, visiting pastures and forests up to 1000 m elevation on the steep wall of the Serranía de Abibe, 25-26 March. The next day I walked down Q. Saisa and the Rio Verde. At Las Pulgas, just above Q. Filito, I finally found *H. gutturalis,* so birded 4:30-8:00 on 28 March, then walked down past Q. Remolina and the mouth of the Rio Verde to Tucurá by 5:45 pm. I visited Queremal briefly, 2 April morning, to collect plants.

In 1966, I visited forest off Calle Séptima at Leticia 8-10 January, staying with Mr. Mike Tsalickis. On 24 April I hired a jeep from Manizales to snow line on the Nevado del Ruiz. I also visited paramo at 3680 m and a patch of woods at 2600 m. On 25 April, Dr. Lehmann arranged a guide for me on a walk up the Río Pichindé at La Margarita 1800 m, in woodlots below the Farallones de Cali; and we walked back down to Cali through open country. On 26 April I drove the Museum carryall to the Anchicayá dam, walking up the Río Blanco from 500 m to 1250 m on a ridge, and found several *Habia cristata.* On 27 April Dr. Lehmann and I checked birds at Cerro La Horqueta, the tower above San Antonio, and at nearby Mares. With visits to Jürgen and Maria Haffer and Padre A. Olivares at the National University in Bogotá, (Instituto de Ciencias Naturales), I flew to Mitú and worked forests, clearings, airport, and even the cerro 28 April-12 May.

RESULTS

Tinamus guttatus – At Mitú and in Brazil, the usual song is a long whistle followed by a shorter one, without the additional notes recorded by *Meyer de Schauensee & Phelps* (1978).

Crypturellus variegatus – Singing at Tres Esquinas, Puerto Umbría, and Leticia, so occurs widely in the eastern lowlands.

Crypturellus (erythropus) columbianus – Songs of red-legged birds attracted by my imitations, in fairly dry forests 5 km N San Pedro and at Boca del Río Verde, were two long whistles (long "u" sound) as in British Honduras. Possibly *C. boucardi* and *C. kerriae* are conspecific with *C. erythropus,* and this related to *C. noctivagus* and allies.

Botaurus pinnatus. – One flushed from a tiny marsh by the airport at Tres Esquinas, Caquetá, with a deep "kwog" alarm call, 22 April; perhaps was a migrant.

Tigrisoma fasciatum – One at Quebrada Saisa 300 m, east of the Serranía de Abibe, on 27 March.

Bubulcus ibis – Common at Limoncocha and Mera, E. Ecuador, in 1965, and probably occurs along the Andes in Putumayo.

Theristicus caudatus – Recorded in the Sinú Valley at Tierralta and Montería, and in the lower Cauca Valley at Caucasia.

Dendrocygna viduata – Recorded at Tierra alta and Caucasia.

Sarcoramphus papa – Recorded at El Tigre.

Coragyps atratus – Absent at Mitú in 1966, and perhaps colonized the area later if the map in *HB* is correct in indicating that the species occurs there.

Elanoides forficatus – Large wheeling flocks passed Mitú, northbound, 28 April.

Ictinia plumbea – Two building nest 20 m in tree over trail to river, Limoncocha (Ecuador), 8 November 1965.

Elanus leucurus – Recorded at Tierralta in 1962 and 1965.

Accipiter superciliosus – Attacked small birds of a treetop *Tangara* flock at Puerto Umbría, hence occurs in Putumayo.

Leucopternis albicollis – Recorded at Mitú and Puerto Umbría.

Leucopternis princeps – Soaring at 650 m over the west slope of the pass, Filo de Abibe.

Buteogallus anthracinus – On nest atop mangroves near Turbo, 11 March.

Buteo platypterus – Migrating along Serranía de Abibe, 25 and 26 March.

Buteo albonotatus – Recorded at Puerto Bélgica, lower Cauca River, in a publication cited by *HB* (*Willis* 1963) and on upper Quebrada Saisa, north end of northern Andes, in a work not cited (*Willis*, 1966 b). Carrying lizard on Sinú River, Tierralta, 29 March.

Harpia harpyja – One glided from one forested 500 m ridge to another, 3 hours walk south of Tierralta, 13 June.

Spizaetus tyrannus–Recorded at Puerto Umbría as well as Leticia.

Micrastur ruficollis – Reported on the ground and at army ant swarms by *Willis, Wechsler & Stiles* (1983). Attacked small birds of forest flock at Tijeras (river valley) 2150 m.

Herpetotheres cachinnans – Recorded at Mitú.

Falco rufigularis – Nest at 5 km N San Pedro, 15 March; male fed female a small bird.

Falco peregrinus – Hunting small shorebirds at Tres Esquinas airport, 20 April.

Ortalis guttata – At Remedios, I saw this species well (not *O. garrulla*) in 1962.

Penelope jacquacu – Noted following army ants at Mitú (*Willis* 1983 a), and half-sized young birds with two adults there on 6 and 8 May.

Crax alector – Recorded at Mitú; orange-yellow base of bill.

Laterallus exilis – In grassy marsh of pastures at Queremal, repeatedly flushed trio; dusky one probably a young bird. Alarm calls a "check" and a blackbirdlike "pseeer" once when prevented trio from their regular evening crossing to an agave hedge row.

Laterallus albigularis – At edge of farm pond, Altamira.

Pardirallus nigricans – Tiny black chick with adult at grassy marsh in pastures, 1750 m above Queremal, 13 March.

Gallinula chloropus – Map 201 in *HB* does not indicate upper Magdalena valley as part of range, but text p. 144 seems to do so; I saw them at Espinal, Tolima.

Jacana jacana – Two tiny downy chicks with adult at Caucásia, 21 June.

Vanellus chilensis – Four eggs in nest in pasture at Queremal, 29 March; four birds present, attacking me and (once) a passing dog.

Tringa solitaria – Mitú airport, 7 May.

Calidris fuscicollis – Rain pools at Mitú airport, 29 April.

Tryngites subruficollis – Mitú airport, 28 April - 3 May; maximum of 4 on 29 April.

Burhinus bistriatus – Recorded at Tierralta.

Sterna hirundo – Flying up Sinú above Tierralta, 29 March.

Columba cayennensis – Flock at ranch near Popayán, Cauca, in area not on map 210 in *HB*.

Columbina talpacoti – Occurs on Pacific slope in Dagua valley and westward: Bitaco, Yuto. Not at Puerto Umbría in 1962, nor at eastern Ecuadorian localities in 1965.

Geotrygon saphirina – Recorded Benjamin Constant, western Brazil, 17 April 1966, where behavior and song similar to birds west of Andes. The species has not been recorded previously in Brazil (*Pinto* 1978), and I do not know the basis for the record in *HB* (p. 196).

Geotrygon montana – Nests at Mitú, 1.0 and 0.4 m up, with 2 eggs each 4 May and 10-11 May.

Zenaida macroura – Two long-tailed birds flushed on dusty plains between Tierralta and Monteria, near Sinú River, 30 March.

Ara macao – West to San Pedro and Tierralta, semiopen regions north of Western Andes, where *A. chloroptera* mainly in forests.

Aratinga wagleri and *A. leucophthalmus* – Both give, in addition to grating notes, a cackling *ca-ca-ca-ca-ca-cack;* the two may be conspecific, with *A. l. "nicefori"* as a hybrid.

Crotophaga sulcirostris – Recorded at Tierralta and Caucasia, in open country.

Neomorphus geoffroyi – I saw adults with young in Ecuador, not in Brazil as indicated by *HB* (*Willis* 1982). On the east slope of the Andes in west Caquetá, my record above Paraíso (in *Haffer* 1977) was at 1100 m, above the elevations given by *HB.* As noted in *Willis* 1982, my record (in *Haffer* 1977) for Puerto Umbría actually was of the following species. It is likely that *N. geoffroyi* occurs on the slopes of the Andes in W Putumayo, as indicated by *HB,* but its presence should be confirmed.

Neomorphus pucherani – The only species recorded at Puerto Umbria (*Willis* 1982) and likely to occur widely north of the Río Napo in the lowlands.

Otus guatemalae – Song known from Panamá heard at 600 m, east base Serranía de Abibe (Quebrada Nútria).

Lophostrix cristata – Song known from Panamá heard at 600 m on the Serranía, above elevations recorded in *HB.*

Lurocalis semitorquatus – Three at Quebrada Saisita junction with Q. Saisa, 23 March.

Nyctiphrynus ocellatus – Often forages on the wing, at midlevels of semiopen parts of the forest, in southern Brazil. Flushed off two white eggs in forest at Quebrada Remolina on 23 March (small, dark bird with white terminal halves outer tail feathers), the eggs being similar to those recorded in Perú (*Koepcke*, 1972) and southern Brazil.

Caprimulgus nigrescens – Song like that of Perú heard on trail through high second growth at El Tigre, Chocó; possibly is song of the little-known *C. sericocaudatus? C. nigrescens* has a completely different song. A pair of smallish birds answering descriptions of *C. sericocaudatus* flushed in saplings of dry woodland at Tres Esquinas, suggesting high second growth and low woodland for habitat (pinkish bib, tail projecting with short white tip, base barred rufous and dark, wings without white).

Chaetura chapmani – Evidently this species, Tres Esquinas, in April.

Chaetura brachyura – Recorded Remedios, Puerto Bélgica to Caucásia, Tierralta to 350 m on Quebrada Saisa, San Pedro and Turbo in northern Colombia; also Nóvita in the west.

Chaetura spinicauda – Recorded at Mitú.

Panyptila cayennensis – Recorded El Tigre and at Mitú (reported to nest on water tower), Tres Esquinas, and Puerto Umbría.

Phaethornis syrmatophorus – April 24 one poked bill down into open gape of young to feed it, in ravine forests at 800 m above Paraíso The young called *seeeee* and waggled its tail back and forth as it waited for another feeding. Leks at 500 m, second growth just below junction Q. Saisita and Q. Nutria, and at 550 m on slopes above Q. Saisita. (*P. superciliosus* recorded on Q. Saisa just below).

Phaethornis ruber – Song at Puerto Umbria a simple *"stee"* repeated over and over.

Phaethornis longuemareus – To 1400 m at Queremal. Nest at Mitú 1.5 m under tip palm leaflet, one young of two young fleeing, 7 May.

Florisuga mellivora – Female in dull plumage fed a white-bellied but dark-chested young with short white tail, and buff down on throat, upper breast, and sides of neck, at Zatzayacu 500 m, Ecuador, 28 October 1965.

Campylopterus largipennis – Alarm note a sharp *"chip"*, call when feeding a fine *"seees"*.

Colibri delphinae – Hovering at edge tall second-growth, ranch at Popayán.

Anthracothorax nigricollis – Nest 7 m in bare tree between airport and river, Tres Esquinas; female usually on nest 11 April onward.

Chlorestes notatus – Male in second at river edger, Puerto Umbría; rounded blue tail noted.

Amazilia tzacatl – Incubating 2 eggs in nest on bare dead *lecropia*, clearing by river at Tucurá, 17 June. On 25 March shortbilled young attended by parent in bushy pasture, 400 m on Quebrada Saisa.

Phlogophilus hemileucurus – Common in forest understory at Paraíso 700 - 1100 m.

Polyplancta aurescens – Bathing in forest pool at Tres Esquinas.

Heliodoxa schreibersii – Males in forest understory at Mitú, 1 and 9 May. Curious, call a *"tsk, see-see-see"* when departing.

Eriocnemis alinae – At 1100 m, Mera, E Ecuador, on 10 November 1965, hence occurs at low elevations.

Acestrura sp. – Immature male, at orange tree edge forest at Queremal, resembled a specimen of *A. berlepschi* in American Museum, having a pied head (dark streak over eyes; dark malar stripe becoming a collar around white throat; white line below eyes becoming a breast band below the dark collar), green across belly and above, white undertail carrying up to sides rump and rufous tail tipped blackish, pale at corners. Identification of Andean woodstars remains problematical; perhaps the Queremal bird was *Philodice mitchellii* if it has this plumage.

Pharomachrus auriceps – Female flushed from big hole in dead tree, edge meadow in mossy forest above Queremal, 13 March. Male flew from nearby tree on forest edge.

Trogon viridis – The accelerating song occurs west of the Andes (*Willis & Eisenmann* 1979), and the nonaccelerating song in *T. v. viridis* east of the Andes.

Trogon melanurus – Nest being built in termitarium at San Pedro, 12 March.

Trogon curucui – Male sang and flew to hole in termite nest 8 m up on spiny palm at edge of second growth near river at Puerto Umbría, May 24.

Trogon rufus – Recorded at Mitú.

Trogon collaris – In swamp forest at Tres Esquinas (pair seen well) and in Central America, the song is a leisurely *"kwo kwo kwo"* as in *Trogon rufus*.

Trogon personatus – At Paraíso 1000 m, the song (*T. personatus* colored male) was a long and rapid series as in *T. curucui* or as *HB* describe for *T. collaris*. It seems possible that two species are involved in *"T. collaris"*, or that songs decribed in *HB* are reversed for *T. personatus* and *T. collaris*.

Momotus momota – Adult called near half-tailed fledgling, which fled, at Tres Esquinas, April 12.

Galbula ruficauda – Excavating nest burrow February 28 at El Tigre.

Galbula leucogastra – Song at Zatzayacu, E Ecuador, *"whit-eeeeet"* four times after a few rough notes.

Galbula dea – Groups of 3 to 10 recorded, including Mitú.

Notharchus macrorhynchus – Recorded Mitú.

Malacoptila fulvogularis – *Willis* (1982 b) recorded one following army ants at Paraíso 1100 m.

Malacoptila panamensis – Male of pair digging nest hole at El Tigre, February 28 (4:27 p.m.).

Capito maculicoronatus – Nests recorded in upper Sinú valley.

Eubucco bourcierii – Song a rapid, hollow *Otus*-like trill; rough *"skaaj"* notes in disputes. Recorded at Paraíso.

Eubucco richardsoni – Recorded at Mitú.

Capito niger – Note in alarm a sharp *"few"* whistle, given every 1.2 seconds (Mera, E Ecuador).

C. n. brunneipectus, between the Madeira and Tapajóz rivers in Brazil, has a rapid, hollow trill and may be a separate species.

Aulacorhynchus haematopygius – At Paraíso, song at 2 notes per second a bit different in tone, *"whimp, whimp".* Gave rough *"kra'a'aagh"* when flushed, and jerked tail up with each flip of body through 90°.

Pteroglossus inscriptus – Facial skin recorded as green, not blue, both in Colombia and Brazil (Carauarí, río Juruá).

Pteroglossus castanotis – Facial skin recorded as green at Puerto Umbría.

Ramphastos citreolaemus – A few seen among many *R. sulphuratus* at San Pedro.

Picumnus pumilus – Recorded at Tres Esquinas as well as Mitú.

Piculus rubiginosus – Male called *"wih wih wih wih wih wih wih"* at La Margarita 1680 m, and female pecked at other female-plumaged birds, seemingly grown young, 25 April.

Celeus loricatus – Nest registered at San Pedro.

Dryocopus lineatus – Nest registered at Q. Nutria.

Melanerpes cruentatus – Feeding noisy young 18 May at Puerto Umbría, in hole 9 m in NE side of 20 m snag of banana plantation in forest.

Veniliornis affinis – Recorded at Mitú. Excavating nest hole 14 m in E side of live tree at Tres Esquinas, 13 April.

Campephilus melanoleucos – Nest cavity generally lower than that of *Dryocopus lineatus* (*Kilham* 1972). On 6 April, visiting hole 15 m on S side of 25 m snag, scattered trees in forest pasture at Tijeras 2150 m. On 10 April, one replaced mate in hole 15 m in 16 m palm stub in forest clearing at Tres Esquinas.

Campephilus haematogaster – At times in trios, low in forest on small trunks, at El Tigre and Queremal 1400 m. Calls include a "pstink" or "psteink", also a short rattle "stit-it-ik".

Dendrocincla tyrannina – Museum specimens indicate some low elevations on Pacific slope - Ricaurte Nariño 1200 m (Los Angeles County Museum), from 730 m elevation for El Tambo, Munchique (Philadelphia Academy of Natural Sciences).

Dendrocincla fuliginosa – Specimens exist for the Guajira (El Bosque, Conejo, Tierra Nueva) and for the upper Magdalena Valley (Pital). Nest at Tres Esquinas, 20 April, 4 m in NW hole near top of stub in recent forest clearing; feeding young (see *Willis,* 1972 a).

Dendrocincla merula – *Willis* (1979) reports on behavior at Leticia, Mitú, and other areas: call is a short rattle, *"tat-at-at"* and song is a music-box, repeated ascending *"wi-wid-wid-di, wi-wid-wid-di".*

Dendrocincla homochroa – *Willis* (1983 b) reports on behavior, including a squeaky sharp "peach" for alarm call.

Deconychura longicauda – Occasional at Tres Esquinas as well as Mitú, mostly 5-15 m up as in rest of Amazonia. The song is a descending series of mournful quavering whistles, head ruffed and retracted with bill to trunk *"cheeeeh, cheeeeh, cherr, cheur, chur, chuh".* Hurries up trunks, pecking or sallying for flushed prey rather than probing.

Deconychura stictolaema – In Brazil south of the Amazon, alarm a *"sip! sip-ip-ip".* Song a rising trill or rattle. In Amazonia, follows flocks and climbs forest trunks rapidly, usually 1-10 m up. Young following one adult at Carauarí, Brazil, 21 March 1966. See *Willis* 1983 c.

Glyphorynchus spirurus – Nest 0.6 m in cavity of palm stub at Tanandó, 23 February, held two white eggs.

Dendrexetastes rufigula – Normal song in Brazil is a descending trill ending in a *Thamnophilus* – like "gounge".

Xiphocolaptes promeropirhynchus – Probing in arboreal termite nest and following army ants at Remedios (see *Willis,* 1983 c).

Dendrocolaptes certhia – Song east of Andes is a descending whinny, slower than that of *D. picumnus.* The alarm call is a rough two-note *"chah-eef",* somewhat different on the two sides of the Andes. Possibly trans-Andean birds are a separate species,

D. sanctithomae – Feeding grown young out of nest at Tucurá, 16 June. A white 30 x 24 mm egg was collected by *G. K. Cherrie* on the Orinoco *(L. F. Kiff, in litt).*

Dendrocolaptes picumnus – See *Willis* (1982 c) for behavior. Recorded at Mitú as well as Leticia.

Hylexetastes stresemanni – See *Willis* (1982 d) for record following army ants at Benjamin Constant, Brazil.

Xiphorhynchus picus – Song south of the Amazon is a descending trill introduced by a *"chip"* and ending in one to several "hew" notes. It is common for young woodcreepers to have darker bills than do adults (esp. *Hylexetastes, Dendrocolaptes*), and I saw a dark-billed *X. picus* with a pale-billed one at Coatá, Brazil, 2 April 1966, the dark-billed bird gave a weak song, and one of the two gave a normal song. Field workers should be alert for different bill colors of young in this group of birds, and be careful with field identifications.

Xiphorhynchus obsoletus – See *Willis* (1983 c). The call in várzeas south of the eastern Amazon in Brazil is a hummingbirdlike *"sip"* or *"si-si-sip"*, the song a rising trill ending in a sharp *"peep!"*. Birds in river-edge woods at Tres Esquinas and Puerto Umbría had the reverse song, a sharp peep followed by a trill.

Xiphorhynchus guttatus – Voice east of Andes different, as noted by *Willis* (1983 c), who tentatively considers forms from Trinidad to Guatemala *X. susurrans*. *HB* describe voice of the latter; true *X. guttatus* has a loud descending *"fee-a-wip, fee-a-wip, wip-wip"*, a *"feeyou"* call somewhat like *X. susurrans*, and a long descending song: *"te-e-e-e-e-e-e-e-e, quirt-quirt-quirt-quirt"*. *X. susurrans* registered at Tanandó, south of range in *HB* (map 644).

Xiphorhynchus lachrymosus – See *Willis* (1983 d) for quantification of tendencies to stay on lower sides of limbs.

Lepidocolaptes affinis – Song high-pitched whistles, descending, *"syeeeee, syee-syee-syee"*, at Queremal.

Lepidocolaptes albolineatus – Registered in treetops at Mitú, 6 May, apparently the first Colombian record. Usually in forest mixed flocks, and very hard to detect because stays well above ground.

Campylorhamphus sp. – In forest flocks at Tres Esquinas.

Synallaxis albigularis – Song and habitat is the same as in *S. spixi* of southeastern Brazil. Perhaps they are conspecific.

Synallaxis brachyura – Song and habitat rather similar to Brazilian *S: hypospodia*, perhaps conspecific.

Synallaxis albescens – Text *HB* (p. 358) indicates does not occur on west slope of western Andes, but map 662 indicates otherwise. At any rate, I recorded it at Bitaco and Queremal.

Synallaxis gujanensis – Heard at Mitú.

Synallaxis azarae – Building stick nest 2 m in thorny bush 3000 m above Vozandes in Quito (Ecuador), 8 December 1965.

Cranioleuca erythrops – Pair building nest 10 m up above Bitaco, 11 March.

Premnornis guttuligera – At times, spreads rufous tail like a redstart.

Ancistrops strigilatus – Recorded Mitú as well as Leticia, Tres Esquinas, and Puerto Umbría. Song very fast long rattle, rising un pitch. Usually with grown young one or two begging (short rattles, *"d'r'r'reee")* after adults at Tres Esquinas and Puerto Umbría, in April and May.

Syndactyla subalaris – Song accelerates (as well as the notes of the song?) Call a buzzy *"chreah"* or *"scaicait"*

Anabacerthia striaticollis – Song accelerates towards end.

Philydor fuscipennis – Not at all like *P. pyrrhodes* in behavior. Common 5-15 m up in forest flocks at Paraíso 700-1100 m and Mera 1100 m, E Ecuador, hence occurs on east slope eastern Andes. Often in "family" groups. Resembles *P. ruficaudatus* in ecology, perhaps is subspecies or superspecies with it.

Philydor pyrrhodes – Loud *"tat-tat-tat"* alarm call in Ecuador and Brazil, flicking wings violently. In Ecuador, rising low buzz or trill for song. Usually singly, not in groups, though follows mixed flocks.

Philydor erythropterus – Song on Tapajoz River, Brazil highpitched song *"Stet stees STEES STEES stees"*, louder in center. Prefers canopy.

Automolus infuscatus – Call and song like *A. leucophthalmus* of south eastern Brazil; possible superspecies or subspecies relationship.

Automolus ochrolaemus – Alarm note at Remédios a nasal *"chraaj"*.

Automolus dorsalis – Call a *"chowk"* or *"chowk-chowk"* at Puerto Umbría.

Automolus rubiginosus – Above Anchicayá, jerked tail upward and gave *"chuc-uc"* in alarm.

Automolus rufipileatus – Alarm call a rough "chough" grunt in eastern Ecuador.

Thripadectes ignobilis – Call at El Tigre a nasal rattling "crrank". I recorded a narrow bare eyering.

Xenops milleri – Recorded Tres Esquinas and Mitú, where one young followed adult May 4.

Xenops rutilans – Excavating cavity 10 m up in rotten stub at 1400 m, Queremal, 20 March.

Sclerurus mexicanus – Recorded Paraíso 900 m.

Sclerurus rufigularis – At Mitú, call a sharp "peesk" and evening song an alternating *"stik eeer eeer eeer eeer eeer stik! stik stik (stik stik) eeer eeer eer eer eer eer!"*, both descending.

Sclerurus caudacutus – Alarm note at Manaus, Brazil is like call of *Dendrocincla fuliginosa*, hence slightly different from that of other leaftossers.

Lochmias nematura – Alarm in Brazil and gorge at 750 m on east face Serranía de Abibe, a triple note: *"di-di-dit"*. Song in Brazil a long piercing trill, and series of high-pitched trills reported by *T. Parker* in *HB* may have been *Premnoplex brunnescens* or an unusually excited *L. nematura*.

Cymbilaimus lineatus Alarm calls also descending *"wheww"* whistle, sharp single or double chips, and a rattle *"a'a'a'a'a'a'a"*.

Frederickena unduligera – Twitches tail from side to side. Alarm a loud *"chakeeeer"* or nasal *"charrrr"* chirr.

Thamnophilus nigriceps – Jerk tail upward now and then when slightly alarmed. Eye reddish.

Thamnophilus aethiops – Jerk or raise tail to line of body now and then. Often perch on vertical saplings.

Thamnophilus unicolor – Tail movement as in preceding two species. Calls include a "cow" and "*cow, rrrrt*".

Thamnophilus punctatus – Amazonian birds have different songs, calls, and behavior: song an accelerating and rising "*kop, kop, kop, kop-op-op-opopopop*" with no terminal whine; calls nasal grunts or rattles; quivers tail up and down persisteltly. In *Clusia* thickets on rocky cerro at Mitú (blackish race).

Thamnophilus atrinuchus – Nest and two eggs at Remédios, May 6, soon robbed.

Megastictus margaritatus – Rattle in Brazil at Mitú a long "*de'e'e'e'e'e'e'e'* " like a *Myrmeciza.*

Raises and lowers tail, commonly twice in "M" fashion, somewhat like *T. punctatus.*

Pygiptila stellaris – Another tail-quivering species. Alarm notes loud "thick" and high-pitched "eeeer" whistles.

Clytoctantes alixi – Low in rank low second growth on east slope Serranía de Abibe, just W of Quebrada Saisa, female gave "*ke'e'e'ew*" chirrs vaguely like Ocellated Antbird, then pecked a strand of dead stem and ripped it outward with a sharp upward movement of the bill. She peered briefly in each gash, probably for insects, and then flew to a new stalk to repeat the process.

Thamnistes anabatinus –Recorded Paraíso 900 m.

Myrmotherula hauxwelli – Alarm note a "tchig" rather like *Geothlypis trichas,* or a brief chirr like *Hylophylax naevioides.* Nest a small thin cup between two upright twigs, 0.2 m from ground, with two brownish-streaked eggs 30 October 1965 at Limoncocha (Ecuador).

Myrmotherula spodionota – Common at Paraíso 700-1100 m (see *Willis* 1984 a) where alarm rattle like that of *M. haematonota.* At Zatzayacu, E Ecuador, on ridges at 900 m while *M. erythrura* at 700 m and in valleys.

Myrmotherula haematonota – At Andoas, NE Perú, occurs with *M. erythrura* in upland forests but tends to forage closer to the ground, to 5 m up, while *erythrura* forages higher. *M. ornata* is more in floodplain forests and cluttered tall second growth there. All these and *M. spodionota* check dead leaves or piles of leaves above ground.

Myrmotherula axillaris – Recorded at Leticia.

Myrmotherula behni? – At Mera 1100 m E Ecuador, well south of range in *HB,* no wingspots evident on black-bibbed male. Possibly *M. sunensis,* which would then be an upland species.

Myrmotherula longipennis – Alarm call a "*beer bin bin*" in many regions, including Mitú (locality not on map 768 in *HB,* though correctly cited to be fairly common there, p. 394).

Dichrozona cincta – Alarm call a short rattle, "*di'i'i'i*". Cup nest at Putuimi, E Ecuador 0.1 m in fork low bush in forest, two tiny bob-tailed young hopping out 27 November 1965.

Herpsilochmus sticturus – Male in treetop at Leticia, probably form *H. s. dugandi* (also seen at Andoas, NE Perú, where a treetop bird of upland forests).

Terenura callinota – Jerks tail upward rather frequently.

Terenura spodioptila – High-pitched *see-see-see* call not registered by *Willis* 1977, although does have this call.

Cercomacra tyrannina – 1 m suspended in fork, female off two whitish eggs with a few spots, 11 May at Mitú.

Myrmoborus myotherinus – One call is a chirring rattle. Members of this genus pound tails downward and otherwise resemble *Myrmeciza;* probably the two genera should be joined.

Hypocnemis cantator – One alarm call a buzzy chirr.

Hypocnemis hypoxantha – Jerks tail upward like *Gymnopithys,* and has a chirr like one. Additional song is a descending "*heep heep hip hip woop woop woop*". Nest at Mitú with young, 3-4 May, an irregular cup suspended by mossy strands 2.5 m up between petioles of parallel bifif epiphyte leaves.

Percnostola rufifrons – See *Willis* (1982 e) for nest and behavior. Probably related to *Gymnocichla,* and like it might be joined to *Myrmeciza* (see *Willis* 1984 b).

Percnostola schistacea – Rattle and "*tchick-ick*" alarm much as in *P. leucostigma,* birds along forest creek at Benjamin Constant, Brazil. Flicks tail upward like *P. leucostigma.*

Sclateria naevia – Female seen at Mitú.

Myrmeciza longipes – Serranía south of Tierralta, also San Pedro and Boca del Río Verde.

Myrmeciza laemosticta – One off thin cup nest, two whitish eggs spotted cinnamon at large end, low in *Piper* sprout on steep gorge at 800 m over left fork Q. Saisa, east face Serranía de Abibe, 26 March.

Myrmeciza hemimelaena – Wags tail side to side like a *Formicivora,* which it resembles greatly.

Myrmeciza fortis – See *Willis* (1984 b) for army ant records and behavior.

Myrmeciza immaculata – Recorded at north end Western Andes at Tucurá and at 1000 m on W side Serranía de Abibe.

Myrmeciza atrothorax – Likely to be close relative of "*Percnostola*" *leucostigma,* judging by color and tail-flicking behavior.

Pithys albifrons – Behavior in *Willis* (1981).

Phlegopsis erythroptera – Behavior in *Willis* (1984 c).

Phaenostictus mcleannani – Not likely to cross Cauca as in Map 818, *HB:* I have not seen the Puerto

Valdivia specimen, nor do I know of records east of Tucurá on the Sinú (pers. obs).

Gymnopithys leucaspis – One heavily purple – streaked egg 20 November 1965, two on 23 November, 0.3 m in hollow top 0.4 m stub in forest at Yaapi (Ecuador).

Hylophylax poecilinota – Apparently the correct spelling, according to *E. Eisenmann (in litt.)*. See *Willis* (1982 f) for behavior.

Hylophylax naevia – To 1100 m at Mera, E Ecuador, and probably to similar elevations in Colombia.

Chamaeza campanisona – Recorded at Paraíso 900 m.

Chamaeza nobilis – Recorded Tres Esquinas as well as Puerto Umbría and Mitú.

Formicarius colma – Alarm call a sharp *"kleek"*, uttered near short-tailed fledgling 31 May at Puerto Umbría. Nest cup and two white eggs in hollow stub, Bahia, Brazil.

Myrmornis torquata – Flicks tail upward and has *"chirr"* like *Phaenostictus* and *Hylophylax*, to which closer related than to antpittas or antthrushes.

Pittasoma rufopileatum – Follows army ants (*Willis* 1985).

Grallaria dignissima – Song a low tinamoulike, whistled *"go, joe"*, and alarm note a *"ruzz ruzz ruzz ruzz"* in northeastern Perú. Same song heard at Benjamin Constant in April, 1966 (across Amazon from Leticia) may have been this or *G. eludens*, latter possibly subspecies.

Hylopezus fulviventris – Alarm a rapid hollow roll with introductory high note *("e-o-o-o-o-o-o-oh")*.

Conopophaga castaneiceps – Paraíso 900-1100 m.

Liosceles thoracicus – Calls "sput" and also *"deek-deek"*, jerking tail upward in alarm.

Manacus manacus – Caucasia records by *Willis* (in *Haffer* 1967).

Machaeropterus regulus – Cup nest under overhanging leaf, in forklet 0.5 m up, two speckled eggs, at Remédios 5 May.

Sapayoa aenigma – Resembles voice of western form of *Pipra coronata*, being a semimusical trill alternating with *"pchuck"* double-grunts.

Pipreola riefferii – Copulation, two birds in female plumage 10 March above Bitaco; rattle during process, "female" hanging head down afterward.

Pipreola chlorolepidota – Paraíso 900 m, 5-10 m up in understory with mixed flocks. High-pitched "stiek" call. In Ecuador, also in canopy and subcanopy, down to 350 m at base mountains.

Iodopleura isabellae – Chases two pairs at Puerto Umbría

Lipaugus subalaris – Upper understory at Paraíso 900 m, uttering "peep" like baby chick as spread and lowered tail to show pale outer rectrices now and then. Peering about like other pihas. Seen at 800 m above Zatzayacu, E Ecuador, possibly author of loud double whistle *"peereet"*.

Lipaugus sp. – Birds looking like *L. unirufus* at north end Western Andes have different calls from normal forms (heard at Apartadó just southwest). The usual call is a loud taxi-calling *"whee-you-wheet"*, alternating with a single *"pertee"* or *"cherp"* with rising inflection. At times a group gest started in loud rolling *"ra'a'a'a'a'a'a'a"* or *"poor' r'r'r'rai"* and other calls, such as "peesherwee, sherereet" at Tucurá when form first noted in 1962. Common San Pedro, and on Río Verde up to 900 m on east side Serranía de Abibe. I did not record either form at Remedios, unfortunately.

Pachyramphus cinnamomeus – Pair building nest 28 February at El Tigre.

Pachyramphus marginatus – In bird flock at Mitú.

Platypsaris homochrous – Nest half completed, being built, 28 February at El Tigre.

Platypsaris minor – See *Oniki & Willis* (1983) for nests at Manaus, Brazil. Loudly squeaking grown young followed female at Mitú, 9 May.

Tityra cayana – Female took something (food for young?) into knothole 15 m up at Tres Esquinas, 16 April.

Cotinga cayana – In Brazil, male perched high on dead limb, extended head and neck, and puffed throat to give a low groaning *"oong-GOOK"* every few seconds.

Phyllomyias griseiceps – Recorded El Tigre, Tierralta, Tucurá.

Myiopagis caniceps – Song in Panamá and Brazil a long accelerating *"see-see-see-see-se-se-e-e-e-e-eee"*; also a "pipipitzee" repeated several times, latter possibly female and former male.

Sublegatus arenarum – Pasture edges at Remedios. Often jerks tail slightly upward.

Elaenia spectabilis – Common along roads at Mitú, 2 to 12 May, silent migrants. Breeding grounds un south Brazil, loud whistled *"whew"*, soft whistled *"weeoo"*, also songs; there prefers bushes along rivers.

Elaenia flavogaster – Recorded Apartadó, Chigorodó and Turbo in northwestern lowlands.

Elaenia strepera – Several at Puerto Umbría in May.

Mionectes olivaceus – To 600 m on wet west side Filo de Abibe, north end Western Andes. Recorded Paraíso 800 m.

Leptopogon amaurocephalus – Swampy woods at Tres Esquinas and Puerto Umbría. Song a long *"pree-e-e-e-e-e, dit"* ending (and sometimes beginning) with sharp note. Sharp note often given separately (Brazil, Colombia).

Pogonotriccus poecilotis – One bringing material to little cup of spider webs and strands sunk in dense tuft of moss 3.5 m up on liana (so that had NE entrance), 17 March at Km 50 near Queremal. Call a thin *"chi-beet"* as recorded by *Miller* (1963) but in disputes longer *"chi-i-i-ee, weet-weet-weet"* and *"chi-i-i-i-i-ee"*.

Pogonotriccus orbitalis – Eye-ring broken at sides eye, Mera 1200 m E Ecuador. Young begging out of nest, fed 15 October 1965.

Lophotriccus pileatus – In patch second growth at 1000 m, east face Serranía de Abibe.

Poecilotriccus capitale – Call of female in eastern Ecuador a *"tik, grrr"*.

Hemitriccus zosterops – Recorded at Puerto Umbría.

Todirostrum chrysocrotaphum – To 700 m at Paraíso.

Todirostrum calopterum – Frequently flash one or other wing. Pairs keep in contact as move low through manioc or low second growth with *"buzz tirrrt"* or *"bizzzt"* buzzes (Puerto Umbría and Ecuador).

Todirostrum latirostre – Young kept up *"tuk"* calls as wandered with adult through bushes of overgrown pasture at Tres Esquinas, April 14.

Ramphotrigon ruficauda – At dawn at Tres Esquinas, alternates normal *"wheeee, lou"*, with opposite: *"toooooo, reer"*.

Rhynchocyclus olivaceus – Song in N Venezuela similar to Panamá (where resembles start of song of Ocellated Antbird), but song south of Amazon (Diamantino, Pará) different *("Chiv-iv-iv-iv-iv-iv-ert")*; perhaps cis-Andean birds differ, as in many other species. Recorded to 800 m on east slope Serranía de Abibe (Quebrada Nutria).

Rhynchocyclus fulvipectus – At 650 m on wet west side same range, Filo de Abibe path.

Tolmomyias sulphurescens – Two grown young in forest patch at Caucásia, 7 June.

Tolmomyias flaviventris – Young seen 18 April at Tres Esquinas; underparts pale.

Platyrinchus saturatus – Faint "chep" notes birds foraging low in understory, Brazil.

Mitrephanes phaeocercus – Wet west side Filo de Abibe, 650 m.

Contopus cinereus – On Río Verde del Sinú only on upper course, above town of Chocó to 700 m at Q. Nutria.

Empidonax alnorum – Song from one at army ant swarm in April, airport scrub at Tres Esquinas (*Willis* 1966 c).

Pyrocephalus rubinus – Recorded at Medellín and Caucasia.

Fluvicola pica – Recorded Caucasia and Leticia.

Machetornis rixosus – Recorded Caucásia,

Myiarchus tuberculifer – Two grown young following adults at Tierralta, 14 June.

Pitangus sulphuratus – Feeding fruit to grown young at Puerto Valdivia, 8 June.

Megarhynchus pitangua – Recorded (rare) at Mitú.

Myiozetetes similis – Building 1.5 m over water at Limoncocha (Ecuador) 31 October 1965.

Myiodynastes granadensis – Nest near Chocó, upper Río Verde del Sinú, 27 March. Building (nest still cup-shaped) 8 November 1965 at Limoncocha, 14 m on limb of tree over trail to river and near huge wasp nest.

Conopias parva – Abundant San Pedro, uncommon on dry-forested western slopes 400 to 700 m elevation on Quebrada Saisa.

Myiodynastes maculatus – Nest at 670 m above Quebrada Nutria.

Myiodynastes chrysocephalus – Pair at clearing on ridge, 1100 m at Paraíso.

Legatus leucophaius – Recorded Apartadó, San Pedro, and Rio Verde del Sinú from mouth to Quebrada Jarupiá but not upstream.

Empidonomus aurantioatrocristatus – One at Mitú, 7 May.

Tyrannus dominicensis – Recorded Montería.

Progne subis – One male on Sinú just above Tierralta, 29 March.

Progne chalybea Recorded at Cali.

Atticora fasciata – Material to nest burrow 1.5 m above river at Puerto Umbria, 27 May. Adult fed one of four young on twig over water at Zatzayacu, E Ecuador, 20 October 1965.

Notiochelidon cyanoleuca – Carrying material to nest in quarry at Queremal, 16 March. Form *N. c. patagonica* abundant in open areas and on wires at Tres Esquinas and Puerto Umbría, n April-May.

Neochelidon tibialis – Recorded Puerto Umbria.

Riparia riparia – Abundant over Tres Esquinas in April, hundreds flying north on wide fronts. Mitú, two on 9 May.

Petrochelidon pyrrhonota – A few in *R. riparia* waves at Tres Esquinas in April.

Campylorhynchus griseus – Building nest 13 March at San Pedro.

Campylorhynchus albobrunneus – Building nest 25 March at 600 m on Filo de Abibe.

Campylorhynchus zonatus – Recorded near *C. griseus* (which more in open areas) at Caucasia and Tierralta, in mixed group with it at San Pedro.

Thryothorus leucopogon – Brown young, with barred wings and tail, in family group at Remedios 2 May. Songs include *"cho-chee-wheedle"* and *"chee, cher, wheeri k-chew"*, all rather short.

Thryothorus nigricapillus – Young *Molothrus bonariensis* following pair by Caño Pulgas on 23 March.

Troglodytes aedon – Feeding young in nest crevice 8 m in trunk tree in pasture, 4 km W Caucasia, 21 June.

Henicorhina leucosticta – To 1100 m atop ridge at Paraíso, where no *H. leucophrys* seen.

Cyphorhinus arada – To 900 m at Paraíso.

Platycichla leucops – Recorded at 350 m in valley of Cordillera Cutucú, E Ecuador (following army ants at Yaapi); perhaps has altitudinal migrations.

Turdus serranus – Alarm note a *"kip-kip"* or *"cop-cop-kip-kip"*.

Turdus lawrencei – Common at Mitú.

Turdus albicollis – Nests with 3 and 2 pale eggs, spotted cinnamon, 0.7 m in crevice big rock and 1 m in hollow top of stump, 1 and 11 May at Mitú.

Microbates collaris – Leading one smudgy-chested young about at Mitú, 29 April.

Ramphocaenus melanurus – Song west of Andes not noted eastward; perhaps western bird a separate species, although vibrating trill common eastward.

Polioptila schistaceigula – Recorded at Chigorodó as well as Río Verde del Sinú (Las Pulgas), Tierralta (Sierra), and Remedios.

Vireolanius eximius – Bird not seen, but songs as in Central America at Apartadó, Chigorodó, San Pedro, and up valley or Río Verde del Sinú from mouth to Serranía de Abibe.

Vireolanius leucotis – Common in treetop bird flocks at Paraíso 800 - 1100 m. Song in Brazil like that on Buenaventura road.

Hylophilus semicinereus – Habitat normally scrub in Brazil, or forest edges along rivers.

Hylophilus brunneiceps – Contrary to range in *HB, H. b. inornata* lives south of the Amazon; seen in forest flock in canopy of várzea at Maloquinha, near Itaituba on the Tapajoz.

Hylophilus semibrunneus – Call at Queremal and Bitaco a *"chit-it-chrie-chrie-chrie"* nasal series.

Hylophilus flavipes – Song white-eyed bird at mouth Río Verde del Sinú a *"sweet..."* rather like *H. olivaceus* of hedgerows at Shell Mera and Mera 1100 m, Ecuador, and like *H. semicinereus* of scrub in Brazil. These three may form a superspecies.

Hylophilus ochraceiceps – The call *"nya-nya-nya"* or the like registered from many at Mitú, Puerto Umbría, and on upper Rio Verde del Sinú, as well as Central America, is not the normal call east of the Negro or south of the Amazon (*"chichick jee-jee-jeep"* at Curuá-una, near the Tapajoz in Brazil). Perhaps different species are involved.

Molothrus bonariensis – See *Thryothorus nigricapillus.*

Zarhynchus wagleri – Visiting noisy young, colony of 25 nests over Río Atrato at Tanandó, 22 - 23 February.

Psarocolius decumanus – Five nests being built high in leguminous tree over forest clearing at Tres Esquinas, 15 April. Several small colonies with nestlings on upper Río Verde del Sinú, mouth of Quebrada Saisa to the Serranía de Abibe.

Psarocolius viridis – Eight nests 23 m up, isolated tree in clearing at Mitú, on 4 May.

Psarocolius angustifrons – Sixteen nests in isolated tree by Tres Esquinas airport, young fed in some, 15 April; several other colonies seen along river.

Gymnostinops guatimozinus – Feeding young 23-27 March in several huge colonies from 3 km below town of Saisa to 500 m by Quebrada Saisa at E base Serranía de Abibe; over 105 nests in a tree on Q. Saisa at 400 m elevation near trail to Río Carepa.

Cacicus cela – Nests 14 March at 5 km SW San Pedro, on trail to Turbo. Building several nests 12 m in palm by Limoncocha (Ecuador) houses, 8 November 1985.

Hypopyrrhus pyrohypogaster – Calls at 800 m above Puerto Valdivia, *"chock"* or (in male) *"k'glock"* or *"chip";* male also gives *"glee-oor, wh'leeeeeee"* or *'t'seeeeee"* and other odd sounds as ruffs head.

Icterus chrysocephalus – Call 1-4 nasal "gamp" notes at Tres Esquinas.

Icterus jamacaii – Several pairs in pastures at Puerto Umbría. Using nest in *Cacicus cela* colony near wasp nest at Limoncocha, 5 m over water, 31 October 1965.

Icterus nigrogularis – One registered in bushy second growth near town of Benjamin Constant, Brazil, singing. Unless escaped cage bird, may be more widespread along the Amazon than registered up to now.

Leistes militaris – Flushed three short-tailed young from pasture at Queremal, 16 March. Recorded Tres Esquinas and Villagarzón (near Mocoa) in the early 1960's.

Mniotilta varia – Registered Putuimi, E Ecuador, 28 November 1965.

Parula pitiayumi – Recorded at north end Western Andes, from mouth Río Verde del Sinú to 1000 m on both slopes Serranía de Abibe.

Dendroica petechia – Registered at Tres Esquinas.

Dendroica fusca – Late record 8 May at Remedios.

Dendroica castanea – Late record 8 May at Remedios.

Protonotaria citrea – Recorded Apartadó, Chigorodó, and other areas to mouth of Río Verde del Sinú.

Geothlypis trichas – One male seen well 24 March, canebrake by Quebrada Saisa two kilometers above town.

Oporornis philadelphia – Late record 4 May at Remedios. Recorded Tres Esquinas.

Myioborus miniatus – Two tiny young (nest oven-shaped, in weeds of bank) and two eggs in Bitaco nests 10 March and one and two eggs in Queremal nests 13 March.

Basileuterus chrysogaster – Flitting in *Chlorospingus* flock, understory wet forest above Anchicayá dam at 800 m; registered as having broad black stripe either side crown and lacking stripes on sides of head.

Basileuterus luteoviridis – Squeaking young after adult 8 April at Tijeras 2500 m, in forest flock.

Basileuterus fulvicauda – Occasional up to 1350 m below Queremal, and at La Margarita 1750 m above Cali. Two nests with eggs on Quebrada Saisa. Recorded Puerto Umbría.

Coereba flaveola – Fledgling, 11 June, Puerto Bélgica. Building nest 10 m in tree over lawn at El Tigre, 28 February.

Diglossa glauca – In bird flocks at Paraíso 900 m.

Diglossa lafresnayii – Call at Páramo de Puracé a sharp *"tchik"*.

Cyanerpes caeruleus – Recorded Paraíso 900 m, Tres Esquinas, Puerto Umbría (common).

Tersina viridis – Recorded at Puerto Umbría.

Euphonia musica – Fairly common at Paraíso 1100 m.

Euphonia chrysopasta – Pair building oven-shaped nest of epiphyte rootlets, 15 m in spines of crown of spiny palm in tall second growth near Tres Esquinas, 17 April. Building 10 m in palm crown by houses, Yarinacocha (San José), E Perú, 22 December 1965.

Chlorochrysa calliparaea – Recorded Paraíso 900 m. Birds of this genus tend to forage 2-10 m up, often in understory.

Tangara velia – To 1100 m at Paraíso.

Tangara callophrys – Recorded at Mitú, Tres Esquinas, and Puerto Umbría, often with *T. velia*.

Tangara chilensis – One gathered nest material as mate pecked at material, Leticia, 10 January. Dull-colored young at Paraíso 1100 m, where two adults bathed in water of bromeliad.

Tangara schrankii – Fairly common Paraíso 800-1100 m as well as Mera and Shell Mera, 1100 m, Ecuador.

Tangara florida – In very wet forest on Antioquia side Filo de Abibe, 600 m, at north end Andes.

Tangara xanthogaster – Recorded Paraíso 900 m.

Tangara rufidula – Pair feeding squeaking juvenile on ridge at 800 m above Anchicayá dam, March 14.

Tangara arthus – Juvenile 9 November 1965 at Mera 1100 m, Ecuador. One off deep mossy cup nest 3 m in bromeliad on limb lemon tree in yard there, 16 October.

Tangara chrysotis – At Paraíso, only at 1100 m atop ridge.

Tangara nigrocincta – Immatures at Mitú in early May.

Tangara mexicana – Two adults fed grown young at Tres Esquinas, April 20.

Tangara inornata – Recorded once at El Tigre.

Tangara nigroviridis – Male followed female as she carried material to nest 5 m in dense epiphytes of palm by hedgerow in Queremal pasture, 1300 m by road, 17 March.

Buthraupis wetmorei – Pairs seen low in bushes with paramo flocks, Parque Nacional de Puracé.

Ramphocelus carbo – Two cup nests with two eggs each, 0.9 and 0.6 m in grass tufts on bushy pastures, 12 and 15 April at Tres Esquinas.

Ramphocelus dimidiatus – Cup nest with two eggs, 0.7 m on fallen spiny *Desmoncus* palm, 7 June at Caucasia. Copulation 14 June, Tierralta.

Ramphocelus nigrogularis – Fed fluttering dull red grown young at Benjamin Constant, Brazil, 17 April 1966. Pair feeding two fair-sized nestlings in straw cup in bush 1 m over water 2 m deep, bay of oxbow lake 5 km above Tres Esquinas, on 21 April.

Ramphocelus icteronotus – Nest with eggs 27 March in banana plantation.

Piranga flava – Alarm of Bitaco birds indeed a single *"chup"*, as registered by *Miller* (1963) and as in southeastern Brazil.

Piranga leucoptera – Pair with Tangara flock at forest clearing on ridge, Paraíso 1100 m.

Chlorothraupis carmioli – Several in forest flocks in open understory at Paraíso 900 m.

Habia rubica – Specimen from north end Western Andes (see *Willis* 1972 b). Recorded at Mitú.

Tachyphonus rufus – Recorded Paraíso 800 m.

Tachyphonus luctuosus – A few at El Tigre, La Elsa 1000 m, and Mitú.

Cyanocompsa brissonii – The name of this bird is *Passerina cyanea* or *Cyanocompsa cyanea*, but a petition has been filled with the ICZN to change its name to *Paserina brissonii*. See *Wetmore, Pasquier* and *Olson* (1984). *"C. brissonii"* is not correct.

Saltator maximus – Bob-tailed young in bushy field at Tres Esquinas, 11 April.

Saltator caerulescens – Grown young, with "chirr" call like an antbird followed adults in bushy pasture at Tres Esquinas, 18 April.

Lysurus castaneiceps – Several hopping on and near ground in forested ravines (landslide second-growth) at Queremal 1400 m and Paraíso 800 m, where boundary dispute noted. Warbling high-pitched song *"psee, psee, see-e-tee sit e fee teu, psee sit-ee, ee tsi'i tsee fee"* on and on.

Atlapetes atricapillus – Family of three in second growth at 1000 m, east face Serranía de Abibe, north end Western Andes.

Arremonops conirostris – Young out of nest at San Pedro, original notes not located.

Arremon taciturnus? – Black-billed bird with black of chest band extending in "Y" pattern down to belly at Puerto Umbría ant swarm; black "cap" and face mask, green upperparts.

Arremon aurantiirostris – Young at El Tigre, 5 March; graygreen underparts, dark bill.

Tiaris olivacea – Female off 3 eggs in grass clump of Queremal hedgerow, 1750 m, 15 March; other off two eggs in nest in grass over trail bank in Parque Arqueológico, San Agustín, 2 April.

Sporophila bouvronoides – Uncommon in seedeater flocks around Tres Esquinas.

Phrygilus unicolor – To 4700 m by snowline on Nevado del Ruiz, being the only bird the guard had seen there.

Ammodramus aurifrons –Male sang as female built oven-shaped nest under burned small log in completely burned clearing at Tres Esquinas, 20 April.

Zonotrichia capensis – Down to 700 m at Paraíso, where begging juvenile. Absent upper Río Verde and from base Serranía de Abibe.

SUMMARY

I report information on breeding or occurrence of Colombian birds, based on visits in 1962, 1965, and 1966. Ten species were new for the country *(Neomorphus pucherani, Phlogophilus hemileucurus, Heliodoxa schreibersii, Lepidocolaptes albolineatus, Myrmotherula spodionota, Rhegmatorhina melanosticta, Pipreola chlorolepidota, Lipaugus subularis, Elaenia strepera,* and *Turdus lawrencei).* A different vocal dialect was recorded for *Lipaugus (unirufus?)* in northern Colombia and in several species with populations separated by the Andes. A brief visit to lower slopes of the eastern Andes, 700-1100 m above Florencia in Caquetá, produced dozens of noteworthy records and showed that further work in the lower subtropical zone is highly desirable. Walking up into zones of rapid deforestation at the north end of the Western Andes produced many other range extensions, notably at 600-700 m on the wet western face of the Serrania de Abibe in a place similar to that in Caquetá. The first nest of *Dichrozona cincta* (Formicariidae) is reported from eastern Ecuador, and of *Myrmeciza laemosticta* (Formicariidae) from the Serrania de Abibe. Some other nest *(Tangara nigroviridis, Ramphocelus nigrogularis)* may have been first records.

ACKNOWLEDGEMENTS

I appreciate the aid of a National Science Foundation predoctoral fellowship in 1962, and of a Frank M. Chapman postdoctoral fellowship from the American Museum of Natural History in 1965 and 1966. Help of many Colombians, especially those listed in the "Itinerary", is gratefully acknowledged. I also appreciate access to collections of the museums of the Universities of Valle, Cali and National of Bogotá, and of the National Museum of Natural History (Washington, D.C.) and American Museum of Natural History (New York).

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BUFO MARINUS: NEW PERSPECTIVES ON AN OLD ENIGMA

By *Wade Davis* [1]

The poisonous toad *Bufo marinus* is native to the New World, where it is a common denizen of low swampy habitats ranging from Florida west along the Gulf Coast to Mexico, then south to Panama and northern South America. In post-Columbian times, it dispersed rapidly throughout the Antilles and south along the Pacific coast of South America, as well as inland into the Amazon basin (Zug 1979). The large paratoid glands on the back of the toad have been described as "veritable chemical factories" (Kennedy 1982, 284); they produce and secrete at least twenty-six compounds, all of which are biologically active. Some of these - the plenylethylamine bases and derivatives such as the catecholamines dopamine, epinephrine, and norepinephrine, as well as a number of indole derivatives such as serotonin - are benign and occur naturally in human tissues. Acting as neurotransmitters, they are the chemical messengers between the synapses which connect individual neurons. These indole derivatives and catecholamines are found in many species and are not toxic in animals. (Anderson n.d.).

However, the venom glands secrete other compounds of considerably greater interest, including bufotenin, a purported hallucinogenic agent (Fabing and Hawkins 1956), and two extremely toxic cardioactive steroids, bufogenin and bufotoxin. These compounds are found in the skin or glands of a number of toads, including the common European species *Bufo vulgaris* (Wieland and Alles 1922), and it is their unique toxic properties that have earned the animal a notorious place in the repertoire of poisoners and black magicians throughout the world.

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As early as Roman times Juvenal (10-128 A.D.) described women using toads (presumably *Bufo vulgaris*) to kill unsuspecting husbands (Chen and Jensen 1929). The toxicity of the venom provided the basis upon which the Talmud differentiated between frogs and toads, classifying the latter with all animals that were poisonous to the touch - a belief that persists to this day in Western societies (Abel and Macht 1911). At the beginning of the fourteenth century, Bishop Guichard of Troyes was accused of poisoning the wife of Philippe le Bel with a preparation of scorpions, toads, and spiders (Chen and Jensen 1929). In that same period, English sorcerers noted erroneously that toads derived their venom from the earth by eating mushrooms –hence the name toadstool– and they commonly prepared poisons using toads that had been macerated in menstrual blood for a month or more (Chen and Jensen 1929). It is to these "menstrums" that Shakespeare referred in *Macbeth:*

> *"Toad, that under cold stone,*
> *Days and nights hast thirty-one*
> *Swelter'd venom sleeping got,*
> *Boil thou first i' the charmed pot".*

Medieval witchcraft boasted a complete collection of such recipes. One from the court astrologer and alchemist for Frederick II reads: "Five toads are shut up in a vessel and made to drink the juices of various herbs with vinegar as the first step in the preparation of a marvelous elixer for the purposes of transformation" (Kennedy 1982).

Soldiers in the Middle Ages believed that a discreet way of killing an enemy was to rub his skin or wounds with the secretions of *Bufo vulgaris. Bufo marinus* reached Europe very soon after the voyages of Columbus, and poisoners quickly discovered that when the toad was placed in boiling olive oil, the secretions of the glands could be easily skimmed off the surface (Holmstedt pers. comm.). In early sixteenth-century Italy, poisoners devised sophisticated processes for extracting toad toxins into a salt, which could then be sprinkled on the intended victim's food (Lewin 1920). In fact, so highly regarded was the toxicity of toad venom that at the beginning of the eighteenth century it actually was added to explosive shells and mixed with the saltpeter used to make gunpowder (Chen and Jensen 1939; Chilton et al. 1979). Presumably, the commanders believed that if the cannon did not kill their enemies, the toad toxins would.

Not surprisingly, European physicians incorporated toad venom into their *materia medica* at a very early point. Dried and powdered toad warranted a prominent place as a treatment for dropsy, fever, and a number of other ailments in numerous important pharmacopoeia, including *Thesaurus Pharmakologicus,* written by Johannes Schroder and published in Leyden in 1672, *Pharmacologia,* by Samuel Dale (London 1692), and *The London Dispensatory,* by William Salmon, published in 1702. Michael Etmuller (1644-1683), professor of medicine at Leipzig, noted of the toads that "living toads aroused to the point of fury are venomous, but found dead they are entirely devoid of poison. Transfixed alive in the month of July, dried, powdered and administered in doses of twelve grains on alternate days, they furnish an excellent cure for dropsy. Others administer this remedy in burning fevers at its height. Powdered toad is also an effective remedy against incontinence of urine, and is said to be efficacious because of its anodyne character while its volatile, penetrating salt acts as a diuretic" (Abel and Macht 1911). Toads remained a prominent therapeutic agent throughout the eighteenth century, appearing in *Pharmacopeia Universalis* by R. James (London 1747) and *The English Dispensatory* by John Quincy (London 1749). As late as 1833, powdered toad was mentioned in an important medical compilation, *Pharmacologia,* written by J. A. Paris.

As in so many things, the Chinese were far ahead of their Western colleagues in their knowledge of the properties of toad venom. For centuries they had been forming the toxic secretions into smooth disks which they named Ch'an Su, or "toad venom" in Mandarin. According to the *Pentsao Kang Mu,* a famous herbal written at the end of the sixteenth century, this venom was used to treat toothache, canker sores, inflammations of the sinus and bleeding of the gums. Taken orally, it was said to break up the common cold (Chen and Jensen 1929).

From this list of rather mundane afflictions, it is difficult to appreciate that the Chinese were dealing with an extremely toxic preparation. Although early medical reports are uncertain as to the species of toad used (Tu et al. 1923; Penget et al. 1921; Chen and Jensen 1929), analysis of Ch'an Su (probably *Bufo vulgaris)* revealed the presence of both bufogenin and bufotoxin (Chen and Jensen 1929). Separate studies suggested that Ch'an Su was fifty to a hundred times more potent than digitalis, a powerful cardiotonic derived from the common European foxglove *(Digitalis purpurea),* which had been used as a heart stimulant in Britain since the tenth century (Chen and Jensen 1929). In one experiment a cat was injected with as little as 0.020 grams of crude toad venom; its blood pressure tripled almost immediately and it collapsed following massive heart failure (Abel and Macht 1911). If one was to accept the physiologically absurd equation of men and cats, it would mean that as little as half a gram of dried venom, injected intravenously, would do similar damage to a 150-pound man.

The toxic properties of toads had certainly not been overlooked by the indigenous peoples of the Americas. Lacerdo de Filho reported in 1878 that indigenous groups in the Amazon made an arrow poison from the toad *Bufo agua* (Abel and Macht 1911). According to an early and perhaps exaggerated report (Pagenstecher 1906, cited in Abel and Macht 1911), these preparations were extremely potent; a deer struck by an arrow that had been dipped in the poison survived only two to four minutes, a jaguar perhaps ten.

The action of the toad-based arrow poisons is of particular interest. D-tubocurarine, the principal constituent of the toxic lianas of the Amazon *Chondrodendron sp., Curarea sp., Abuta sp.),* acts as a muscle relaxant, causing death by asphyxiation. The skin of *Bufo marinus,* on the other hand, contains chemical substances resembling the active principles of the strongest African vegetable arrow poisons (Flier et al. 1980). These latter are derived from a number of plants *(Strophanthus kombe, S. gratus, Acokanthera venenata),* and they act in quite a different way. The active compound is ouabain, a powerful heart stimulant. In moderate dosages, ouabain is used today to treat emergency heart failure; in excessive doses, it makes the heart pump wildly until it collapses (Robb 1957).

Given the toxicity of these compounds, it is perhaps difficult to appreciate a controversy that has developed in the anthropological literature in recent years over whether *Bufo marinus* was used as a hallucinogen by New World Indians—in particular by the advanced civilization of the lowland Maya (Dobkin de Rios 1974; Kennedy 1982; Furst 1972). Although the hypothesis initially seems untenable from an ethnobiological point of view, it is worth exploring, for it now appears that a solution may be at hand, and the explanation is one of startling simplicity.

The argument in favour of the toad as hallucinogen has rested until now on several lines of evidence. First, throughout Central America the toad was a prominent symbol, particularly in Mayan iconography (Furst 1972). Numerous Mayan artifacts that have been discovered, including small ceramic serving bowls, have obvious representations of the toad and especially graphic portrayals of its distinctive paratoid glands (Furst 1974; Kennedy 1982; Dobkin de Rios 1974). Second, at one post-Classic Mayan site on Cozumel Island, Mexico, an archaeologist found that virtually all amphibian remains were *Bufo marinus* (Hamblin 1979). This report complemented an earlier, similar discovery at San Lorenzo, Mexico, that led one prominent archaeologist to suggest that the Olmec civilization used the toad as a narcotic (Coe 1971). Third, one of the substances secreted by the toad is bufotenin, a compound that is found in a hallucinogenic snuff made today by South American from the seeds of *Anadenanthera peregrina.* This member of the Leguminosae is common in the upper Orinoco Valley of Venezuela and elsewhere in South America (Schultes and Hofmann 1980). One report from Western medical literature has suggested that pure bufotenin, injected intravenously into human subjects, induces hallucinations (Fabing and Hawkins 1956). Fourth, the proponents of the hallucinogen hypothesis all cite an unpublished report of the contemporary use of *Bufo marinus* in a hallucinogenic preparation in Vera Cruz, Mexico (Knab n.d., cited in Furst 1974; Kennedy 1982).

On the face of it, however, this cumulative evidence is fairly inconclusive. Whether or not Mayan iconography represents the toad *Bufo marinus,* the werejaguar, or any other symbol is for the archaeologists to decide; it is specious at best to argue that if the motifs do represent *Bufo marinus,* one may conclude, *ipso facto,* that the Maya used the toad as a hallucinogen. Symbols, in particular ritual symbols, incorporate a wide range of meanings. Moreover, they are not necessarily diachronically stable. Kennedy (1982) herself points out the remarkable fecundity of the toad. Once could speculate with equal assurance that the toad motifs relate to fertility, to water or rain, or even, given the life cycle of the creature, to some notion of sacred metamorphosis and renewal.

By the same token, it is not always possible to draw a direct relationship between a decorative motif applied to ceramic wares and a purported use of the depicted object itself. Hellmuth, in an amusing comment, has noted that today, in the central market in Guatemala City, native women sell a great variety of modern toad-shaped artifacts. Does this imply, he asks rhetorically, that "these little old ladies secretely imbibe mindexpanding doses of toad-juice cocktails under their counters?" (Hellmuth 1974, 156). Certain investigators (Schultes 1979; Schultes and Hofmann 1980; Sharon 1978) have noted correlations in the provocative shapes and decorations of archaeological artifacts, but they have made such pronouncements only when their conclusions are supported by, contemporary documentation as well as extensive ethnohistorical records of the use of the hallucinogen in the particular region. It is a different and purely speculative exercise to draw conclusions in the complete absence of corroborative ethnographic and/or historical evidence (Dobkin de Rios 1974; Kennedy 1982).

The paucity of such evidence presents yet another apparent flaw in the argument. It seems likely that, if the use of *Bufo marinus* as a hallucinogen was an important enough element of a state religion to warrent iconographic representation, there would be some record of it in the early chronicles. Dobkin de Rios (1974) speculates that the notable absence of ethnohistorical documentation is due to the fact that use of the drugs by the general population was suppressed by the Mayan hierarchy and, in turn, concealed from the Spanish. Yet it was precisely this "diabolical" use of hallucinogens, along with other indigenous religious practices, that the Spanish so zealously ferreted out and described in detail in their writings – if only as a way of rationalizing their own nefarious actions. It comes as no surprise to find extensive accounts of the use of ololoiuqui *(Rivea corymbosa);* teonanacatl *(Psilocybe sp., Panaeolus sp., Conocybe sp.);* peyote *(Lophora williamsii);* San Pedro-achuma *(Trichocereus pachanoi);* cohoba-vilca *(Anadenanthera peregrina);* tlapatl-chamaico *(Datura sp.)* (Schleiffer 1973).

Moreover, although it is true that the Spanish tried to suppress the use of psychotropic drugs in Mesoamerica, they mostly succeeded in driving these practices underground. In the case of virtually all the known hallucinogens, it has been possible to demonstrate the continuity and subsequent modifications of the pre-Columbian practices into colonial times; in most instances, extensive ethnographic evidence exists documenting their contemporary use (Schultes and Hofmann 1980; Sharon 1978; Furst 1972; Davis 1983). What, one is forced to ask, happened to *Bufo marinus?*

At least one ethnohistoric source does mention the use of a toad in a ritual preparation. Peter Furst notes that the "17th century English friar, Thomas Gage, described the Potoman Maya practice of steeping venomous toads in fermented beverages used for ritual intoxication, to give them extra potency" (Furst 1974, 154). The original source, however, is somewhat less precise. It speaks of a chicha consisting of water, honey or sugar cane, tobacco leaves, various roots "which they knew to be strong in action", and a live toad. This mixture was placed in a sealed container "till all that they have put in be thoroughly steeped, the toad consumed, and the drink well strengthened" (Thompson 1970, 120). It appears from the original syntax that the potency of the preparation was believed to be enhanced as much from the month it spent fermenting as from the addition of an unidentified toad.

Interpretations of the ethnographic data have been equally imprecise. Furst (1974) cites a paper by Carneiro (1970) which suggests that the Amahuaca Indians of Peru introduce frog or toad venom into self-inflicted skin burns to bring on a trance state. Yet neither Carneiro or Furst identify the animal in question. They use the terms frog and toad interchangeably and take no account of the existence of numerous genera of toxic amphibians completely unrelated to and morphologically dissimilar to *Bufo marinus.*

Those who suggest that the toad was used as a hallucinogen also draw attention to the distribution of *Bufo marinus* remains at a number of archaeological sites (Hamblin 1979; Coe 1971). Michael Coe noted in discussing his osteological remains at San Lorenzo: "These toads are a puzzle, as they cannot be skinned without an extremely dangerous poison getting into the meat. We are now looking into the possibility that the Olmecs used them for a hallucinogenic substance called bufotenine (sic), which is one of the active ingredients" (Coe 1971, 74). As it turns out, a survey of the archaeological literature shows that a significant quantity of *Bufo marinus* remains have been found in middens throughout Central America, leading other archaeologists to believe that pre-Columbian Indians used the toad, not as a hallucinogen, but as food, after carefully cutting away the skin and paratoid glands (Cooke 1979, 1981). In spite of Coe's cautionary words, Richard Cooke (1979) himself butchered and cooked several specimens, which he was pleased to note tasted rather pleasantly like smoked chicken. Based on the temporal and spatial distribution of *Bufo marinus* remains, he proposed that the toad was not used as a drug, but as a survival food, a suggestion partially corroborated by the fact that it is today employed for precisely that purpose by the Campa Indians of the lower Apurimac River in Peru (Weiss pers. comm.).

A central fallacy of the hallucinogen hypothesis has been the fact that no one has been able to demonstrate how this reputed toad preparation could have been consumed safely. It is true that the glands secrete bufotenin, a known constituent of South American hallucinogenic snuffs (Schultes and Hofmann 1980). Bufotenin is the methylated derivative of serotenin or 5-hydroxytryptamine. Unlike its parent compound, it is mildly lipid soluable so is weakly capable of crossing the blood brain barrier. Thus is might well have psychotropic properties (Anderson n.d.).

However, also present in the toad venom are the extremely potent cardioactive steroids bufotoxin and bufogenin (Chilton et al. 1979; Chen and Jensen 1929). It is almost certain that ingesting a straight maceration of the paratoid glands would cause cardiac failure long before the recipient would get a chance to experience the putative hallucinogenic properties of bufotenin (Alger 1974). It seems unlikely that the Maya would have been interested in poisoning vast numbers of their priesthood, who presumably would have been the ones taking the drug. Only if some process had been developed that selectively neutralized the toxic constituents could *Bufo marinus* have been made into much of a hallucinogen. Folk healers have often demonstrated a sophisticated biological and chemical knowledge, as is evident in their ability to enhance certain hallucinogenic potions by the careful use of various admixtures (Schultes and Hofmann 1980). However, the knowledge of chemistry and differential solubilities required to eliminate both bufotoxin and bufogenin in an orally ingested preparation would represent, on the face of it, a formidable achievement.

Such a process was not altogether inconceivable. Kennedy (1982) elaborately discusses her suggestion that the Maya used ducks as bioprocessors of the toxin; the idea was that the toad toxins were somehow metabolized, leaving the psychotropic components in the flesh of the bird, which could then be safely consumed. She went as far as demonstrating that ducks could safely eat the toads, but she failed to take the obvious next step of butchering the birds and bioassaying their meat.

A more promising attempt was made by Dr. Timothy Knab, who searched the backcountry of Mexico for evidence of a contemporary curandero who might have preserved the ancient knowledge. It is Knab's unpublished account that is heralded by Kennedy. "Knab", she writes, "has penetrated the arcana of several curanderos in the Veracruz area and details the recipe for the preparation of *Bufo marinus* paratoid glands which eliminates the most toxic compounds" (Kennedy 1982, 285). Furst mentions the "taped interview by Timothy Knab with a curandero from Veracruz describing precisely how a 'brujo' treats the venom extracted from bufo to eliminate or neutralize its more dangerous toxic effects when preparing his magic potion" (Furst 1974, 154). It is to Knab's credit that he is somewhat more modest in reporting his own discovery.

After considerable effort, Knab finally located an old curandero in the mountains of southern Veracruz who claimed to know the formula of a preparation that had not actually been used by his people in fifty years. The old man ground the glands of ten toads into a thick paste, to which he added lime water and the ashes of certain plants. The mixture was boiled all night, or until it no longer smelt foul, and then was added to corn beer and filtered through palm fiber. The liquid was mixed into corn meal and then placed in the sun for several days to ferment. Finally the mixture was heated to evaporate the remaining fluid, and the resulting hardened dough was stored until the time came to rehydrate it to prepare the final potion.

Although Knab had persuaded the curandero to prepare the potion, under absolutely no circumstances would the recalcitrant old man actually sample it. Only very reluctantly did he consent to give a dose to Knab. From what happened, it appears that he knew something the anthropologist did not. Knab's intoxication was marked by sensations of fire and heat, convulsive muscle spasms, a pounding headache, and delirium. He writes of his experience:

> The drink starts to take effect within a half hour; profuse sweating is noted along with a sudden increase in heart beat. The heart beat becomes continuously harder and stronger. A pronounced chill sets in with twitching of the facial and eye muscles. A pounding headache and delirium shortly follow the onset of twitching. During this delirium, the individual is unable to walk, sit up or move about, as he lies in a specially excavated depression in front of the fire. This state usually lasts from three to five hours and wears off slowly (Knab n.d.).

Knab reports no hallucinations, and from his subjective description of the intoxication it appears that he merely suffered the initial symptoms of a severe poisoning (Knab pers. comm.). He never did find out whether or not the preparation actually neutralized any of the toxic compounds, for the preparation was never analyzed.

Yet another unresolved issue in the controversy is the pharmacological activity of the purported hallucinogenic agent itself, bufotenin. Virtually every report that characterizes bufotenin as a psychotomimetic dates to a single experiment completed by a medical doctor, Howard Fabing, in the 1950s. Fabing obtained permission to inject bufotenin intravenously into a number of inmates at the Ohio State Penitentiary. The recipient of the mildest dose complained of prickling sensation in his face, nausea, and slight difficulty in breathing. With a higher dosage these symptoms became more pronounced and the subject's face and lips became purplish. The final dose caused mild hallucinations and delirium, and the skin turned "the colour of an eggplant", indicating that the drug was preventing oxygen from getting to the blood. The hallucinations were ephemeral. Three minutes after injection, the subject vomited, and at the time, "he saw red spots passing before his eyes and red-purple spots on the floor. Within two minutes, these visual phenomena were gone, but they were replaced by a yellow lens filter" (Fabing and Hawkins 1956, 887), That is the extent of the hallucinations experienced by any of the recipients of the bufotenin injections.

Turner and Merlis (1959) attempted but failed to replicate these results. They noted that upon muscular injection of bufotenin, the recipient "suddenly developed an extremely rapid heart rate; no pulse could be obtained; no blood pressure measured ... onset of auricular fibrillation ... extreme cyanosis developed". Massive resuscitative procedures were immediately implemented and fortunately the pulse eventually returned to normal (Chilton et al. 1979). After the failure of this and other experiments the investigators concluded that "we must reject bufotenin as capable of producing the acute phase of cohoba *(Anadenanthera perigrina)* intoxication" (Chilton et al. 1979, 64).

On the basis of this and other reports, Schultes himself concluded, "it seems probable that 5-OH-DMT (bufotenin) does not contribute to the psychotomimetic activity of the snuffs" (Schultes and Hofman 1980, 90). In other words, even assuming that a folk preparation could eliminate the toxic constituents in the toad venom, it became questionable whether bufotenin alone would be hallucinogenic. This issue was never resolved by a full range of experiments, including different techniques of administering the drug, but the doubts cast on the psychoactive properties of bufotenin led many to conclude that *Bufo marinus* could not have been used as a ritual narcotic, let alone serving as the basis of a state religion.

Crosscutting this negative evidence, however, and perhaps beginning to resolve the matter once and for all is the important recent discovery by Dr. Andrew Weil of the University of Arizona (pers. comm.) of a group of individuals in New Mexico, U.S.A. who apparently have been using the toad as a ritual hallucinogen for several years. Their means of administration is simple and direct. They milk the paratoid glands by hand, taking some care to avoid contact between the secretions and their mucous membranes. They then smoke the toad venom and, according to preliminary reports, the psychoactive effects are unmistakeable while the noxious side effects one might expect from the associated compounds in the secretions are negligible. If true, this discovery suggests that the cardioactive steroids bufogenin and bufotoxin may be denatured by smoking, while the potential of the active constituent, presumably bufotenin, is fully realised. The form of administration is consistent with the known pharmacological properties of other tryptamines. In general, those compounds may be smoked or absorbed as snuffs; ingested orally they are in most instances inactive. The full significance of Weil's discovery will be determined by a battery of field and laboratory experiments.

For the moment, however, he has provided the only firsthand, concrete evidence of the psychoactive properties of this remarkable amphibian.

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SHRUBS: THE FORGOTTEN RESOURCE

By *Noel D. Vietmeyer, Ph. D.* [1]

Shrubs are the botanical resource without a constituency. Too tall for agriculture, too short for forestry, they fall between the disciplines. Agricultural textbooks do not discuss shrubs; forestry literature neither. Around the world institutes of agronomy and forestry research abound, but there is hardly one for shrub research. Shrubs are either too woody, too branchy, too thick, or not thick enough. And therefore they are scorned, and their potential as resources is overlooked.

However, shrubs are no less worthy than their smaller cousins the herbaceous plants or their larger ones the trees. They do not deserve neglect. It is not wise to turn our backs on shrubs merely because they do not fit into our twin pillar traditions of agronomy and forestry.

Actually, shrubs can provide many valuable resources: food for people; feed for animals; ingredients for drugs and medicines; wood for fuel; fiber for paper pulp; materials for housing, fencing, tools, and handicrafts; as well as industrial products such as rubber, resins, gums, oils, and rope. On top of that, shrubs are one of the most promising answers to the Third World's massive shortages of firewood.

Shrubs are small, many-branched trees. They are annuals or, perennials-just like other classes of plants. Many grow in the most derelict terrain. A number of them (notably legumes) fix nitrogen that aids soils and neighboring plants. They have particular promise for developing countries because shrubs are one of the most vigorous and tenacious of all life forms. Their often deep taproots and extensive lateral-root systems allow them to tolerate drought and barrenness. Without them, livestock and wildlife could not survive. This is because grasses die when the upper soil dries out, but the shrubs' deeper and more extensive root system reaches underground moisture and keeps them flourishing. "If you had to choose one life form that has the most security it would be shrubs," notes United States agronomist Charles Driver.

Shrubs have such exceptional promise that they deserve widespread international recognition and research attention. Here are some promising species to start with for food, fuel, forage, and industrial products.

FOOD

Only one world food crop is a shrub– cassava. But there are many other interesting species yet to be explored. Among them are chaya, pigeon pea, and ye-eb.

Chaya is a fast-growing Central American shrub that provides large amounts of nutritious greenery, requires little maintenance, and keeps yielding for years. Chaya plants tested in Puerto Rico outproduced all other leafy vegetables. From Mexico to Costa Rica these shrubs are often seen as attractive hedges from which the people pick their daily food.

Chaya comes in two species: *Cnidoscolus aconitifolis* is found from southern Mexico to Costa Rica; *Cnidoscolus chayamansa* is native to Mexico's Yucatan peninsula and to Belize. The young shoots and tender leaves of these shrubs are cooked and eaten like spinach. They are high in protein, calcium, iron, and vitamins. The plants are propagated from stem cuttings, which begin producing

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food in 2 or 3 months. They tolerate heavy rainfall and respond with luxurious growth. They also tolerate drought and recover well when the rain returns.

Pigeon pea is another neglected shrub that produces food-in this case a nutritious seed. It is one food-shrub that has received some research attention, but it is not nearly as well known or used as it should be.

One of the oldest of the world's food crops the pigeon pea *(Cajanus cajan)* was cultivated in ancient Egypt and has been used in Africa and Southeast Asia since prehistoric times. It is probably native to northeastern Africa but today more than 90 percent of the worls's production is in India. The crop is also very popular in the West Indies.

This woody shrub is a multipurpose crop extraordinarie. It produces food in about the same time as annual food crops –3 to 9 months– but then continues yielding for several years. Its seeds are cooked and eaten like other dry beans. In addition, its green seeds and the immature pods are eaten as fresh vegetables. Moreover, pods, husks, and foliage are fed to animals. And on top of that the shrub's stalks or side-branches provide firewood to cook the family's meals.

The living plant has uses also. It rapidly produces dense ground cover that protects soil from erosion. It is sometimes used as a windbreak and it makes a hedge that also provides food and fuel.

The pigeon pea reflects the shrubs' general propensity for vigorous and robust growth. It is one of the best nitrogen-fixing legumes and survives on lands unsuitable for other crops due to infertility. Some cultivars tolerate toxic soils that have excess salt, soluble aluminum, or manganese. Its deep roots find moisture and keep it productive when other food crops have succumbed to drought.

But it is not the most drought-tolerant food-shrub. That distinction probably goes to ye-eb.

One of the most endangered plants in the world ye-eb is a shrub that could contribute to the world's arid zones the way macadamia and cashew do to the humid zones. It produces an edible nut. Native to a semi-desert region in the Horn of Africa ye-eb *(Cordeauxia edulis)* survives where rainfall is sometimes only a meager 150-200 mm a year. A dwarfed, many-stemmed shrub, usually only about 1.6m tall, it has long root that reach deep soil moisture allowing it to remain green year-round.

Ye-eb seed is a nutritious and tasty nut with a chestnut-like flavor. Destitute peasants living in the Somali hinterland rely on it for subsistence. In season, it is a staple of the poorer nomads; during drought it is sometimes the only food plant left surviving in the parched and baking Ogaden Desert. Eaten raw or cooked the seeds have a smooth consistency and taste that one author likens to that of cashew. The are much relished, being often preferred to the usual diet of rice and dates. For arid regions they make an unusually nourishing and balanced food, containing substantial amounts of starch, sugar, protein, fat, and various minerals.

In the dry hinterland of Somalia the ye-eb once grew profusely. (In 1929 it was reported to constitute up to half the woody vegetation in many areas.) Today it is threatened with extinction because of war and over-harvesting caused by drought.

Ye-eb has only recently been grown outside its native habitat. After experiments at Kew Gardens in London, it is now growing well in trial plots in Kenya, Sudan, Yemen, and India. The plant holds the promise of providing a valuable food for local use in hot, dry areas with low uncertain rainfall and possibly for export. It may prove useful in many dry countries where irrigation is not possible, and where rainfall is too low for the cultivation of more conventional crops.

FIREWOOD

Ye-eb, pigeon pea, and chaya show that shrubs have an important role to play in providing food, but shrubs can also provide the fuel to cook food with. As is now well known, the Third World has vast shortages of firewood. However, what is only now being recognized is that the firewood crisis cannot be solved by planting trees alone. Poor people cannot afford to wait for a tree to grow, let alone the expense of plantation-grown wood. To reach the people most in need shrubs are one major answer.

The pigeon pea is an example of a shrub that already produces fuel. And there are more examples. Two are dhaincha and calliandra.

Dhaincha is a shrub that is so quick-growing it can produce firewood in only 6 months. A native of the Indian subcontinent, dhaincha *(Sesbania bispinosa,* also known as *S. aculeata)* has been distributed to parts of tropical Africa; Southeast Asia, China, and the West Indies. To researchers outside of two or three laboratories in India and Pakistan, however, it is little known.

The wood is light, but it can be produced quickly and in high yield. In northern Pakistan and in Vietnam it is used as a firewood crop. (Pakistani villagers commonly use it for evaporating water from sugar.) It matures so rapidly that two harvests a year are possible. Vietnamese farmers grow it to fertilize rice fields and gather its stems for firewood before the rice crop is planted.

Dhaincha, too, is a multipurpose species. All parts of the plant are useful and the crop appears easy to produce on large scale with little care or investment. Its seeds contain a water-soluble gum that produces a smooth, light colored, coherent, and elastic film useful for sizing textiles and paper and for products such as the mud used in oil drilling. Also it can be used as a rotation crop to fertilize and improve soil for food crops. The living plant is used to provide windbreaks, hedges, erosion control, and shade and cover for crops. Its foliage is used to increase soil fertility, especially on saline and wet soils. It also reportedly makes good cattle fodder.

Dhaincha stems can be processed to provide a jutelike cordage fiber, useful for items such as fishing nets, gunnysacks, and sails. They have an exciting potential as a new source of paper. The fibers are very similar to those of birch, one of the best hardwoods used for pulping. In Italy, one dhaincha crop yielded 15 bone-dry tons per hectare. In the tropics, where more than one crop can be harvested each year, the annual production could be even higher.

Dhaincha is just one member of a genus of shrubby legumes that deserve much greater development. In the Cameroons, villagers plant another fast-growing *Sesbania* shrub for firewood. And more species are known in other parts of Africa and Asia.

An example of a shrub's utility as a firewood source is provided by calliandra. This leguminous species is native to Central America, and its seeds were introduced to Indonesia in 1936. In Eastern Java calliandra *(Calliandra calothyrsus)* proved so successful as a village resource that in 1970 the Indonesian State Forest Enterprise (Perum Perhutani) began planting it on a large scale as a plantation crop, so that by early 1979 about 30,000 ha were under cultivation.

This small bush is unusually quick growing and when it is cut down it sprouts so vigorously that it produces firewood on an annual basis. In Indonesia it has been cut for fuel after only a year's growth and harvested each year for the next 20 years. In many parts of Java, calliandra branches have become a favorite fuelwood. It is used for cooking as well as in small industries; for example, those making lime, tiles, or bricks.

I the 1960s government officials noted that villagers had spontaneously adopted calliandra and were cultivating it for their firewood needs. Today Javanese cultivate calliandra widely, often intercropping it with fruit trees and vegetables. The shrub has become so popular in rural areas that "Kalliandra" is now a widely used name for children.

The plant's value is dramatically exemplified by the village of Toyomarto in East Java. There, land that was once grossly denuded and erosion-pocked is now covered with calliandra forest. Today, the villagers make a good living selling the firewood, actually earning more from it that from their food crops.

Calliandra's abundant nodulation enriches the soil in which it grows, making it useful for rejuvenating worn-out agricultural land. Some formerly abandoned agricultural areas now produce good sugarcane yields following four years of calliandra cultivation.

FORAGE

During drought or flood, or other periods when grasses are unavailable shrubs often supply the only forage. For example, during the severe six-month dry season in Brazilian savannas (cerrados), cattle get as much as 60 percent of their feed from shrubs and trees. In Ghana's savannas, the precentage is thought to be higher. And it has been judged that more animals are fed from shrubs than from man-made pastures. In fact, in many locales stock raising probably would not be possible without them. During the dry season they provide green feed (leaves, flowers, and fruits), often rich in proteins, vitamins, and valuable mineral elements. Wherever these shrubs and trees are absent, animals have only poor straw from native annual grasses. This very poor feed brings on avitaminosis and mineral deficiencies that generates deadly toxemias.

One leguminous plant (that comes in both a many-branched shrub and single-trunked tree forms) is leucaena, *Leucaena leucocephala.* A native of Central America, this species has an irrepressible vigor and has been much in the news in recent years. But so far researchers have concentrated most on its use as a tree crop. Its value for feeding animals is not so well known.

Yet, in the lowland tropics forage can be produced more efficiently and economically from leucaena than from virtually anything else. Because it is a shrub leucaena produces a pasture that is a block of forage rather than a sward-like pasture. A field of leucaena is almost 2m high. Cattle are lost among the bushes, only the tops of their heads are visible. But this gives an added dimension; cattle find forage from ground level to eye level, and the production is outstanding.

Cattle relish the leaflets and young stems and often leave the bushes stripped bare. But leucaena quickly regrows new foiage, and within 2 weeks a "bare" field can be ready for grazing once more. So resilient is the plant that pastures near Brisbane, Australia, have been browsed almost continously for about 20 years without requiring replanting.

Leucaena leaves, similar to alfalfa in digestibility, protein content, and nutritional value, are particularly palatable to dairy cows, beef cattle, water buffalo, and goats. Cattle feeding on leucaena near Brisbane gained an average of almost 1 kg of weight each day for more than 200 days. That is about twice what is normally expected from animals grazing in tropical pastures, and approaches the weight increases normally obtained only in feedlots.

For some time researchers have worried about mimosine, an uncommon amino acid that comprises about 5 percent of the protein of the leaflets, but now it is known that cattle, goats, and water buffalo in most parts of the world have stomach microbes that detoxify mimosine. Only in Australia, Papua New Guinea and perhaps a few other countries is mimosine likely to be a concern.

Leucaena's promise is for the humid tropics, but fodder shrubs find their most outstanding promise in arid lands. Here their deep roots keep them green and productive when grasses are shrivelled and desiccated. A family of shrubs with notable promise for drylands is the saltbushes.

Saltbushes (members of the genus *Atriplex)* grow throughout the world. They are highly salt tolerant, and many are perennial shrubs that remain green all year. They make useful forage in arid zones of the world. They resist low temperatures, withstand heavily textured soils, and tolerate salinity in soil or water.

Old man saltbush *(Atriplex nummularia)* is an important forage plant in arid and semiarid areas of Australia. It should be among the first to be introduced into regions with similar climate. One of the most palatable of the atriplexes, it is also highly drought resistant. It has been introduced into Israel, South Africa, North Africa, and several South American countries for testing as a forage plant; yields reportedly have been high.

Atriplexes are salt tolerant. Laboratory experiments have demonstrated that *Atriplex halimus,* for instance, will grow when irrigated with saline solution containing about as much salt as sea water. They actually excrete the salt through their leaves. This is done by forming small salt-filled bubbles on the leaf surfaces. When full, the bubbles burst, releasing the salt to the wind.

INDUSTRIAL PRODUCTS

Another shrub that has been much in the headlines is jojoba *(Simmondsia chinensis).* The seeds of this North American desert shrub contain a vegetable oil unlike any other to be found in the vegetable kingdom. It is potentially an important industrial oil with potential uses in quenching and cold-rolling of steel, in leather dressing, in lubricating high-speed machinery and precision instruments, and in the textile industry.

Already some 16,000 hectares of jojoba plantations have been established in the arid southwestern regions of the United States and plantations are springing up in Mexico, Israel, Australia, South Africa, Sudan, Argentina, Brazil, Costa Rica, and elsewhere. The crop's future is still not clear, but this is one little-known shrub that is "taking off".

A second promising North American shrub is guayule *(Parthenium argentatum).* It contains a rubber that, when purified, is virtually indistinguishable from natural rubber from the rubber tree. A potential source of exports for arid lands, it grows in poor desert soils in otherwise unused marginal areas.

The rubber is contained within cells throughout the entire guayule plant, and to obtain it the whole plant is harvested, and the rubber extracted with solvent or floatation in water. Yields of up to 12 percent (dry weight) have been obtained from wild plants and over 20 percent from improved varieties. Guayule can be planted, harvested, and processed with equipment already developed for other crops.

Guayule, jojoba, saltbushes, leucaena, calliandra, dhaincha, ye-eb, pigeon pea, and chaya are just nine examples of the exciting promise of shrubs. Others include tamarugo *(Prosopis tamarugo),* a salt-resistant, drought resistant forage of the Chilean desert; *Cassia sturtii,* an Australian shrub that is proving a valuable forage source in Israel; *Desmodium discolor,* which along with other woody *Desmodium* species are promising forages for tropical zones; sunnhemp *(Crotolaria juncea),* a nitrogen-fixing shrub of India that produces a high quality fiber for cordage or paper; vasaka *(adhatoda vasica),* a goat-proof evergreen shrub of India promising for firewood, insecticides and perhaps medicinals; and candelilla *(Euphorbia antisyphilitica),* a native of Mexican desert this leafless shrub is covered with a high-melting wax that is used to coat candies and goes into many industrial products.

Most of the world's agricultural and forestry researchers have never heard of these species. That is the tragedy of the subject of shrubs. It is a situation that must not continue.

SOBRE LA NECESIDAD DE UN ESPACIO INSTITUCIONAL ESTABLE PARA LA CIENCIA Y LA TECNOLOGIA EN COLOMBIA [1]

Por *Luis Eduardo Mora-Osejo*

Aunque pueda resultar un poco extraño, quisiera iniciar mi intervención haciendo énfasis en la diversidad y complejidad del entorno natural de nuestro país, que lo hace no solamente atrayente sino sobre todo, motivante para el escudriñamiento y la captación de las leyes naturales que rigen los procesos que la hacen posible. Así, Colombia presenta uno de los climas más variados del globo, no solamente en función de la diversidad de alturas, sino también de la diversidad de regímenes de viento y de la complicada orografía y topografía de la región andina. Su flora también es de las más diversas y complejas. Otro tanto podríamos decir de su geología, de su suelo, de sus ríos, de sus dos costas, y, en fin, de todos sus sistemas naturales; llámense selvas, llanuras, bosques de montaña, páramos, litorales, manglares o desiertos. Tal diversidad de ambiente, de microambientes, de nichos ecológicos, se refleja desde luego también en los problemas inherentes a los procesos productivos, así se trate de agricultura, ganadería, silvicultura, ingeniería de vías, minería, procesos industriales, entre otros muchos.

El conocimiento científico de un entorno naturàl de las características señaladas para el nuestro, ha constituido en todo tiempo para la comunidad humana respectiva, un gran desafío y al mismo tiempo la mayor motivación para intentar comprender las regularidades o leyes subyacentes.

Así nos lo enseña el ejemplo de los Incas y de los Mayas en nuestra América, de los Griegos en el Mediterráneo, o más recientemente de los pueblos de Europa que con el transcurrir de los siglos aprendieron a comprender su entorno, a aprovecharlo en la consolidación de su cultura y en la construcción de su civilización ya milenaria.

Por ello mismo, podría esperarse quizás que en Colombia debería haberse ya iniciado al menos un proceso semejante y que entre tanto se hubiese ya conformado una Comunidad científica sólida, no solamente por el número de sus investigadores, sino también por los logros científicos alcanzados. Sin embargo, como ya se ha dicho en este Foro, en repetidas ocasiones, la realidad es diferente. Contamos solamente con 6.000 investigadores de acuerdo a los datos disponibles en COLCIENCIAS, cifra que se reduce sensiblemente si se tiene en cuenta que muchos investigadores solamente pueden dedicar una fracción de su tiempo hábil a las tareas de la investigación científica, propiamente dicha.

Injusto sería aceptar las tesis de algunos que pretenden señalar la calidad humana intrínseca como uno de los factores determinantes de tal situación. Sabemos que somos el resultado de un mestizaje de razas heterogéneas que asegura una población con un rico patrimonio genético el cual se refleja no solamente en el vigor biológico, sino con la presencia de habilidades intelectuales, imaginación creadora como muestran las realizaciones en diferentes campos de la cultura, tales como las artes plásticas, la literatura y, a nivel individual, en la propia ciencia.

Es pues en otros ámbitos donde debemos buscar las causas determinantes de la carencia en nuestro país de una Comunicad Científica consolidada, a la altura de las exigencias de la complejidad de nuestra realidad natural y, en general, de la hora presente.

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1 Intervención del Presidente de la Academia, Doctor Luis Eduardo Mora-Osejo, en el "Foro Nacional sobre Política de Ciencia y Tecnología para el Desarrollo", Bogotá, 7, 8, 9 de octubre de 1987.

Al respecto, la tesis central que deseo plantear en esta contribución es la de señalar, como factor preponderante y decisivo, la falta a lo largo de la historia de nuestra nación, de un espacio institucional suficientemente estable y propicio para que la ciencia germine, se desarrolle exuberantemente, produzca sus frutos y simientes.

Así, al finalizar el siglo XVIII cuando se intentó por parte de la metrópoli española establecer un Instituto científico en nuestro medio, poco tiempo después de haber inaugurado José Celestino Mutis sus cátedras de Filosofía, Astronomía y Ciencias en el Colegio Mayor de Nuestra Señora del Rosario, se le solicitó morigerar sus contenidos críticos. Ya en la República, se hicieron varios intentos de retomar los grandes objetivos del Instituto Mutisiano, por ejemplo, a través del establecimiento de la Expedición Corográfica de Codazzi, o más tarde, en 1867 mediante la fundación de la Universidad Nacional, como entidad abierta al estudio de la realidad colombiana, particularmente a través de su Facultad de Ciencias y de otras Dependencias, tales como el Observatorio Astronómico y el Jardín Botánico. Pero también esta iniciativa y los esfuerzos complementarios habrían de verse pronto interrumpidos. Ya en 1885 se decide desintegrar la Universidad Nacional en Escuelas Profesionales separadas y suspender la Facultad de Ciencias y en general la enseñanza de las carreras científicas cuyo espíritu quizás se consideraba opuesto al de la regeneración triunfante.

Lo cierto es que solamente en 1935 se reconstruye la Universidad Nacional y 9 años después, en 1946, se crea la Facultad de Ciencias con el propósito central de formar investigadores, pero sorprendentemente ya en 1955 deja de funcionar.

En 1965 se restablece la Facultad de Ciencias, aunque esta vez bajo el propósito prioritario de racionalizar la administración. Aunque es justo reconocer que merced a los esfuerzos de superación cumplidos a lo largo de los últimos 20 años, en el seno de la nueva facultad surgieron a la postre, núcleos de investigación estables y productivos, los mismos que, en la hora presente, desarrollan el mayor número de Proyectos de investigación científica en la Universidad colombiana.

Pero, volviendo a la tesis central, pienso que el sucinto recuento histórico nos muestra de qué manera para el desarrollo de nuestra ciencia no se ha podido consolidar un espacio institucional estable, propicio y fecundo, aun en el propio seno de nuestras Universidades mayores.

La carencia de ese espacio institucional para la ciencia, desde luego, impide o al menos dificulta que se produzca un desarrollo o proceso de cualificación al interior de la propia ciencia, que le permita superar definitivamente el nivel descriptivo y elevarse al nivel interpretativo; esto es, al hallazgo de la explicación de los problemas o a la formulación de tesis o teorías que expliquen las peculiaridades de los fenómenos naturales. Por la misma razón, no ha sido posible que se den otros pasos importantes, en el proceso de consolidar un Sistema de Ciencia y Tecnología, como es la utilización de los conocimientos que se logren merced a la investigación básica en el desarrollo de procesos y de conocimientos útiles, esto es aprovechables en el manejo de los recursos para el desarrollo económico, o sea, en la creación de una Tecnología autóctona.

Bajo esta circunstancia, la Ciencia y la Tecnología propias, han pasado a ser consideradas como actividades marginales y muy raras veces han tenido la oportunidad de hacer aportes al desarrollo económico del país, lo cual de suyo ha conducido a que se abra una amplísima brecha para el empleo de conocimientos y tecnologías foráneas en los procesos de producción económica, cuya aplicación generalmente, no tiene en cuenta las condiciones particulares del país que, como hemos visto, determinan no solamente su singularidad, sino que sea uno de los más diversos y complejos del planeta. Además, la transferencia y aplicación masiva de tecnologías foráneas impide que la Ciencia y la Tecnología propias logren reconocimiento del sector productivo el que no solamente se abstiene de formular demandas de conocimientos sino que ignora a la comunidad científica nacional.

Bajo estas circunstancias no es sorprendente que la formación de nuevos cuadros de investigadores tropiece también con grandes dificultades. La carencia de un espacio institucional propicio y fecundo para el desarrollo de la ciencia, ha impedido también que evolucionen los métodos pedagógicos de la enseñanza y ha determinado que aún, en las postrimerías del Siglo XX, continuemos aferrados a los métodos escolásticos del medioevo, que de suyo limitan la enseñanza a la repetición del saber consolidado en otros países. La aplicación de tal método contribuye a que, entre otros, profesores y estudiantes tengan la posibilidad de ser protagonistas de su propio trabajo. Los Profesores en cuanto que agobiados por la enseñanza repetitiva memorística, sumada a la falta de facilidades operativas para la investigación científica ven reducir su autonomía para desarrollar su propia iniciativa, tan indispensable para el trabajo creativo y para la formación de las nuevas promociones de investigadores dentro de una atmósfera de libertad que propicie el trabajo intelectual.

Desde luego, no podemos contentarnos con el simple diagnóstico sobre los factores que inciden y determinan la condición marginal de nuestra Ciencia y Tecnología locales. En el intento de buscar una solución y recordando nuestro planteamiento central, en mi opinión, lo prioritario consistiría en crear un Espacio Institucional propicio y fecundo para desarrollar la investigación científica bajo el impulso decidido y la voluntad política firme de los gobiernos, que se traduzca también en una generosa financiación y dotación de facilidades logísticas para el estudio de los problemas, garantizando una atmósfera de libertad y autonomía intelectual que permita que los investigadores sean protagonistas de su propio trabajo y, en tal medida, puedan también cumplir, de la mejor manera, sus tareas científicas y su responsabilidad inalienable de formar los nuevos cuadros de científicos que requiere el país para asegurar un desarrollo de acuerdo con sus peculiaridades.

Dentro de esa atmósfera podrá ser cierto que la investigación y la docencia para la formación de nuevos investigadores son tareas que lejos de oponerse se complementan mutuamente. En esa medida la práctica no podrá limitarse a la simple realización de experimentos bajo condiciones idealizadas, sino que podrá abarcar el abordamiento y solución de problemas concretos de la realidad del país. Pienso que solamente así los nuevos investigadores estarán a la altura de los problemas que les aguarda el futuro y podrán contribuir a la consolidación de la comunidad científica colombiana, y a que algún día nuestro desarrollo tenga por fundamento el conocimiento científico de nuestra diversa y compleja realidad natural.

NOTAS DE SECRETARIA

A partir del primer número de esta Revista se inició la publicación de una sección de "NOTAS" sobre asuntos diversos y mediante la cual las directivas de la Corporación han dado a conocer, en forma resumida, las principales actividades adelantadas por la Academia al igual que informes breves de interés para la comunidad científica. A partir de esta entrega, se reinicia la publicación de estas Notas a través de las cuales la Secretaría presentará a los lectores esta información.

NUEVOS ESTATUTOS

Con el fin de contar con normas estatutarias acordes con la época y de dar mayor dinamismo a la Corporación, se inició durante el período académico 1984 – 1986 el estudio conducente a una reforma estatutaria; para ello se tomó como base el proyecto elaborado por los académicos LUIS ENRIQUE GAVIRIA SALAZAR y EDUARDO CARO CAYZEDO. Tras el análisis por parte de la Junta Directiva durante las primeras sesiones de 1986, el texto de la reforma pasó a consideración de la Academia el 12 de marzo de 1986. El primer debate se abrió en la sesión ordinaria del 9 de abril, continuándose la discusión durante la sesión ordinaria celebrada el 12 de mayo. La versión final fue aprobada en primer debate el 30 de julio de 1986. El segundo debate, correspondiente al período académico 1986 – 1988, se realizó el 17 de septiembre de 1986, fecha en la cual fue acogida la reforma. Los nuevos estatutos entraron en vigencia en julio de 1987, una vez fue aprobado su texto por parte de la Alcaldía Mayor del Distrito Especial de Bogotá – Resolución No. 0165 del 24 de junio – y de publicarse la misma en el Diario Oficial. Al tiempo que se modificaban los Estatutos, se renovó la Personería Jurídica de la Corporación.

Los primeros estatutos se aprobaron en 1936 y tuvieron vigencia hasta 1957, año en que sufrieron una primera modificación. En 1969 y luego de amplio debate se produjo una nueva reforma que tuvo vigencia hasta 1987, cuando entra en funciones la tercera reforma.

Para conocimiento de nuestros lectores el nuevo texto se publicará en la próxima entrega de esta Revista.

ACTIVIDADES ACADEMICAS (Período 1986 – 1987)

Durante el año académico comprendido entre el 20 de agosto de 1986 y la misma fecha en 1987, la Academia realizó un total de veinticuatro sesiones, de las cuales doce corresponden a reuniones de la Junta Directiva, nueve a sesiones ordinarias y tres a sesiones públicas y solemnes.

El 10 de octubre de 1986 tomó posesión como Académico de Número la Dra. INES BERNAL DE RAMIREZ, quien presentó como discurso de fondo un interesante estudio bajo el título "Una experiencia didáctica. La enseñanza de la Química Analítica en la Universidad a Distancia". Correspondió a la Dra. BERNAL DE RAMIREZ el sillón No. 36 en el cual la había precedido el destacado botánico LORENZO URIBE URIBE. Dio respuesta al discurso de posesión el Dr. CARLOS EDUARDO CALDERON.

El 3 de diciembre de 1986, la Academia realizó en el Auditorio Enrique Pérez Arbeláez del Instituto de Ciencias Naturales – Museo de Historia Natural de la Universidad Nacional una sesión solemne conmemorativa del cincuentenario de la creación del Instituto de Ciencias Naturales y del Departamento de Química de la Facultad de Ciencias de la Universidad Nacional. Durante este acto hicieron uso de la palabra los académicos SANTIAGO DIAZ PIEDRAHITA y SVEN ZETHELIUS PEÑALOSA.

En la sesión solemne estatutaria realizada el 19 de agosto llevó la palabra el académico de número GONZALO CORREAL URREGO quien presentó un interesante estudio de fondo bajo el título "Paleopatología en restos óseos precerámicos de la Estación Aguazuque I". Durante este acto fueron entregados a través de los agregados culturales de sus respectivos países, los diplomas de miembro correspondiente extranjero; al geólogo austríaco ADRIEN SCHEIDEGER y el geógrafo francés JEAN TRICART.

La nómina de la Academia se vio enriquecida durante el último año académico al ingresar distinguidos científicos, tanto nacionales como extranjeros. Como académicos correspondientes ingresaron a la Corporación el físico y astrónomo WOLFGANG GIEREN, quien tomó posesión el 14 de octubre de 1987 dando lectura al estudio titulado "El uso de las estrellas cefeidas para el establecimiento de distancias dentro y fuera de nuestra Galaxia". La presentación del nuevo miembro estuvo a cargo del académico de número JORGE ARIAS DE GREIFF.

El día 28 de octubre de 1987 tomó posesión como académico correspondiente el naturalista JORGE HERNANDEZ CAMACHO quien presentó el estudio titulado "Ensayo sobre la Biogeografía de la cuenca del río Magdalena". La presentación de este nuevo miembro estuvo a cargo del académico correspondiente ALBERTO CADENA GARCIA.

CHARLAS ACADEMICAS

Durante las sesiones ordinarias de la Corporación ha continuado con éxito el ciclo habitual de conferencias. En el período académico 1986 – 1987 se escucharon las siguientes:

"Astronomía de posición" a cargo del académico de número EDUARDO BRIEVA; "La Asamblea General del Consejo Internacional de Uniones de Ciencia" a cargo del académico de número JULIO CARRIZOSA UMAÑA; "El concepto de vecindad y sus implicaciones en la Topología" a cargo del académico correspondiente JANUARIO VARELA; "Adaptaciones de las plantas" a cargo del académico de número LUIS EDUARDO MORA; "La dinámica nutricional del sistema suelo-planta" a cargo del académico correspondiente JOSUE QUINTERO; "Ciencia y cultura – la discontinuidad de la energía" a cargo del académico correspondiente JOSE LUIS VILLAVECES; "El desarrollo de la Física en la América Latina" a cargo del académico correspondiente JUAN HERKRATH.

NUEVAS COLECCIONES DE LIBROS

En febrero de 1985 la Academia aprobó la creación de tres colecciones de libros destinadas a promover la investigación y permitir la fácil divulgación de estudios en tres áreas de la ciencia. La primera de estas series lleva el nombre de *"Colección Jorge Alvarez Lleras"* y está destinada a la publicación de los resultados de trabajos investigativos en cualquier área de las ciencias. La segunda serie, denominada *"Colección Julio Carrizosa Valenzuela"* está destinada a la publicación de obras de carácter didáctico. La tercera serie llamada *"Colección Enrique Pérez Arbeláez"* tiene por objeto publicar trabajos sobre la historia de la ciencia.

El primero de los libros publicado dentro de estas colecciones lleva por título *"Estudios morfológicos, autoecológicos y sistemáticos en Angiospermas"* y corresponde al resultado de investigaciones realizadas por el Dr. LUIS EDUARDO MORA OSEJO en los últimos años sobre el plan estructural de las plantas y sobre las implicaciones sistemáticas planteadas por los diversos biotopos generados por factores autoecológicos. En la primera parte del libro se proporciona una sencilla pero detallada explicación del método tipológico, valiéndose el autor de ejemplos concretos con los que logra demostrar las bondades de este sistema, mediante el cual es posible obtener una visión global de la estructura de las plantas, de la disposición de sus elementos y de las diversas configuraciones que se pueden derivar del tipo fundamental como respuesta adaptativa a diversos factores. La segunda parte del libro incluye la revisión de las especies americanas del género *Oreobolus* de la familia de las ciperáceas.

PROMOCIONES ACADEMICAS

Durante la sesión realizada el 18 de noviembre de 1987 fueron exaltados por consentimiento unánime a la categoría de miembros de número los académicos SANTIAGO DIAZ PIEDRAHITA y JOSE LUIS VILLAVECES CARDOSO. Ocuparán, de acuerdo con la sucesión cronológica, los sillones número 22 y número 38. El sillón No. 22 ha sido ocupado por los doctores ALFONSO ESGUERRA GOMEZ y CARLOS PAEZ PEREZ, en tanto que el sillón No. 38 tan sólo ha sido ocupado por el Dr. AGUSTO GAST GALVIS.

PREMIOS

En sesión realizada el 11 de febrero de 1987 (Acta No. 2), la Academia Colombiana de Ciencias Exactas, Físicas y Naturales, en cumplimiento de una de sus finalidades, como es la de fomentar la investigación en los diversos campos de las ciencias y contando con los auspicios de la Academia de Ciencias del Tercer Mundo, estableció un premio anual de ciencias destinado a promover el desarrollo de la ciencia básica en el país estimulando entre los científicos colombianos menores de 35 años, la producción de trabajos originales, alternativamente en los campos de la biología, la física, la química y las matemáticas. Para poner en marcha este concurso, la Academia constituyó una comisión integrada por los doctores LUIS EDUARDO MORA, JOSE LUIS VILLAVECES, LUIS GUILLERMO DURAN y MOISES WASSERMAN. El 18 de marzo (Acta No. 3), la Corporación acogió el reglamento preparado por la Comisión.

El 1o. de abril (Acta No. 6), la Junta Directiva creó un segundo premio auspiciado totalmente por la entidad, quedando estos galardones establecidos como sigue:

1. PREMIO ACADEMIA COLOMBIANA DE CIENCIAS

Otorgado por la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.

Para cada año, la Junta Directiva fijará el área sobre la cual versarán los trabajos; concursarán campos de la ciencia no contemplados en el Premio Academia de Ciencias del Tercer Mundo. Ningún área podrá repetirse antes de cuatro años. Para 1987 se convocó el área de Ciencias de la Tierra y se fijó el monto del premio en $480.000.oo.

2. PREMIO ACADEMIA DE CIENCIAS DEL TERCER MUNDO

Otorgado anualmente por la Academia Colombiana de Ciencias Exactas, Físicas y Naturales.

El área del concurso será diferente cada año, rotando en el siguiente orden: Biología, Física, Química y Matemáticas. La convocatoria se abrió paralelamente con la del otro premio, concursando para 1987 trabajos en el área de Biología. El monto del premio se fijó en $480.000.oo. A partir de éste, los premios se convocarán anualmente de acuerdo con el siguiente calendario:

Convocatoria: 21 de marzo.

Recepción de trabajos hasta el 21 de agosto.

Calificación de los mismos hasta el 9 de noviembre.

Declaratoria de resultados: 10 de noviembre.

Premiación: 30 de noviembre.

Los premios se convocaron de acuerdo con los siguientes reglamentos:

PREMIO "ACADEMIA COLOMBIANA DE CIENCIAS"

ARTICULO 1. La Academia Colombiana de Ciencias Exactas, Físicas y Naturales, establece un premio anual, para motivar a jóvenes en la carrera de Investigación Científica.

ARTICULO 2. Se otorgará un premio al mejor trabajo, por un monto que será fijado cada año por la Junta Directiva de la Academia.

Se otorgará además una Mención Especial al Trabajo que obtenga la segunda calificación.

ARTICULO 3. Para cada año, la Junta Directiva fijará el área sobre la cual versarán los trabajos. Concursarán áreas de la ciencia no contempladas en el Premio Academia de Ciencias del Tercer Mundo; ningún área podrá repetirse antes de cuatro años.

ARTICULO 4. Sólo se premiará un trabajo excelente. De no haberse presentado ninguno con tal característica, el premio se declarará desierto.

ARTICULO 5. El trabajo debe ser original y haber sido realizado en Colombia en su totalidad. Puede ser inédito, o haber sido presentado como tesis, o publicado, durante los 4 años inmediatamente anteriores a la adjudicación del premio.

ARTICULO 6. El trabajo debe ser presentado por triplicado, con el formato de un artículo científico. Debe contener: a) Una Introducción donde se revisa brevemente el estado del tema y se plantea la hipótesis y los propósitos del trabajo. b) Una sección de metodología clara y concisa. c) Resultados presentados brevemente, con las gráficas y tablas que sean necesarias. Debe ser coherente con la introducción. d) Una discusión amplia, que tome en cuenta la literatura internacional en el tema. e) Bibliografía precisa y correctamente citada.

Se debe adjuntar una hoja de vida.

ARTICULO 7. El autor del trabajo debe ser colombiano. Se entenderá por tal quien lo sea de acuerdo con la Constitución Nacional y las leyes colombianas sobre la nacionalidad.

ARTICULO 8. Los concursantes no deben ser mayores de 35 años al 31 de diciembre del año de la convocatoria.

ARTICULO 9. La Junta Directiva de la Academia nombrará una comisión verificadora, compuesta por 3 académicos, por lo menos uno de ellos de número, que recibira los trabajos, verificará las condiciones de presentación, el área de la investigación y la edad y nacionalidad del investigador.

La comisión numerará los trabajos y los repartirá al jurado calificador sin el nombre del autor.

ARTICULO 10. La Junta Directiva propondrá a la Academia, para su nombramiento, un jurado calificador, compuesto por 3 académicos, entre los cuales debe haber por lo menos uno de número. Los miembros del jurado serán científicos de reconocida trayectoria en el área del premio. Se podrán nombrar además otros jurados, no necesariamente pertenecientes a la Academia.

ARTICULO 11. En principio se escogerán los cinco trabajos mejor calificados y entre ellos el jurado escogerá el premio y la mención.

PREMIO "ACADEMIA DE CIENCIAS DEL TERCER MUNDO"

ARTICULO 1. La Academia Colombiana de Ciencias Exactas, Físicas y Naturales, con la colaboración de la Academia de Ciencias del Tercer Mundo, establece un premio anual, para motivar a jóvenes en la carrera de Investigación Científica.

ARTICULO 2. Se otorgará un premio al mejor trabajo, por un monto que será fijado cada año por la Junta Directiva de la Academia.

El dinero provendrá de los fondos que aporte para tal objeto la Academia de Ciencias del Tercer Mundo o en su falta, de las donaciones, que la Academia consiga.

Se otorgará además una Mención Especial al trabajo que obtenga la segunda calificación.

ARTICULO 3. El área de los trabajos premiados será diferente cada año, y rotará en el siguiente orden: Biología, Física, Química y Matemáticas.

A partir del artículo 4 los dos reglamentos son iguales.

En sesión realizada el 4 de septiembre del año pasado (Acta No. 16), la Academia designó los jurados encargados de evaluar los trabajos presentados en la convocatoria de 1987, los cuales quedaron integrados en la siguiente forma:

Premio Academia de Ciencias del Tercer Mundo. Area Biología.

Hermano DANIEL GONZALEZ – Académico de Número.

Padre CARLOS EDUARDO ACOSTA – Académico de Número residente en Medellín.

Doctor MOISES WASSERMAN – Académico correspondiente.

Premio Academia Colombiana de Ciencias – Area Ciencias de la Tierra.

Doctor LUIS GUILLERMO DURAN – Académico de Número.

Doctor HERNANDO DUEÑAS – Académico correspondiente.

Doctor MICHEL HERMELIN – Geólogo y Catedrático residente en Medellín.

Al concluir el plazo de entrega de trabajos, se había recibido un total de 24 trabajos, de los cuales resultaron 18 en el área de Biología, 5 en el área de Ciencias de la Tierra y 1 en un área no convocada (Física). La lista de trabajos recibidos es la siguiente:

PREMIO ACADEMIA COLOMBIANA DE CIENCIAS–
Area Ciencias de la Tierra

- LOS TERREMOTOS EN COLOMBIA Y CARACTERISTICAS DE SU ORIGEN PROFUNDO. Por Carlos E. Coral Gómez.
- METODOLOGIA PARA LA DETERMINACION DE LA INFLUENCIA SINODICA DE LA LUNA Y EL SOL EN LOS TERREMOTOS COLOMBIANOS. Por Diego Tovar Cock.
- PETROGRAFIA DE LAS ROCAS METAMORFICAS DE EL RETIRO – ANTIOQUIA. Por Ricardo José Ardila Macías.
- DISEÑO Y CONSTRUCCION DE UN EQUIPO GEOELECTRICO. APLICACION DE PRUEBA EN LA MINA EL ROBLE (CHOCO). Por José Vicente Franco Serna.
- FORAMINIFEROS BENTONICOS RECIENTES DE ISLA DE BARU. Por Carmen Parada Ruffinatti y Juan Pinto Nolla.

PREMIO ACADEMIA DE CIENCIAS DEL TERCER MUNDO –
Area Biología

- CULTIVO DE MERISTEMOS Y PARTES DE EMBRION EN PINUS CARIBEA. Por Carmen Rincón Meneses.
- APLICACION DE LA FUSION CELULAR Y DEL BLOQUEO PROLIFERATIVO INDUCIDO (FUNCION DE ACUMULACION) EN EL ANALISIS DEL CICLO CELULAR DE LINEAS CELULARES CULTIVADAS IN VITRO. Por Blanca L. Reyes O. y Mauricio Camargo G.
- TOXICOLOGIA Y CONTAMINACION POR ACIDO 2, 4-DICLOROFENOXI-ACETICO EN EL PEZ GUPPY (Lebistes reticulatus). Por Carlos Alberto Forero.

- LA PLACENTA EN EL EMBARAZO NORMAL Y DE ALTO RIESGO. Por Josué Fernando Becerra C., Jacqueline Puello Gutiérrez, José Alejandro Ramírez Medina, Juan Carlos Tovar.
- ESTUDIO SOBRE LA INCIDENCIA Y SUSCEPTIBILIDAD A FARMACOS DE MYCOBACTERIUM EN PECES ORNAMENTALES COLOMBIANOS (Cichlidos). Por Luis Saúl Serna C.
- ANALISIS REPLICATIVO DE ALTA RESOLUCION DEL EFECTO DE UNA BASE ANALOGA ANTINEOPLASTICA (5-FLUORO-DEOXIURIDINA) SOBRE LA DUPLICACION Y LA REPARACION CROMOSOMICA. Por Juan B. López O., y Mauricio Camargo G.
- IMPLEMENTACION DE UNA NUEVA TECNICA PARA EVALUAR INTERACCION DE LA CAFEINA CON CLASTOGENOS AMBIENTALES POTENCIALES. Por Esperanza Trujillo, Gabriel Rodríguez A., y Mauricio Camargo G.
- CUESTIONANDO EL CONCEPTO DE VARIANZA AMBIENTAL CON BASE EN ESTUDIOS DE VIABILIDAD DE UNA POBLACION DE *DROSOPHILA PSEUDOOBSCURA* DEL ALTIPLANO CUNDIBOYACENSE COLOMBIA. Por José Rodríguez.
- ACCION DE *Eucaliptus globulus, Pinus radiante* Y OCHO ESPECIES NATIVAS DEL BOSQUE ALTO ANDINO SOBRE EL SUELO. Por Constanza Inés Buitrago Bernal, y Liliana Salazar López.
- LA OSTRA COMERCIAL DE LA CIENAGA GRANDE DE SANTA MARTA *C. rhizophorae* Y LA PROBLEMATICA DE LA CONTAMINACION POR METALES. Por Néstor Hernando Campos C.
- LA EDAFOFAUNA DEL BOSQUE ALTO ANDINO EN UNA REGION DE MONSERRATE. Por Mary Ruth García Conde.
- ANALISIS GENETICO DE LA VARIACION ALOZIMICA EN EL CLUSTER *MARTENSIS* DEL GRUPO *REPLETA* DE *DROSOPHILA* EN LA GUAJIRA COLOMBIANA. Por Alirio Montaño Arias.
- ESTUDIO CLADISTICO EN LA FAMILIA IGUANIDAE (SAURIA: REPTILIA) CON BASE EN LA MUSCULATURA DEL MIEMBRO POSTERIOR. Por Julio Mario Hoyos Hoyos.
- CROTALARIA (Fabaceae – Faboideae). Por Henry Yesid Bernal M.
- ACTIVIDAD BIOLOGICA DE XANTUMINA, SOBRE LA GERMINACION Y CRECIMIENTO DE ALGUNAS PLANTAS. Por Saúl Mejía Amador.
- PECES DE LAS ISLAS DEL ROSARIO Y DE SAN BERNARDO (COLOMBIA). Por Arturo Acero P., y Jaime Garzón F.
- PALMAS DEL DEPARTAMENTO DE ANTIOQUIA. Región occidental. Por Gloria Galeano y Rodrigo Bernal.

El 28 de septiembre a las 5:30 p.m. se reunió en la sede de la Academia la Comisión con el fin de verificar el cumplimiento por parte de los concursantes de los requisitos establecidos y para iniciar el proceso de evaluación. El 14 de octubre se realizó una nueva reunión en la cual se seleccionaron como trabajos finalistas los siguientes:

PREMIO ACADEMIA COLOMBIANA DE CIENCIAS – Area Ciencias de la Tierra.

- Los terremotos en Colombia y características de origen profundo.
- Petrografía de las rocas metamórficas en El Retiro – Antioquia.
- Diseño y construcción de un equipo geoeléctrico, aplicación de prueba en la mina El Roble.

PREMIO ACADEMIA DE CIENCIAS DEL TERCER MUNDO – – Area Biología.

Se escogieron por su nivel sobresaliente los siete trabajos siguientes:

- Aplicación de la fusión celular y del bloqueo proliferativo inducido (función de acumulación) en el análisis del ciclo celular de líneas celulares cultivadas in vitro.
- Acción de Eucaliptus globulus, Pinus radiata y ocho especies nativas del bosque altoandino sobre el suelo.
- Peces arrecifales de las Islas del Rosario y del Archipiélago de San Bernardo.
- Crotalaria –Fabaceae– faboideae. (Revisión).
- Palmas del Departamento de Antioquia – Región noroccidental.
- Estudio cladístico de la familia Iguanidae (Sauria – Reptilia) con base en la musculatura del miembro posterior.
- Análisis genético de la variación alozímica en el cluster Martensis del grupo repleta de Drosophila en la Guajira, Colombia.

El jurado señaló la dificultad en escoger entre estos trabajos sobresalientes por su calidad y nivel, uno ganador. Tras varias deliberaciones se seleccionaron como finalistas los trabajos Palmas de Antioquia, Crotalaria y Estudio cladístico de la familia Uganidae.

Para la versión 1987, el cuadro de ganadores quedó como sigue:

PREMIO ACADEMIA COLOMBIANA DE CIENCIAS – Area Ciencias de la Tierra.

Primer lugar: Los terremotos en Colombia, características de origen profundo presentado por el geofísico CARLOS E. CORAL GOMEZ.

Segundo lugar. Mención Especial: Diseño y construcción de un equipo geoeléctrico. Aplicación de prueba en la mina El Roble, presentado por el ingeniero de minas JOSE VICENTE FRANCO SERNA.

Mención de Honor al joven estudiante DIEGO TOVAR COCK por el trabajo Metodología de la Determinación de la Influencia sinódica de la Luna y el Sol en los terremotos colombianos.

PREMIO ACADEMIA DE CIENCIAS DEL TERCER MUNDO – – Area Biología.

Primer lugar: Compartido por los trabajos: Palmas de Antioquia Región noroccidental y Crotalaria-Fabaceae, Faboideae presentados respectivamente por los ingenieros agrónomos GLORIA GALEANO GARCES y RODRIGO BERNAL GONZALEZ y por el biólogo HENRY YESID BERNAL.

Segundo lugar - Mención Especial: Estudio cladístico de la familia Iguanidae (Reptilia Sauria) con base en la musculatura del miembro posterior presentado por el biólogo JULIO MARIO HOYOS H.

La entrega de los premios se llevó a cabo en el paraninfo de la Academia de la Lengua, en sesión pública y solemne realizada el 30 de noviembre. Fue profundamente satisfactorio para la entidad haber organizado estos premios y comprobar la acogida que tuvieron entre la comunidad científica colombiana y especialmente en el ámbito universitario. Se espera que la convocatoria correspondiente a 1988 tenga el mismo éxito y cuente con una nutrida participación de trabajos en los campos de la Física y la Biotecnología.

CONFERENCIAS CONMEMORATIVAS

La Academia, en colaboración con la Universidad Nacional de Colombia y con el Grupo de Física Teórica de la misma Universidad, organizó un ciclo de conferencias conmemorativas, en el Centenario del nacimiento de ERWIN SCHRODINGER, creador de la mecánica ondulatoria y Premio Nobel de Física en 1933. Este ciclo se inició el cinco de octubre en el Auditorio Enrique Pérez Arbeláez del Instituto de Ciencias Naturales de la Universidad Nacional y durante el mismo se pronunciaron las siguientes conferencias:

1. Erwin Schrödinger y la física de su tiempo a cargo del académico EDUARDO BRIEVA.
2. La ecuación de Schrödinger y el nacimiento de la mecánica ondulatoria a cargo del académico GUILLERMO CASTILLO.
3. La visión actual de la naturaleza a través de la mecánica cuántica: impacto sobre la física, a cargo del profesor BERNARDO GOMEZ.
4. El influjo de la obra de Schrödinger sobre la química del siglo XX a cargo del académico JOSE LUIS VILLAVECES.
5. ¿Qué es la vida? – ¿Dio Schrödinger la respuesta?, a cargo del profesor RAMON FAYAD.
6. Schrödinger y la biología: el drama de la interdisciplinaridad, a cargo del profesor PAUL BLOMBERG.
7. Causalidad y sentido del tiempo, a cargo de la profesora ALICIA GUERRERO DE MESA.
8. Interpretación de la mecánica cuántica: Schrödinger-Copenhague, a cargo del profesor VIRGILIO NIÑO.
9. Anotaciones filosóficas en torno a determinismo e indeterminismo, a cargo del profesor CARLOS GUTIERREZ.
10. Algunas consecuencias técnicas de la mecánica cuántica, a cargo del profesor GERMAN ARENAS.

SANTIAGO DIAZ PIEDRAHITA
Secretario

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