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About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

12. Seminar

Frequent or occasional attendance by professors at the Seminar for graduate students would be helpful to all. Some of the students' reports may be tiresome, but there are also interesting ones. Students are doing good work in using German and French.

13. A Five-Year Plan

The Department can not be built up in a day to the desired place in the scientific and educational world. Let us plan ahead both for the Department and for ourselves. Each one who advances helps the rest; each one who vegetates drags the rest of us down. What fields should we most cultivate? Does our geographical situation suggest anything to us? How can we secure more good students? How keep those we now have? What kinds of masters' and doctors' theses will be most likely to secure recognition? These things should be considered not vaguely but specifically; the reputation of the Department and of its professors depends largely on the research published by staff and students.

NOTE: These suggestions, prepared for the Biology Department, may interest the Faculty. The printing cost is paid by the author.—F. R.

Suggested Standards

for

The University of Colorado Department of Biology

By Francis Ramaley

Our University competes with institutions having greater financial resources, larger faculties, bigger libraries, and better laboratories. To have a place in the sun it is for us to make the best use of all facilities at our command. Undergraduate courses seem to be satisfactory but if improvements are possible from time to time needed changes can be made. At the present time attention should be given more particularly to graduate courses and to research and publication by members of the staff.

1. Who Should Carry on Research?

There ought to be no room on a university faculty for professors who entirely neglect research and writing or for instructors who merely teach and make no attempt to advance in academic standing. Not only should professors engage in research for publication but every instructor and assistant who has not already attained the doctorate should enroll in the Graduate School. Those who have the doctor's degree are expected to carry on research just as if they were professors. It is the business of the University to enlarge the bounds of knowledge quite as much as to teach college undergraduates.

2. Time for Research

Members of the professorial staff who will set aside certain definite hours each week for real research on a particular problem and who carry on this research regularly in the laboratory or library at the time specified should have this work counted in lieu of some of the usual teaching. An attempt will be made to give some relief to research workers by assigning additional duties to those not doing productive work.

3. Choice of Research Projects

In chosing research projects for ourselves or for our graduate students let us keep in mind the financial limitations of the University. Ambitious projects requiring considerable outlay for books and apparatus are not necessarily of greater value than pieces of work which may be carried out with less expense. Even the most wealthy institutions frankly state that there are certain fields which they do not cultivate.

4. Apparatus and Books for Research

An attempt will be made to secure needed apparatus and books for each piece of research, but things that merely would be "nice to have" can not be purchased under present conditions.

5. Reprints

When a paper is published, the author should send a certain number of reprints to specialists known to be interested. Each year the reprints in zoology of the various members of the staff should be sent by the Department to zoology departments in leading universities and a like procedure should be followed for botanical articles. Reprints sent out bring valuable exchanges in return. The expense of envelopes and stamps should be paid for out of Department funds.

6. Book-Reviews, Criticisms, and Text-books

Not only will published research bring recognition to the author and to the Department; but published book reviews, criticisms, and text-books show that we are alive, and, as suggested by one of our staff, may serve to attract for graduate work students who have become acquainted with these writings when they were undergraduates here or elsewhere.

7. Membership in Professional Societies and Academies

Membership in societies should be considered as a sine qua non for membership in a university faculty. Our institution will not get out of the normal-school or hick-college stage until faculty members meet this necessary professional requirement. Attendance at meetings whenever possible should be considered as a part of one's regular duties. We must expect to make some personal sacrifice of time and money if we as individuals and the Department as a whole expect to be recognized in the world of science.

8. Books of Value for Class Work

All members of the staff are asked to watch the reviews of books and to make exact note of author, title, publisher, date, and price of any book which seems highly desirable for advanced work, especially any book which will be used by a number of people, either professors or students. Hand requests to the Head of the Department. As many will be bought as funds will permit; unfortunately our funds are very limited during the present business depression. There is no money at present to buy books of a popular nature nor copies of college textbooks, which ordinarily have nothing new in them.

9. Periodicals

A considerable part of the fund which should be available for books is now necessarily used in the purchase of periodicals because of reduction in allowances for the general University Library. Let us make good use of these periodicals. We must do so if we are to keep up with the times. Why not look over once a week the magazines and pamphlets in the pigeon-hole on the telephone desk, Hale, 211? Graduate students should be trained to use both the recent numbers of journals and the bound volumes.

10. Departmental Library

Is the departmental library made use of to the fullest extent by professors and graduate students? Probably all could be helped by an occasional "browse." New books will from now on be placed for a couple of weeks in a special pigeon-hole on the telephone desk in the departmental library. The biology stacks in the General Library should become familiar. These have many books of value.

11. Weekly Report Meeting

If the Department is to maintain the proper degree of solidarity every professor, instructor, and graduate student should attend the Report Meetings. These afford an opportunity to know what others are doing. We are none of us such great geniuses or so learned that we will not profit by these meetings.

CU Proposal No. 70.5.254
5/70

A Proposal to the

National Science Foundation

for support of

COMPILATION OF A COMPUTERIZED IOPB CHROMOSOME DATA BANK

Name and Address of Institution: The Regents of the
University of Colorado
Boulder, Colorado 80302

Desired Starting Date: October 1, 1970

Amount Requested from NSF: $91,110

Time Period for which Support is Requested: 2 years (5 years if appropriate)

Co-Principal Investigators: Áskell Löve, Professor and Chairman
Doris Löve, Faculty Research Associate
Department of Biology
University of Colorado
Boulder, Colorado 80302
Telephone: 303-443-2211, ext. 7921 & 7325

Áskell Löve, Co-Principal Investigator
Chairman, Department of Biology

Doris Löve
Co-Principal Investigator

I certify that the distribution of costs between the direct and indirect categories as shown in the proposal conforms to the usual accounting practices of the institution and to the distribution used by the cognizant Federal audit agency.

Thurston E. Manning
Vice President for Academic Affairs
Eugene H. Wilson
Vice President for Business Affairs

ABSTRACT

This proposal is for the compilation of a computerized data bank and retrieval system for critical chromosome information of the approximately 40,000-45,000 species of higher plants and around 10,000 species of lower plants studied from this point of view in more than 20,000 publications since 1882. The compilation of the bank is endorsed by the International Organization of Plant Biosystematists, and it is estimated that it may require up to five years to list the backlog of information to the stage when only annual increments are required. Since the bank will include complete and critical taxonomical and bibliographical information on all chromosome numbers and on the size and morphology of chromosomes when available, it is expected to be useful as a tool for taxonomists, phytogeographers, geneticists, plant breeders, radiobiologists, and others who depend upon chromsome information for their investigations.

I. Background

Since the biosystematic approach to plant taxonomy has grown into an important venture in recent decades, the need for some aid in retrieval of pertinent information has long been pressing. This has been clearly recognized, especially by the large membership of the International Organization of Plant Biosystematists, which already in 1960 made information retrieval one of its main goals. The matter has been discussed at every meeting of this organization, but not until the Botanical Congress in Seattle in early September, 1969 was there any new progress available to demonstrate in what way this might be achieved. At that meeting, the Co-Principal Investigators presented their first attempts at computerizing available chromosome information in a data bank; although the results were only preliminary, they met with enormous enthusiasm and the venture was strongly supported and endorsed by the IOPB membership and executives.

Although biosystematic data are of various kinds, the majority of them at present are directly connected with chromosome studies and, especially, with determinations of chromosome numbers. The first chromosome numbers were counted in 1882 by the French botanist Guignard and the German botanist Strasburger, but it took more than a generation before the taxonomical importance of such studies became generally recognized. Not until around 1940 did the significance of this approach become generally acknowledged as the strongest basis for evolutionary classification, with the result that the number of published chromosome numbers has grown from about 500 in 1940 to well above 7,000 in 1969. Although only about 40,000-45,000 species of higher plants and around 10,000 species of lower plants have been studied from this point of view, the published items are well over 400,000, in more than 20,000 different publications. These numbers indicate the magnitude of the problem, because all other biosystematic publications together are estimated to reach less than ten percent of this figure. It ought to be mentioned that although chromosome numbers are important for solving many taxonomic and evolutionary problems, they are also of great value for studies of dispersal and distribution, and for all phases of practical and theoretical cytogenetics, and that the number, morphology, and size of chromosomes are known to be significant for the

results of experiments on artificial mutations and several other studies of basic evolutionary processes, theoretical and practical.

Although the need for retrieval of chromosome data has become particularly acute in recent years, it has long been recognized. The first attempt to index published chromosome numbers was made by the German cytologist Tischler in 1915, when he published a 120-page list of chromosome numbers and their bibliography. He continued this indexing and published, from 1927 to 1938, a series of five chromosome number reviews in Tabulae Biologicae, a publication which now is extremely rare and difficult to find even in university libraries. Later, in 1950, Tischler also published a list of chromosome numbers of the higher plants from Central Europe. Four chromosome lists were published, from 1926 to 1934, by the Canadian botanist Gaiser, and the French cytologist Delay compiled, in 1950, a list to cover the period from Tischler's list (1938) up to 1949. Other chromosome indexes covering selected parts of the world's flora have been published, e.g., for the cultivated plants of Japan by Kihara, Yamamoto, and Hosono (1931), for cultivated plants in general by Darlington and Janaki-Ammal (1945), and for flowering plants in general by Darlington and Wylie (1955) and by Fedorov and associates (1969). Since 1958, an annual index of chromosome numbers has been published under the editorship, first, of Cave, later by Ornduff, and presently by Moore, by the University of North Carolina Press and now by Regnum Vegetabile. That list is compiled by a number of cytologists, mostly American.

Lists of more restricted floras or groups of plants have been published by various scientists since Tischler (1934) indexed the chromosome numbers then known for the flora of Schleswig-Holstein. For the Pteridophytes, Chiarugi (1960) and later Fabbri (1963, 1965) have published critical lists in Caryologia. Maude (1939) and Rutland (1941) made critical taxonomical chromosome lists of the flora of the British Isles; Löve and Löve (1942) have published a critical list for the flora of the Scandinavian countries, followed by another critical list for all the Northern countries of Europe in 1948 and for the flora of Central and Northwestern Europe in 1961; they also made a critical review of the chromosome numbers of the Icelandic flora in 1956 and of the flora of Mount Washington, N.H., in 1966. Other substantial lists covering entire floras are those by Tarnavschi (1948) for Romania, by Jörgensen, Sörensen, and Westergaard (1958) for Greenland, and by Taylor and Mulligan (1968)

for the Queen Charlotte Islands, whereas several other lists cover smaller and more specialized areas. All these lists are good evidence in support of the claim that an effective retrieval system is greatly needed for chromosome information. The publications mentioned have been a substantial help, but the tremendous growth in this field of information has made it very difficult to employ conventional and classical methods for such compilations. It is evident also from the unavoidable mistakes that have crept into all the major lists and keep being repeated. It is also becoming more and more difficult to find copies of the older publications, and the newest, by Fedorov and his associates, was printed in a very small edition in Russia, from which it is always almost impossible to get copies of books.

For some few years we have been running a pilot study of methods for computerization of chromosome information that would make it possible to build up a biosystematic data bank which, first, would include complete and critical references on chromosome numbers and, later, make it possible to add information as to voucher specimens and origin and amount of material on which these numbers were counted, and then also the size and form of the chromosomes and other pertinent biosystematic data. Our pilot study was run on the ferns and fern allies, since we were aware of the tremendous taxonomical problems that have resulted here from most of the chromosome numbers of these taxa having been reported under several synonyms and on material of variable taxonomical certainty. As expected, we ran into innumerable problems with this group, but have been rewarded by being able to work out almost every problem and difficulty which can be expected to present inself when the entire bank is compiled.

Our application for support is based on this pilot study, since it has convinced us that time and methods are now ripe for the creation of a biosystematic data bank, commencing with chromosome information.

CYTOTAXONOMICAL ATLASES

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Chiarugi, A. 1960: Tavole cromosomiche delle Pteridophyta. - Caryologia 13: 27-150.

Darlington, C.D. and Janaki-Ammal, E.K. 1945: Chromosome atlas of cultivated plants. - London.

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Delay, C. 1950: Nombres chromosomiques chez les phanérogames. (Ire liste: 1938 & 1950). - Revue Cytol. Biol. Végét. 12: 1-368.

Fabbri, F. 1963: Primo supplemento alle "Tavole cromosomiche delle Pteridophyta" di Alberto Chiarugi. - Caryologia 16: 237-335.

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Fedorov, A.A. (ed.) 1969: Chromosome numbers of flowering plants. - Leningrad.

Gaiser, L.O. 1926: A list of chromosome numbers in angiosperms. - Genetica 8: 401-484.

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Kihara, H., Yamamoto, Y. and Hosono, S. 1931: A list of chromosome numbers of plants cultivated in Japan. - Shokobutsu Senshokutaisu no Kenkyu, Tokyo: 195-330.

Löve, Á. and Löve, D. 1942: Chromosome numbers of Scandinavian plant species. - Bot. Notiser 1942: 19-59.

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Löve, Á.and Löve, D. 1956: Cytotaxonomical conspectus of the Icelandic flora. - Acta Horti Gotob. 20: 65-290.

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Moore, R.J. (ed.) 1970: Index to plant chromosome numbers for 1968. - Regnum Vegetabile (in press).

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Rutland, J.P. 1941: The Merton catalogue. A list of chromosome numbers of British plants. Suppl. 1. - New Phytol. 40: 210-214.

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Tischler, G. 1938: Pflanzliche Chromosomenzahlen IV (Nachtrag Nr. 3). - Tab. Biol. 16: 162-218.

Tischler, G. 1950: Die Chromosomenzahlen der Gefässpflanzen Mitteleuropas. - s'Gravenhage.

II. Methods

It is a generally accepted fact that the computer is a tool of immense importance for statistical, classificatory, and retrieval studies of the kind that taxonomists have been concerned with since times immemorial. Many taxonomists, however, have discusse/ this facility rather than used it, for various reasons, the most obvious of which is perhaps that it requires certain basic knowledge which has not yet been included in the training of this group of scientists.

Many pilot systems have been developed in recent years with taxonomical information storage and retrieval in mind, the most comprehensive ones being the SIIR system of the Smithsonian Institution and the TAXIR system of David D. Rogers of the University of Colorado. Although our interest in such techniques reachs farther back than our knowledge of these systems, it was when we were brought in contact with TAXIR that we became ultimately convinced that computers were the only solution of the need for a good biosystematic data bank where chromosome information would be the basic material for storage and retrieval.

Since a chromosome data bank actually must be in several parts because it includes not only chromosome numbers but also other chromosome information, voucher information, synonyms, notes on origin, etc., and, later, information on chromosome size and form, in addition to automated bibliographical information, we ultimately rejected all specialized systems available in favor of a simply constructed system that is based on a keypunch and its operator, index cards that later can be transferred to tape, printers, and other inexpensive facilities which are available in any computer facility. All equipment and facilities essential to the program are available at Boulder and elsewhere, and there is no risk that we will be forced to revise our methods in the middle of the project because of a change or improvement in the equipment.

At present, in our pilot study, we have almost completed the first step, which is the compilation of a critical bank of all valid names of families, genera, and species in the evoluticnarily defined system of categories of the ferns and fern allies, with references to valid synonyms and other names used by cytologists, and a complete list of chromosome reports, followed by an exact list of bibliographic references. This

study was first based on available chromosome number compilations, notably those by Chiarugi and Fabbri, Tischler, Delay, and Löve and Löve, and then completed by checking back to the original papers. Since the critical nature of the list requires that taxonomical judgments be made within areas of knowledge in which we regard ourselves as amateurs, we have sought and will constantly seek advice from critical specialists. In the case of the ferns and fern allies our main helpers are Professor R. Pichi Sermolli of the University of Genoa and Dr. C. Jermy of the British Museum, both of whom agree that for such a work the biological concept, and those of the restricted genera and lower categories in cases of restricted knowledge, are the only ones to be followed in order to reduce the already existing confusion to a minimum.

The following stages of the work, for which we seek support in this proposal, will be concerned with the flowering plants, whereas the last stage will review plants at a systematic level below the pteridophytes. We will, then, start with the aid of all previously published chromosome atlases, continue by checking back to the originals available in our library, and conclude by checking every one of those papers to which we have found a reference and which can be located through personal contacts or library services, and/or copied as a standing reference. It is evident that in order to get as up-to-date information as possible we will ask for the assistance of Dr. Moore and his assistant compilers (of whom Á. Löve is one), and also contact specialists whenever they are needed. In order to make it easier to locate rare publications which may have escaped other compilers of chromosome numbers, we will try to ask for additional information through notices about our work on the data bank in available journals, as it becomes pertinent.

At the same time that we collect basic data for the chromosome bank, notes will be made on origin of material, location of vouchers, size and form of chromosomes, and other data of taxonomic importance that can easily be hooked onto the system when its taxonomical background has been completed. This part of the work may have to wait until the basic bank is completed and only annual additions become necessary to insert, but from the beginning space has been provided in our system for such additional data.

III. Samples of Pilot Results

A. Chromosome list

OPHIOGLOSSACEAE	1-0070-00000-00000-0000-101
	1-0070-00000-00000-0000-199
BOTRYCHIUM SW. X=15	1-0070-10500-00000-0000-201
ALABAYENSE MAXON	1-0070-10500-00500-0000-401
180 WAGNER,W.H. 1963	63H1-0070-10500-00500-0000-701
AUSTRALE R. BR.	1-0070-10500-01000-0000-401
90 BROWNLIE,G. 1958	58P1-0070-10500-01000-0000-701
90 BROWNLIE,G. 1961	61P1-0070-10500-01000-0000-702
BITERNATUM (SAVIGNY) UNDERW.	1-0070-10500-01500-0000-401
90 WAGNER,W.H. 1963	63P1-0070-10500-01500-0000-701
BOREALE MILDE	1-0070-10500-02000-0000-401
90 LOEVE,A./LOEVE,D. 1961A	61Q1-0070-10500-02000-0000-701
90 LOEVE,A./LOEVE,D. 1961D	61Q1-0070-10500-02000-0000-702
180 WAGNER,W.H. (IN FABBRI 1963)	63P1-0070-10500-02000-0000-703
DAUCIFOLIUM WALL.	1-0070-10500-02500-0000-401
SYN. SCEPTRIDIUM DAUCIFOLIUM (WALL.) LYON	1-0070-10500-02500-0000-402
180 MANTON,I./SLEDGE,W.A. 1954	54P1-0070-10500-02500-0000-701
180 NISHIDA,M/KURITA,S/NIIZEKI,S.1964	64P1-0070-10500-02500-0000-702
[illegible]	1-0070-10500-03000-0000-401
90 BRITTON,D.M. 1953	53P1-0070-10500-03000-0000-701
90 WAGNER,W.H. 1955	55P1-0070-10500-03000-0000-702
JAPONICUM (PRANTL) UNDERW.	1-0070-10500-03500-0000-401
SYN. SCEPTRIDIUM JAPONICUM(PRANTL) LYON	1-0070-10500-03500-0000-402
270 NISHIDA,M/KURITA,S/NIIZEKI,S.1964	64P1-0070-10500-03500-0000-701
LANCEOLATUM (GMEL.) ANGSTR.	1-0070-10500-04000-0000-401
SSP. ANGUSTISEGMENTUM (P./M.)R.CLAUSEN	1-0070-10500-04000-0020-501
90 WAGNER,W.H. 1955	55P1-0070-10500-04000-0020-701
SSP. LANCEOLATUM	1-0070-10500-04000-0040-501
90 LOEVE,A./LOEVE,D. 1961A	61P1-0070-10500-04000-0040-701
90 WAGNER, W.H. (IN FABBRI 1963)	63P1-0070-10500-04000-0040-702
LANUGINOSUM WALL.	1-0070-10500-04500-0000-401
180 MANTON,I./SLEDGE, W.A. 1954	51P1-0070-10500-04500-0000-701
180 WAGNER,W.H./LORD, L.P. 1956	56P1-0070-10500-04500-0000-702
180 NINAN, C.A. 1956B	56P1-0070-10500-04500-0000-703
180 NINAN, C.A. 1958A	58P1-0070-10500-04500-0000-704
90 VERMA, S.C./LOYAL,D.S. 1960A	60P1-0070-10500-04500-0000-705

LUNARIA (L.) SW. 1-0070-10500-05000-0000-401
90 HAGERUP,O. 1941 41Q1-0070-10500-05000-0000-701
90 MANTON, I. 1950 50P1-0070-10500-05000-0000-702
C 180 WAGNER,W.H.1955(V.ONONDAGENSE) 55P1-0070-10500-05000-0000-703
90 WAGNER,W.H./LORD,L.P. 1956 56P1-0070-10500-05000-0000-704
90 LOEVE,A./LOEVE, D. 1961A 61P1-0070-10500-05000-0000-705
90 LOEVE,A./LOEVE,D. 1961D 61P1-0070-10500-05000-0000-706

LUNARIOIDES (MICHX.) SW. 1-0070-10500-05500-0000-401
90 WAGNER,W.H. 1963 63P1-0070-10500-05500-0000-701

MATRICARIIFOLIUM (RETZ.) A.RR. 1-0070-10500-06000-0000-401
C 180 WAGNER,W.H. 1955 55P1-0070-10500-06000-0000-701
180 WAGNER,W.H./LORD,L.P. 1956 56P1-0070-10500-06000-0000-702

MINGANENSE VICTORIN 1-0070-10500-06500-0000-401
180 WAGNER,W.H./LORD,L.P. 1956 56P1-0070-10500-06500-0000-701

MULTIFIDUM (S.G.GMEL.) RUPR. 1-0070-10500-07000-0000-401
SYN. SCEPTRIDIUM MULTIFIDUM (GMEL.)NISHIDA 1-0070-10500-07000-0000-402
SSP. MULTIFIDUM 1-0070-10500-07000-0020-501
90 WAGNER,W.H. 1955 55P1-0070-10500-07000-0020-701
90 NISHIDA,M/KURITA,S/NIIZEKI,S.1964 64P1-0070-10500-07000-0020-702
90 WAGNER,W.H./CHEN,K.L. 1964 64P1-0070-10500-07000-0020-703
SSP. SILAIFOLIUM (PRESL) JAVORKA 1-0070-10500-07000-0040-501
90 SORSA,V. (IN FABBRI 1963) 63P1-0070-10500-07000-0040-701
90 TAYLOR,R.J./VULLIGAN,E.A. 1968 68P1-0070-10500-07000-0040-702

OBLIQUUM MUEHL. 1-0070-10500-07500-0000-401
C 100 CHAMBERLAIN 1920 20P1-0070-10500-07500-0000-701

ONEIDENSE (GILBERT) HOUSE 1-0070-10500-08000-0000-401
90 WAGNER,W.H. 1955 55P1-0070-10500-08000-0000-701

PUMICOLA COVILLE 1-0070-10500-08500-0000-401
90 WAGNER,W.H. 1955 55P1-0070-10500-08500-0000-701

SCHAFFNERI UNDERW. 1-0070-10500-09000-0000-401
C 90 WAGNER,W.H. 1963B 63P1-0070-10500-09000-0000-701
C 90 MICKEL,J.T/WAGNER,W.H/CHEN,K.1966 66P1-0070-10500-09000-0000-702

SIMPLEX E. HITCH. 1-0070-10500-09500-0000-401
90 WAGNER, W.H. 1955 55P1-0070-10500-09500-0000-701

STRICTUM UNDERW. 1-0070-10500-10000-0000-401
SYN. JAPANOBOTRYCHIUM STRICTUM (UNDERW.)NISHIDA 1-0070-10500-10000-0000-402
C 90 NIIZEKI,S/NISHIDA,M/KURITA,S.1963 63P1-0070-10500-10000-0000-701
C 135 NIIZEKI,S/NISHIDA,M/KURITA,S.1963 63P1-0070-10500-10000-0000-702

TERNATUM (THUNB.) SW. 1-0070-10500-10500-0000-401
SYN. SCEPTRIDIUM TERNATUM (THUNB.) LYON 1-0070-10500-10500-0000-402
88 OKUNO,S. 1936 36P1-0070-10500-10500-0000-701
90 NISHIDA,M/KURITA,S/NIIZEKI,S.1964 64P1-0070-10500-10500-0000-702
90 WAGNER,W.H./CHEN,K.L. 1964 6411-0070-10500-10500-0000-703

VIRGINIANUM (L.) SW. 1-0070-10500-11000-0000-401
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C 184 BRITTON,D.M. 1953 (182-184) 53P1-0070-10500-11000-0000-701
184 WAGNER,W.H. 1955 55P1-0070-10500-11000-0000-702
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C 180 LOEVE,A./LOEVE,D. 1961D 61P1-0070-10500-11000-0000-704
184 NIIZEKI,S/NISHIDA,M/KURITA,S.1963 63P1-0070-10500-11000-0000-705
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*

CHEILANTHES SW. X=15,29 1-0200-16100-00000-0000-201

AEMULA MAXON 1-0200-16100-00500-0000-401
60 KNOBLOCH,I.W. 1967 67P1-0200-16100-00500-0000-701

ALABAMENSIS (BUCKL.) KUNZE 1-0200-16100-01000-0000-401
C 87 WHITTIER,D.P. 1965 (87-88) 65P1-0200-16100-01000-0000-701
C 87 WAGNER,W.H./WAGNER,F.S. 1966 66P1-0200-16100-01000-0000-702
87 KNOBLOCH,I.W. 1967 67P1-0200-16100-01000-0000-703

ALBOMARGINATA CLARKE 1-0200-16100-01500-0000-451
SEE ALEURITOPTERIS ALBOMARGINATA 1-0200-16100-01500-0000-452

ANCEPS BL. 1-0200-16100-02000-0000-451
SEE ALEURITOPTERIS ANCEPS 1-0200-16100-02000-0000-452

ARGENTEA (GMEL.) KUNZE 1-0200-16100-02500-0000-401
C 116 MITUI,K. 1965 (116-120) 65P1-0200-16100-02500-0000-701

BULLOSA KUNZE 1-0200-16100-03000-0000-451
SEE ALEURITOPTERIS BULLOSA 1-0200-16100-03000-0000-452

CALIFORNICA (NUTT.) METT. 1-0200-16100-03500-0000-401
60 KNOBLOCH,I.W. (IN FABBRI 1965) 65P1-0200-16100-03500-0000-701
60 KNOBLOCH,I.W. 1966 66P1-0200-16100-03500-0000-702

CARLOTTA-HALLIAE WAGNER/F.S.GILB. 1-0200-16100-04000-0000-401
90 KNOBLOCH,I.W. (IN FABBRI 1965) 65P1-0200-16100-04000-0000-701
C 90 KNOBLOCH,I.W. 1966 66P1-0200-16100-04000-0000-702

CHRYSOPHYLLA HOOK. 1-0200-16100-04500-0000-451
SEE ALEURITOPTERIS CHRYSOPHYLLA 1-0200-16100-04500-0000-452

DALHOUSIAE HOOK. 1-0200-16100-05000-0000-451
SEE ALEURITOPTERIS DALHOUSIAE 1-0200-16100-05000-0000-452

EATONII BAKER 1-0200-16100-05500-0000-401
C 174 LLOYD,R.M. 1966 66P1-0200-16100-05500-0000-701

FARINOSA (FORSK.) KAULF. 1-0200-16100-06000-0000-401
58 MANTON,I./SLEDGE,W.A. 1954 54D1-0200-16100-06000-0000-701
60 MANTON,I./SLEDGE,W.A. 1954 54P1-0200-16100-06000-0000-702
C 87 MANTON,I./SLEDGE,W.A. 1954 54P1-0200-16100-06000-0000-703
90 MANTON,I. 1959 59P1-0200-16100-06000-0000-704
120 MANTON,I. 1959 59P1-0200-16100-06000-0000-705
58 VERMA,S.C./LOYAL,D.S. 1960A 60D1-0200-16100-06000-0000-706
58 VERMA,S.C.(IN MEHRA,P.N.1961B) 61D1-0200-16100-06000-0000-707
58 ABRAHAM,A/NINAN,CA/MATHEW,P.1962 62D1-0200-16100-06000-0000-708
60 ROY,R.P./PANDEY,S.N. 1963A 63P1-0200-16100-06000-0000-709
60 ROY,RP/SAKYA,AR(IN FABBRI 1963) 63P1-0200-16100-06000-0000-710
60 VERMA,S.C./KHULLAR,S.P. 1965B 65P1-0200-16100-06000-0000-711
60 MANTON,I/ROY,SK/JARRET,FM.1966 66P1-0200-16100-06000-0000-712
90 MANTON,I/ROY,SK/JARRET,FM.1966 66P1-0200-16100-06000-0000-713
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THE EVIDENCE FROM MEIOSIS.
ANN. BOT.
N. S. 1* 439-460
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13107.0000-1-008.0062
13107.0000-1-008.0080
13107.0000-1-008.0099

IV. The Use of the Data Bank

It is evident that when this IOPB data bank has been completed up to the stage of annual increments, it will become an invaluable tool for all taxonomists, geneticists, evolutionists, and others with interest in the data included. It will become useful even during its compilation, as soon as a section, even family or genus, is completed. It has already saved us considerable time when finding information asked for by colleagues in localities poor in library or other facilities, or by those who need information on the very last reports which they may not be acquainted with. We foresee innumerable ways of making the bank useful to everybody interested. A few of these ways are listed below:

1) The data bank can be the basis for a single comprehensive publication, which could include all information available up to a certain date, if printing of such a book is deemed feasible. In that case, annual supplements could replace the presently compiled Regnum Vegetabile lists, since the critical list will be even more dependable.

2) It ought to be available, for a reasonable fee, to those who are in need of this information even though it may not be printed. This could be made possible, for instance, by including the bank in an IOPB or IAPT center for biological information which could duplicate the tapes or cards and sell them to libraries or individuals, or sell limited or complete printouts to those who apply for them. If the collection of papers is also kept in the same place, xerox or microfilm copies of these could also be made available to those who otherwise would not be able to locate a copy.

3) The bank could also become a kind of a source of speedy publication of the information it includes, by giving research workers an opportunity to add to it their unpublished data with appropriately supporting information which then would immediately become available to those interested. In that way it could replace even the speediest possibility of publishing new chromosome data now available through the IOPB chromosome number reports published in every number of Taxon under the editorship of Á. Löve.

4) For every section finished, the bank could easily give quick answers to questions such as the following:

a) All chromosome numbers known in a special genus, family, etc.

b) Basic chromosome number and chromosome form and size for any genus.

c) All chromosome numbers determined by a particular author, later to be widened to include also all numbers from a particular region.

d) Complete bibliographical references for each chromosome number or species.

e) Number of diploids and polyploids in any particular group of taxa.

f) Earliest or latest date of publication of given chromosome information, or a graphic review of annual number of publications in a particular field.

g) List of authors and co-authors, together or separately.

h) List of journals and publications where chromosome information has been printed.

i) Chromosome number for any particular group in any particular year or number of years.

j) Complete synonymy for plant names which have been used by various authors in these publications and later changed taxonomically.

V. Facilities

Facilities for the compilation of the data bank are nowhere better than in Boulder. The Co-Principal Investigators' personal library includes about 30,000 reprints and over 6,000 books in this field, in addition to a good supply of journals owned by the Co-Principal Investigators or available in the University library. The limited office space needed is available, and so also are sufficient computer facilities. Equipment to be used can easily be rented, and supplies can be bought without delay from the local IBM facility, where expert advice is available upon request.

VI. Personnel Data

A. LÖVE, Áskell

Born: 20 October 1916

Position: Professor and Chairman, Department of Biology, University of Colorado

Education:

B.A., Reykjavik College, 1937
M.S., Cytogenetics, Botany, Zoology, University of Lund, Sweden, 1941
Ph.D., Cytogenetics, Botany, University of Lund, Sweden, 1942
D.Sc., Cytogenetics, University of Lund, Sweden, 1943

Employment Record:

Research Associate, Institute of Genetics, University of Lund, 1942-45
Research Worker (on leave), University of Iceland Research Institute, Reykjavik, 1942-45
Director, Institute of Botany and Genetics, University of Iceland Research Institute, Reykjavik, 1945-51
Associate Professor of Botany, University of Manitoba, Winnipeg, 1951-56
Research Professor of Biosystematics, Institut Botanique, Université de Montréal, 1956-63
Associate Professor, Department of Biology, University of Colorado, 1964-66
Professor and Chairman, Department of Biology, University of Colorado, 1966-

Fellowships and Professional Honors:

Fellow, Icelandic Academy of Learning since 1946; corresponding member since 1951
Permanent member of the Board of the International Association of Plant Geographers since 1953
Rapporteur and Vice President, Section of Cytology, VIIIth International Botanical Congress, Paris, 1954
Member, International Committee for Genetical Nomenclature and Symbolization (I.U.B.S.), 1956-58
Member of the Editorial Board of the journal Nucleus since 1958
Technical Consultant on Cytotaxonomy for Flora Europaea since 1955
President, International Organization of Biosystematists, 1960-64
Honorary Foreign Member, Swedish Phytogeographical Society since 1960
President, Symposium on North Atlantic Biota and their History, Reykjavik, July 1962
Vice President, International Committee on Chemotaxonomy, 1964-
John Simon Guggenheim Memorial Fellow, 1963-64
Honorary Foreign Member, Czechoslovak Botanical Society since 1968
President, International Organization for Chemosystematics, 1970-

Publications:

(Dr. Löve has published over 500 papers and books, of which the following selected publications are relevant to the proposed project).

Cytogenetic studies in Rumex. Botaniska Notiser, 157-169 (1940).

Études cytogénétiques des Rumex. II. Polyploidie geographique-systématique du Rumex subgenus Acetosella. Botaniska Notiser, 155-172 (1941).

Polyploidy in Polygonum Convolvulus L. s. lat. Hereditas 28, 227-228 (1942).

Cytotaxonomic studies on boreal plants. I. Some observations on Swedish and Icelandic plants. Kungliga Fysiografiska Sallskapets i Lund Forhandlingar 12 (6), 1-19 (1942), with D. Löve.

Chromosome numbers of Scandinavian plant species. Botaniska Notiser, 19-59 (1942), with D. Löve.

Cytogenetic studies in Rumex. III. Some notes on the Scandinavian species of the genus. Hereditas 28, 289-296 (1942).

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The significance of differences in distribution of diploids and polyploids. Hereditas 29, 145-163 (1943), with D. Löve.

Cytogenetic studies on Rumex subgenus Acetosella. Hereditas 30, 1-136 (1943).

The dioecious forms of Rumex subgenus Acetosa in Scandinavia. Botaniska Notiser, 237-254 (1944).

Cytotaxonomical studies on boreal plants. II. Some notes on the chromosome numbers of Juncaceae. Arkiv for Botanik 31B (1), 1-6 (1944), with D. Löve.

Cytotaxonomical studies on boreal plants. III. Some new chromosome numbers of Scandinavian plants. Arkiv for Botanik 31A (12), 1-22 (1944), with D. Löve.

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Islenzkar jurtir (Icelandic flora). E. Munksgaard, Copenhagen 1945, pp. 281.

Studies on the origin of the Icelandic flora. I. Cyto-ecological investigations on Cakile. Iceland University Institution of Applied Sciences, Department of Agriculture, Reports B2, 1-29 (1947), with D. Löve.

Chromosome numbers of Northern plant species. Iceland University Institution of Applied Sciences, Department of Agriculture, Reports B3, 1-131 (1948), with D. Löve.

The geobotanical significance of polyploidy. I. Polyploidy and latitude. Portugaliae Acta Biologica (B), R.B. Goldschmidt Jubilee Volume, 273-352 (1949), with D. Löve.

Some innovations and nomenclatural suggestions in the Icelandic flora. Botaniska Notiser, 24-60 (1950).

Taxonomical evaluation of polyploids. Caryologia 3, 263-284 (1951).

Studies on the origin of the Icelandic flora. II. Saxifragaceae. Svensk Botanisk Tidsskrift 45, 368-399 (1951), with D. Löve.

The Icelandic type of Glyceria fluitans. Botaniska Notiser 1951, 229-240 (1951).

Preparatory studies for breeding Icelandic Poa irrigata. Hereditas 38, 11-32 (1952).

The geobotanical significance of polyploidy. Proceedings of the VIth International Grassland Congress, State College, Pennsylvania, 1952, 240-246 (1953), with D. Löve.

Subarctic polyploidy. Hereditas 39, 113-124 (1953).

Studies on Bryoxiphium. Bryologist 56, 73-94, 183-203 (1953), with D. Löve.

Cytotaxonomical remarks on some American species of circumpolar taxa. Svensk Botanisk Tidsskrift 48, 211-232 (1954).

Cytotaxonomical studies on the northern bedstraw. American Midland Naturalist 52, 88-105 (1954), with D. Löve.

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Cytotaxonomical conspectus of the Icelandic flora. Acta Horti Gotoburgensis 20, 65-291 (1956), with D. Löve.

Chromosomes and taxonomy of eastern North American Polygonum. Canadian Journal of Botany 34, 501-521 (1956), with D. Löve.

Chromosomes and relationships of Koenigia islandica. Canadian Journal of Botany 35, 507-514 (1957), with P. Sarkar.

Cytotaxonomy of Carex section Capillares. Canadian Journal of Botany 35, 715-761 (1957), with D. Löve and M. Raymond.

Drug content and polyploidy in Acorus. Proceedings of the Genetics Society of Canada 2, 14-17 (1957), with D. Löve.

Arctic polyploidy. Proceedings of the Genetics Society of Canada 2, 23-27 (1957), with D. Löve.

Taxonomic and biosystematic categories. Brittonia 10, 153-166 (1958), with D.H. Valentine.

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Biosystematics and classification of apomicts. Feddes Repertorium 62, 136-148 (1960).

Taxonomy and chromosomes - a reiteration. Feddes Repertorium 62, 192-202 (1960).

Some nomenclatural changes in the European flora. I. Species and supra-specific categories. Botaniska Notiser 114, 33-47 (1961), with D. Löve.

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Some notes on Myriophyllum exalbescens. Rhodora 63, 139-145 (1961).

Chromosome numbers of Central and Northwest European plant species. Opera Botanica 5, I-VIII, 1-581 (1961), with D. Löve.

Hylandra, a new genus of Cruciferae. Svensk Botanisk Tidsskrift 55, 211-217 (1961).

A note on amphi-pacific Lysichitum. Journal of Japanese Botany 36, 359-361 (1961), with S. Kawano.

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Typification of Papaver radicatum - a nomenclatural detective story. Botaniska Notiser 115, 113-136 (1962).

Cytotaxonomy of the Isoetës echinospora complex. American Fern Journal 52, 113-123 (1962).

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Biosystematische Analyse der Elytrigia Junceae Gruppe. Die Kulturpflanze, Beiheft 3, 74-85 (1962).

North Atlantic Biota and Their History. Pergamon Press, Oxford (1963), editor together with D. Löve.

Chromosome numbers of some Carex species from Spain. Botaniska Notiser 116, 241-248 (1963), with E. Kjellqvist.

Chromosome numbers of some Iberian Cistaceae. Portugaliae Acta Biologica (A) 8, 69-80 (1964), with E. Kjellqvist.

The biological species concept and its evolutionary structure. Taxon 13, 33-45 (1964).

The evolutionary framework of the biological species concept. Genetics Today II, 409-414 (1965).

The North Atlantic flora - its history and late evolution. Tenth International Botanical Congress (1964), Abstracts, 139-140 (1965), with D. Löve.

Taxonomic remarks on some American alpine plants. University of Colorado Studies, Series in Biology 17, 1-43 (1965), with D. Love.

Chromosome numbers from central northern Canada. Canadian Journal of Botany 44, 429-439 (1966), with J.C. Ritchie.

Cytotaxonomy of the alpine vascular plants of Mount Washington. University of Colorado Studies, Series in Biology 24, 1-74 (1966), with D. Löve.

An alloploid Ophioglossum. Nucleus 9, 132-138 (1966), with B.M. Kapoor.

The variations of Blechnum Spicant. Botanisk Tidsskrift 62, 186-196 (1966) with D. Löve.

Íslenski dílaburkninn (Dryopteris assimilis S. Walker in Iceland). Flóra, Journal of Icelandic Botany 4, 5-9 (1966), with D. Löve.

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Cytotaxonomy of Blechnum Spicant. Collectanea Botanica 7, 665-676 (1968), with D. Löve.

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Cytotaxonomical notes on some American orchids. Southw. Natural. 13, 335-342 (1968), with W. Simon.

Chromosome numbers of Orchidaceae. Taxon 18, 312 (1969) with D. Löve.

Remarks on the cytotaxonomy of Mediterranean plants. Publ. Univ. of Seville 1969, 285-291, with D. Löve.

Íslenzk ferdaflóra (Icelandic excursionsflora). Reykjavik 1970 (in press).

Cytotaxonomical vindication of the genus Conosilene. Journ. Ind. Bot. Soc. 50th Anniversary Volume, 1970, with E. Kjellqvist.

Chromosomes of Rocky Mountain Ranunculus. Caryologia 23, 1970, with B.M. Kapoor.

IOPB chromosome number reports. I-XXVIII. Taxon. 1964-1970.

(Altogether over 550 publications.)

B. LÖVE, Doris

Born: 2 January 1918

Position: Faculty Research Associate, Department of Biology, University of Colorado

Education:

B.S., Kristianstad College, Sweden, 1937
M.S., Cytogenetics, Botany, Geography, University of Lund, Sweden, 1941
Ph.D., Cytogenetics, Botany, University of Lund, Sweden, 1943
D.Sc., Cytogenetics, University of Lund, Sweden, 1944

Employment Record:

Instructor (amanuensis), Institute of Genetics, University of Lund, 1940-43
Research Associate, Institute of Genetics, University of Lund, 1943-45
Geneticist, University of Iceland Research Institute, Reykjavik, 1945-51
Herbarium Curator, University of Manitoba, Winnipeg, Canada, 1951-56
Associate Professor (research), Institut Botanique, Université de Montréal, Canada, 1956-63
Faculty Research Associate, Department of Biology, Institute of Arctic and Alpine Research, and University Museum, University of Colorado, 1964-

Fellowships and Professional Honors:

Fellow, Mendelian Society of Lund, Sweden since 1941
Several research scholarships and awards from the Royal Physiographic Society of Lund, Lund Botanical Society, and the Swedish Academy of Sciences, 1941-45
Research Fellowship from the Icelandic Cultural Fund, 1945-50
British Council invitation to visit British institutions in genetics and plant breeding, Summer 1949
Research grants from the National Research Council of Canada, 1956-64, and the National Science Foundation, 1967

Publications

(Mrs. Löve has published over 100 papers and books. The following selections relate to the proposed project.)

Some contributions to the cytology of Silenoideae. Svensk Botanisk Tidsskrift 36, 262-270 (1940).

Cytotaxonomic studies on boreal plants. I. Some observations on Swedish and Icelandic plants. Kungliga Fysiografiska Sällskapets i Lund Förhandlingar 12 (6), 1-19 (1942), with Á. Löve.

Chromosome numbers of Scandinavian plant species. Botaniska Notiser 1942, 19-59 (1942), with Á. Löve.

The significance of differences in distribution of diploids and polyploids. Hereditas 29, 145-163 (1943), with Á. Löve.

Cytogenetic studies on dioecious Melandrium. Botaniska Notiser 1944, 125-213 (1944).

Cytotaxonomical studies on boreal plants. II. Some notes on the chromosome numbers of Juncaceae. Arkiv för Botanik 31B (1), 1-6 (1944), with Á. Löve.

Cytotaxonomical studies on boreal plants. III. Some new chromosome numbers of Scandinavian plants. Arkiv för Botanik 31A (12), 1-22 (1944), with Á. Löve.

Studies on the origin of the Icelandic flora. I. Cyto-ecological investigations on Cakile. Iceland University Institute of Applied Sciences, Department of Agriculture, Reports B, 2, 1-29 (1947), with Á. Löve.

Chromosome numbers of Northern plant species. Iceland University Institute of Applied Sciences, Department of Agriculture, Reports, B, 3, 1-131 (1948), with Á. Löve.

The geobotanical significance of polyploidy. I. Polyploidy and latitude. Portugaliae Acta Biologica (B), R.B. Goldschmidt Jubilee Volume, 273-352 (1949), with Á. Löve.

Studies on the origin of the Icelandic flora. II. Saxifragaceae. Svensk Botanisk Tidsskrift 45, 368-399 (1951), with Á. Löve.

The geobotanical significance of polyploidy. Proceedings of the VIth International Grassland Congress, State College, Pennsylvania (1952), 240-246 (1953), with Á. Löve.

Cytotaxonomical remarks on Gentianaceae. Hereditas 39, 225-235 (1953).

Studies on Bryoxiphium. Bryologist 56, 73-94, 183-203 (1953), with Á. Löve.

Cirsium Flodmanii (Rydb.) Arth. f. albiflora, forma nova. Rhodora 55, 362-363 (1953).

Cytotaxonomical studies on the northern bedstraw. American Midland Naturalist 52, 88-105 (1954), with Á. Löve.

A plant collection from SW Yukon. Botaniska Notiser 109, 153-211 (1956), with N.J. Freedman.

Cytotaxonomical conspectus of the Icelandic flora. Acta Horti Gotoburgensis 20, 65-291 (1956), with Á. Löve.

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VII. Personnel and Budget

Our pilot study has shown that it is impossible to compile a data bank of this kind with the aid only of computer technicians or secretaries, though both can be of value for the speeding-up of certain operations. It has also become evident that the main compiler must not only know the methods to be used and be skilled in keypunching and other basic mechanical procedures, but must also have expert knowledge of plant taxonomy and cytotaxonomy, because otherwise qualified judgment of the many critical cases cannot be made. Therefore, Co-Principal Investigator Doris Löve, who already has both a Ph.D. and D. Sc. degree and has published over 100 papers in related fields, has added computer techniques to her skills, which also include knowledge of nine languages. Áskell Löve will contribute with his biosystematical and taxonomical experience, which spans thirty years on two continents.

The budget includes a professional salary for Doris Löve for full-time work on the project, and three months' summer salary for Áskell Löve, who will also spend much of his research time during the academic year on this work. Three months' summer salary is requested in Áskell Löve's case because travel to centers with more complete libraries must be undertaken during the summer, and time must be allowed for this. In addition, we ask for a salary for a skilled secretary-technician to help with certain parts of the basic work, in order to save time for the Co-Principal Investigators in fields that require different skills.

Permanent equipment consists of filing cabinets for cards and tape material.

Supplies include IBM and other cards and office and miscellaneous supplies.

Funds are requested to permit travel to centers with more complete libraries.

Funds to cover keypunch machine rental are included under Other Direct Costs.

It should be emphasized that this budget reflects the optimal condition which we believe ought to make it possible to complete the bank within five years, up to the stage when only annual increments are required. However, salaries could be reduced to those of the two Co-Principal Investigators and other costs to the rental of the keypunch and minimum supplies, without risking more than a few years' delay in the completion of the basic data bank.

CU Proposal No. 70.5.254
5/70

NATIONAL SCIENCE FOUNDATION

Budget

Institution: The Regents of the University of Colorado
Boulder, Colorado 80302

Title: Compilation of a Computerized IOPB Chromosome Data Bank

Co-Principal Investigators: Áskell Löve
Doris Löve

Starting Date & Duration: October 1, 1970 (Two years)

	1st Yr. NSF	1st Yr. CU	2nd Yr.* NSF	2nd Yr.* CU
A. Salaries and Wages				
Co-Principal Investigators:				
Áskell Löve				
25% time, 9 mos. AY		$ 4,590(2MM)		$ 4,955(2MM)
100% time, 3 mos. summer	$ 6,120(3MM)		$ 6,610(3MM)	
Doris Löve				
100% time, 12 mos.	14,000(12MM)		15,120(12MM)	
Technical Assistant				
100% time, 12 mos.	6,000(12MM)		6,360(12MM)	
Total Salaries and Wages	$26,120	$ 4,590	$28,090	$ 4,955
B. Fringe Benefits				
TIAA: 7% of faculty salaries	1,410	320	1,520	345
PERA: 8% of staff salaries FY-71, 8.5% of staff salaries FY-72	480		540	
Total Fringe Benefits	$ 1,890	$ 320	$ 2,060	$ 345
C. Permanent Equipment				
IBM file cabinets	2,000		500	
D. Expendable Supplies and Equipment				
Office supplies	500		500	
Xerox copying	600		600	
Miscellaneous supplies	200		200	
Total Expendable Supplies & Equipment	$ 1,300		$ 1,300	

CU Proposal No. 70.5.254
Budget Cont'd

	1st Yr. NSF	1st Yr. CU	2nd Yr.* NSF	2nd Yr.* CU
E. Travel				
Domestic: to research libraries during summer months	$ 600		$ 600	
F. Publication Costs				
Page costs and reprints	600		600	
G. Other Direct Costs				
Keypunch machine rental	800		800	
H. Total Direct Costs	$33,310	$ 4,910	$33,950	$ 5,300
I. Indirect Costs				
On campus: 44% of salaries and wages	11,490	2,020	12,360	2,180
J. Total Costs	$44,800	$ 6,930	$46,310	$ 7,480

TOTAL REQUESTED FROM NSF FOR TWO YEARS: $91,110

*This budget covers the first two years of an anticipated five-year project.

VIII. Current Support and Pending Applications

No other support is currently available for the proposed project. This proposal is being submitted concurrently to the National Science Foundation and the Atomic Energy Commission.

(1)
COPY

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

Office of Science Information Service

Action NSF
PP
File Löve

June 28, 1968

AIRMAIL

Dr. Doris Löve
Institute of Arctic and Alpine
Research
University of Colorado
Boulder, Colorado 80302

N-3070 (CU Proposal No. 68.5.68)

Dear Dr. Löve:

This is in reference to your proposal for support of the publication of the monograph, Mt. Washington and Its Alpine Flora. The proposal is in the final stages of processing, and there are several questions which remain to be answered:

1) The budget contains an item of $8,500 for "warehousing, shipping, and billing". These charges would occur after the publication was put on sale, and would be paid for out of sales income, under the usual arrangement used in the Foundation's publication grants. This arrangement was used previously with other grants involving Columbia University Press, and if applied in the present proposal it would mean that the amount requested would become $2,000, rather than $10,500. Can this arrangement be used in the present proposal, and if not, why not?

2) Will the monograph be published within one year of the effective date of a grant?

3) The "recovery clause", as stated on page one of the proposal, is not applicable as stated since the estimates used might not be actual costs. May we have an acceptance of the recovery clause in its usual form, which states that "all proceeds from sales during the first three years after publication, over and above the amount contributed by the grantee or publisher, and up to the amount of the grant, will be returned to the Foundation."

4) Will the entire run of 2,000 copies be offered for sale, or will there be some author and review copies?

Sincerely yours,

Randall Worthington
Professional Assistant
Information Services Program

Copy to:

Mr. Howard D. Roark
Acting Director
Graduate School of Research Svcs.
University of Colorado
380 Willard Hall
Boulder, Colorado 80302

Mr. Robert J. Tilley, Ass't. Director
Columbia University Press
Columbia University
New York, New York 10027

Action NSF
PP

File Löve

15 March 1968 Encl. 20

Program Director for Information Services
Office of Science Information Science
National Science Foundation
Washington, D.C. 20550

In Reply Refer To: CU Proposal No. 68.5.68

Gentlemen:

Enclosed are twenty (20) copies of a proposal entitled "Mount Washington and Its Alpine Flora." This proposal is in the amount of $10,500. Doris Löve, Research Associate, Institute of Arctic and Alpine Research, is the Principal Investigator.

The University represents that it has not employed or retained a company, other than a full-time employee, to solicit or secure this contract and agrees to furnish information thereto as requested by the Contracting Officer. The proposal has been examined by and has the approval of this administration. We hope that it may receive your favorable consideration.

Since we have the responsibility for contract negotiations and administration, better service can be expected if future correspondence is specifically directed to the attention of this office.

Sincerely,

Howard D. Roark
Acting Director

HDR/sd

Enclosures

NSF 20
Löve 10
Dept. 1
ORS 1 + master

CU Proposal No. 68.5.68
2/68

A Proposal to

The National Science Foundation

for

the Publication of a Book on

MOUNT WASHINGTON AND ITS ALPINE FLORA

Name and Address of Institution: The Regents of the
University of Colorado
Boulder, Colorado 80302

Desired Starting Date: As Soon As Possible

Amount Requested from NSF: $10,500

Time Period for Which Support is Requested: Not Applicable

Principal Investigator: Doris Löve, Research Associate
Institute of Arctic and Alpine Research
University of Colorado
Boulder, Colorado 80302
Telephone: (303) - 443-9980

J.D. Ives, Chairman
Institute of Arctic and
Alpine Research

Doris Löve
Principal Investigator

I certify that the distribution of costs between the direct and indirect categories as shown in the proposal conforms to the usual accounting practices of the institution and to the distribution used by the cognizant Federal audit agency.

Thurston E. Manning
Vice President and Dean of the Faculties

ABSTRACT

This is a proposal for support of the publication of a book on the history and evolution of the alpine flora of Mt. Washington in New Hampshire. The book is the first of its kind in North America and treats this remarkable mountain in greater detail than has been done with any other similar area elsewhere in the world.

The sum of $10,500 is requested from NSF, and $17,000 will be provided by the Columbia University Press.

The manuscript has also been offered to other publishers, all of whom have acknowledged it merits, but cannot for various reasons undertake to publish it now. The Columbia University Press can do so only if the requested subsidy is made available.

The book will be sold to the general public and will not be distributed free. Any proceeds from sales amounting to more than $17,000 will be refunded to NSF until the requested sum of $10,500 is repaid. There will be no royalties paid to the author, and any additional sums received from the sale of this book will accrue to the Columbia University Press.

SHORT DESCRIPTION OF THE WORK

During a number of years the applicant and her associates have spent considerable time and effort to study the higher plants of Mount Washington in New Hampshire. A great part of this work dealt with the exact cytotaxonomical determination of the 183 taxa growing in the alpine zone of this mountain and determination of their taxonomic status and nomenclature, since a very exact taxonomy is basic for any detailed phytogeographical considerations. The main purpose of the work was, however, to elucidate the history and evolution of the arctic-alpine flora of this highest mountain of northeastern America, since a good understanding of its origin and history is important for the comprehension of the history of the arctic flora in general and of the floras in the alpine zones of temperate mountains in particular.

The work also required a good deal of gemorphological, pedological, climatological, etc. studies, since without a knowledge of such factors studies in historical phytogeography cannot be complete.

Most of the collection work was supported by grants from the National Research Council of Canada and the Science Division of NATO, whereas the compilation of the results was supported in part by the National Science Foundation grant G-3371 as a part of a more comprehensive study of the cytotaxonomy of the arctic-alpine flora.

Some of the botanical results of the investigations have already been published in preliminary papers (see list of publications!) whereas the bulk of the observations has been collected in a manuscript of about 500 typewritten pages, augmented by numerous pictures, drawings, graphs, and tables, which together are estimated to make a printed book of about 580 to 600 pages. This manuscript discusses the characteristics and

history of Mount Washington and its flora and vegetation in greater detail than has previously been done for any other mountain on the American continent.

During the course of the work, separate chapters and in some cases the entire manuscript have been read by a number of colleagues who with their constructive criticism have contributed much to the quality of the finished product. To list all their names here would fill too much space but those who have contributed the most valuable help are:

Dr. L.C. Bliss (Urbana, Ill.), Dr. H. Harries (Sackville, N.B., Canada), Dr. J.D. Ives (Boulder, Colo.), Dr. A. Löve (Boulder, Colo.), Dr. W.F. Thompson (Natick, Mass.), Dr. P.S. Martin (Tuscon, Ariz.), Dr. Margaret Davis (Ann Arbor, Mich.), Dr. E. Hultén, (Stockholm, Sweden), Dr. T.W. Böcher (Copenhagen, Denmark), Dr. A.I. Tolmachev (Leningrad, USSR), Dr. A. Borza (Cluj, Romania), Dr. H. Meuzel (Halle, Germany DDR), Dr. A.E. Porsild (Ottawa, Canada), Dr. J.A. Elson (Montreal, Canada) and Dr. Estella Leopold (Denver, Colo.). Needless to say, all those who have read the manuscript or parts thereof have strongly recommended its publication in book form.

The manuscript has been offered to several publishers. The Pergamon Press, John Wiley and Sons, University of California Press, McGraw-Hill, and the University of Colorado Press all found it to lay outside their present plans and possibilities. The Harvard University Press, Yale University Press, and Columbia University Press expressed strong interest, but the first two wanted it only if it had not already been offered to somebody else. As it was already offered to the Columbia Press the present proposal is based on their estimate of the costs for publication. We find this publisher without doubt the best equipped to print this manuscript and make it an attractive book and give it the widest possible distribution.

The contents of the book have been summarized below, partly by aid of the summaries ending each chapter:

I. Introduction and acknowledgements (7 pages)

The scope of the book is outlined briefly and thanks given to all those who have helped and assisted in making the work possible.

II. Geography and history (32 pages)

Mount Washington was first discovered by white man in 1642. Since that time it has become intensely popular both as a "tourist attraction" for the general public, and also as a study object for various kinds of science, botany, zoology, climatology, geography, glaciology, etc. The chapter gives a chronological review, year by year, of the main events in the history of the mountain, including such feats as the development of trails, roads, cograilroad, hotels, weather stations, and military research on its summit. This review serves as a background for how human influence affects a natural area of great scientific importance and covers the period from 1642 to the late 1960's.

III. Climatology (16 pages, 34 tables, 74 graphs)

Summary: 1) the summit of Mount Washington (44°N, 71°W, 1,918 m., 6,288 ft.) has a very severe climate. The winters are long and cold, summers short and cool; the precipitation is high and the wind speed extreme.

The mean annual temperature is - 2.8°C (27.0°F), the mean annual precipitation 1,882 mm. (74 in.). The snowfall averages 6,000 mm. (200 in.) a year. The average wind speed over the year is 16.6 m/sec. (37.2 mph), stronger in the winter than in the summer. Up to half the days of the

winter months and two to four of the summer months have winds over 33.5 m/sec. (75 mph). Gusts have been measured up to 103.3 m/sec. (231 mph).

2) Tables 1-4, 16-21, 30-32 and Graphs 1-10, 23-53, 55-59, 62-69 illustrate the differences between the summit climate and that of the surrounding valleys, which are on the average much milder (although the temperature amplitudes may be larger), sunnier, less humid, and less windy.

3) In comparison with oceanic and continental stations (Tables 5-15, 22-29, 33; Graphs 12-22, 37-44, 70-78), the Mount Washington summit is sub-oceanic to oceanic in respect to amount of precipitation, but more continental and arctic as regards pattern of precipitation and temperature. In severity its climate is comparable to that of the coast of Labrador and southwest Greenland.

4) It is suggested that the climate along the coast of Nova Scotia was not more severe in early postglacial time than on Mount Washington at present and that Mount Washington, during summers, was not much warmer at the height of the Hypsithermal climatic period than present day Iceland or present day Nitchequon, Quebec. It is further assumed that only a slight lowering of the present mean temperature of Mount Washington might lead to a lowering of the nivation line and give rise to permanent snow-fields and incipient glaciers.

5) The present climate in the alpine areas of Mount Washington serves to maintain its present flora but is a deterrent to the advance of the more temperate flora from lower levels on the mountain.

IV. Geomorphology (22 pages, several drawings and maps)

In order to get a firm background for the discussion of the history of the flora, detailed studies on the geomorphology and glaciology of the

mountain have been performed. These have resulted in the following revised hypothesis of the geomorphogenesis of the Mount Washington area from Pliocene to the present:

Summary: 1) End of Pliocene: With the deteriorating climate, a "pre-Ammonosuc valley - pre-Presidential plateau" anemo-orographic system starts to excavate the east flank of the plateau, giving it the overall crescent shaped pattern that is characteristic of the northern part of the present Presidential Range from Mount Madison to Boott Spur and Mount Monroe. (Fig. 18a).

2) Nebraskan Ice Age, Aftonian Interglacial, Kansan Ice Age, Yarmouth Interglacial: The anemo-orographic system operative throughout this period and the ice ages contribute to the initial breaking up of the Presidential plateau and the excavation of the "pre-Great Gulf" and "pre-Tuckerman Ravine." The flora is repeatedly depleted and built up and changes from an essentially warm-climate to a colder-climate type of vegetation occur.

3) Illinoian Ace Age: This was a time of total inundation of the whole area by a continental ice sheet with the complete extinction of all existing flora. The plateau was dissected to very near its present condition and cirques and valleys were forcefully deepened. The glaciers on the lee side of the mountain were maintained longer than on the windward side at the time of deglaciation.

4) Sangamon Interglacial: The anemo-orographic system continues to work on the landscape emphasizing the cirques cut by the maximal ice sheet (Fig. 18b). The flora makes a comeback from the south. Weathering in the alpine zone is intense and the till deposited by the Illinoian ice sheet on the peaks suffers extensive disintegration.

5) Wisconsin Ice Age: At the Wisconsin maximum the upper surface of the continental ice sheet does not exceed the 1,525 - 1,615 m. (5,000 -

5,300 ft.) level and the higher peaks remain as nunataks. The ice sheet is somewhat higher on the thrust side than on the lee side. The anemo-orographic system acts on the exposed peak of Mount Washington to form the Alpine Garden and its headwall, similarly on Mount Monroe and its east-facing terrace and on Mount Jefferson and its Monticello Lawn (Fig. 18c).

The till deposited on the peaks by the Illinoian ice sheet is slowly disappearing due to mass-wasting and blocks lifted from the bed-rock by frost action are deposited on top of the fine material and arranged into "fossil" stone rings and nets. Towards the end of the glaciation, eolic soil and organic debris is trapped by the rocks and deposited on the lee side of the slopes providing an early possibility for re-vegetation.

During late-glacial time the cirques and valleys attain approximately their present appearance (Fig. 18d).

6) Postglacial Time: The anemo-orographic system continues to over-steepen cirque walls, especially below passes, and to keep these as open habitats with a cold micro-climate favoring an alpine-arctic flora. Frost action is still active in the alpine zone, but less so than during the Wisconsin glaciation. Chemical weathering is probably more active today than during the relatively colder climates of the past.

V. Soils (9 pages)

Summary: 1) The montane zone has a prevalence of podsolic soils. In the subalpine belt a transition takes place from podsolic soils to ranker on a mica schist rockbase and braunerde on a gneiss-granulite base. Along streams there is a paternia soil. In the alpine zone, ranker is predominant. A humus, called "dust-humus" is prevalent at high altitudes and occurs

mixed with raw humus and moder at subalpine levels. For detailed and modern information on soil conditions on Mount Washington, the reader is referred to Bliss (1963b) and Harries (1965).

2) All kinds of patterned ground phenomena resulting from frost action can be seen above timberline in the mountaintop detritus, stone mesh in the form of sorted circles, sorted stone steps and garlands, and sorted stripes. Exfoliation of exposed bedrock is also common.

3) Active, small-sized stone mesh (terminology according to Washburn, 1956) is particularly prevalent in the Lakes of the Clouds col in calcium-silicate and gneiss-granulite areas. Presently inactive (as far as can be judged from botanical evidence) large-sized stone mesh is prevalent in mica schist areas.

4) On boulders and rocks in the active stone mesh there are no lichens, but the inactive stone mesh is covered by a rich assortment of lichens often forming large individual patches on the rock surfaces.

5) The vegetation on the active patterned ground is scanty and patchy, consisting of few species with short and shallow root systems.

6) The vegetation on the inactive patterned ground is rich and continuous, consisting of species with deep-growing and widespreading root systems, and rhizomes.

7) The general impression of the soils on Mount Washington is one of maturity and stability.

VI. Pleistocene events and late glacial development of the flora in eastern North America (24 pages, 1 table)

Summary: On the basis of the review presented, we dare to propose the following hypothesis for the origin and development of the late-glacial and postglacial flora of the Mount Washington area:

1) An ice cap over the northern Appalachian, at first isolated, later coalescing with the Laurentide Ice Sheet, covered the Mount Washington area in early Wisconsin time, leaving only a few peaks standing above the ice sheet. The area must have been generally forested when the snow and ice began to accumulate, except for the peaks of such high mountains which for local reasons probably never carried forests in Pleistocene time (cf. Chapter on Geomorphology).

2) An ice cap remained in the area after it had become detached from the continental ice sheet when the latter was withdrawing north of the St. Lawrence valley. The ice cap may have expanded or flowed radially during Valders time, around 11,500 years. B.P. (cf. Fig. 30).

3) Final and total deglaciation of the Mount Washington area did not occur until in post-Valders time, not before 10,000 yr. B.P. and possibly not until the beginning of the Hypsithermal period after the Champlain Sea phase.

4) Immediately following deglaciation, a tundra vegetation occupied the denuded ground. This flora was composed of truly arctic species which we believe had migrated south from the east-arctic coast along the system of continental shelves outside New England, as these became available during the time of falling sea level and deteriorating climate in early and full-glacial time (Table 35). The arctic flora now on the peak of Mount Washington and other peaks of northeastern New England seems to have arrived there in late-glacial times from an eastern or southern (but not from a northern or western) direction, migrating north and west from the above-mentioned shelves.

5) The tundra may have been a mixture of completely open tundra with ericaceous heaths, sedge- and grass-meadows as well as a park-tundra in protected habitats with Betula glandulosa, Alnus viridis crispa, Salices,

and during later stages possibly Picea, Abies and Pinus. Long-distance dispersal of pollen, especially of conifer trees, may however, give a false impression of the correct time for the actual presence of conifer species in the flora.

6) The tundra flora may have covered a considerable area of New England and southeastern Canada, especially on the unglaciated parts of the raised continental shelves and on the mainland after the withdrawal of the ice. As soon as the climate ameliorated sufficiently, it was rapidly replaced by a forest on the lowland (Table 35). During the time of deglaciation of the White Mountain area, it may have been reduced to a relatively narrow belt and probably already split into a patchwork of tundra ascending the slopes of various mountains. The valleys meanwhile quickly filled with conifer forests.

7) Due to local climatic-ecological conditions (cf. chapter on Geomorphology, especially regarding the anemorcorographic system) prevailing in the Presidential Range at present, a transect of its flora from the top to the base may give a fair illustration of the sequence of vegetation in granitic areas from late-glacial time to the present (cf. also chapter on Ecology). The alpine areas may represent a late-glacial tundra, the subalpine, the park-tundra, and the montane slopes the advancing conifer forests, while the present river valleys at the base of the mountain may be similar to deciduous forests in early Hypsithermal times. Due to local ecological conditions, there are no pines in the vicinity of Mount Washington at present.

VII. Dispersal and life-forms (11 pages, 5 tables, 2 graphs)

Summary: 1) Studies of re-vegetation of glacier forelands in present times indicate that a period of at least 100 - 150 years is required from glacier recession to development of a mature vegetation cover. The type

of pioneer vegetation will depend on what disseminules are available from the flora in the close vicinity of the glacier. Higher plants, mosses, and lichens are independent pioneers and do not follow each other in any definite pattern during early stages of succession.

2) There is no definite information on which pioneer plants followed in the wake of the receding continental and alpine glaciers on Mount Washington. However, they were probably species with anemochorous seeds and of arctic-alpine types of lifeforms.

3) At present, nearly 35% of the flora existing above 1,370 m. (4,500 ft.) on Mount Washington consists of species which are potentially windspread over distances of 10 meters (30 ft.) or more from the mother plants. The figure rises over 35% when only the 68 arctic-alpine species found exclusively above 1,370 m. (4,500 ft.) are considered (Table 36).

4) Animal dispersal of seeds is less important, but the figure of near 20% for the total flora above 1,370 m. (4,500 ft.) altitude may be too low, as grass and sedge species have not been considered (Table 37). It is remarkable that among those species which are potentially animal-dispersed, there are only 8% of the 68 arctic-alpine ones, indicating that a boreo-montane flora may be more dependent on animals for its dispersal than an arctic-alpine flora.

5) Dispersal of disseminules by raindrop splashing (Brodie 1955, 1957) is a possibility at least for lower plants. Rain wash-off and water-dispersal by run-off may displace alpine plants to lower altitudes, but can have had no effect for the re-vegetation of the mountain in late- and post-glacial times.

6) The lifeform spectrum (Raunkiaer, 1934) of the total flora above 1,370 m. (4,500 ft.) altitude on Mount Washington reveals the arctic-alpine

nature of its vegetation; the arctic-alpine element of this flora shows this characteristic even more than the boreo-montane element, and shows the same trend in this respect as does the truly arctic and subarctic elements in the flora of Greenland (Böcher, 1938a). See also Tables 38-40; Graphs 79 and 80).

VIII. Ecology (36 pages, 16 tables)

Summary: 1) The term "alpine region" is, in the Presidential Range, in general applied to the more or less treeless area above 1,370 m (4,500 ft.) altitude, extending from Mount Franklin in the south to Mount Madison in the north and comprising approximately 20 square miles.

2) More specifically and seen from an ecological point of view the area above the continuous forest can be differentiated into a subalpine zone with patches of dwarfed trees and "krummholz" bush, and a treeless alpine zone. In the latter it is possible to distinguish a low-alpine belt and a mid-alpine belt. The former is characterized by an ericaceous and a "meadow-like" heath vegetation, strongly related to the field-layer vegetation of the subalpine zone and the montane boreal forest in New England, but in ecologically suitable habitats harboring elements of a subarctic - low-arctic nature related to those of Labrador and Greenland. The mid-alpine belt is characterized by ericaceous as well as sedge heaths, largely with a vegetation related to the low (-mid-) arctic flora of the Canadian Eastern Arctic and Greenland and in a wider sense to a North Atlantic arctic-alpine vegetation complex. A truly high-alpine belt is not represented more than very locally in the mountaintop detritus and the peak of Mount Washington itself, at 1,918 m. (6,288 ft.) is covered by a vegetation of mid-alpine nature only.

3) The climate has a decisive influence on the vegetation, in that, for instance, the wide temperature range (perhaps in combination with the strong winds) permits the presence in the alpine zone of elements of mid-arctic or low-arctic, continental climatic type, while the abnormally high precipitation favors plants of oceanic type.

4) Wind and precipitation in the form of snow are the most important factors for the presence and distribution of various plant communities in the alpine and subalpine zones as well as for the forests and forest limits. In the mid-alpine belt, wind exposure and a scanty or unreliable winter snow cover favor the development of a Juncus trifidus type of heath, whereas a snow cover continuous throughout the winter makes Carex Bigelowii heaths flourish.

5) In the low-alpine belt, a medium snow duration allows Vaccinium uliginosum - Empetrum - Arctous alpina heaths to develop, but where the snow lasts longer one is more likely to find an Avenella flexuosa-montane type of "meadow" heath.

6) In the subalpine zone a deciduous Alnus thicket is confined to warm slopes, often where the avalanche danger is great whereas coniferous forests are more general in colder habitats with a relatively stable ground.

7) Generally, the soil is very acid and permits only an acidophilous flora. A mesotrophic vegetation is confined to areas where flushing accounts for an increase in calcium content of the soil. Some low-arctic elements that require better soil have found niches at a relatively low altitude in such habitats.

8) Human activities, though intense and varied, seem to have had no influence on the alpine vegetation of the mountain range. As far as we know, no "weed" has succeeded in establishing itself in the alpine zone proper.

IX. Phytogeography (35 pages, 18 tables)

Summary: 1) The flora of Mount Washington above 1,370 m (4,500 ft.) elevation consists of 183 taxa which we have divided into two major elements: I. Arctic-alpine, 69 taxa, and II. Boreal-temperate, 114 taxa (Tables 52 and 53).

2) The large elements have been subdivided into a number of groups according to the general pattern and size of their distribution areas. Table 54 gives a survey of these. Tables 56 - 68 enumerate the taxa of the individual groups.

3) Maps of the distribution areas of the individual species have been grouped and superimposed upon each other to form equiformal areas. (Fig. 50 - 62).

4) From these maps, the conclusion can be drawn that the alpine area of Mount Washington represents a southern outpost for taxa of arctic-alpine type, but is well situated within an area with predominantly boreal taxa.

5) Further it is possible to conclude that the connections with the main areas of the arctic-alpine taxa must have followed the east side of the continent to Mount Washington and that no arctic-alpine species can have arrived directly from the western mid-continent in glacial or late-glacial times along a route such as the southern border of the ice-sheet.

X. Polyploidy and altitude on Mount Washington (6 pages, 2 tables)

Summary: 1) The frequency of ploypoids in a flora is generally higher at higher latitudes and in areas of climatically severe conditions.

2) Polyploids are generally better suited to withstand severe conditions because of a wider genetic amplitude and variability.

3) Coös county, New Hampshire, with a boreal forest flora, has about 60% polyploid species, which correspond to the figures for the boreal forests of northern Scandinavia (Löve and Löve, 1949).

4) The alpine flora of Mount Washington above 1,370 m. (4,500 ft.) altitude has 64.5% polyploids, similar to the figure for Iceland (Löve and Löve, 1949).

5) The boreal-temperate element in the alpine flora of Mount Washington has 59.4% polyploids, exactly the same as that of the flora of Coös county when the arctic-alpine element is subtracted from the total.

6) The Arctic-alpine element in the alpine flora of Mount Washington has 72.1% polyploids, a figure corresponding to that of southern Greenland (Löve and Löve, 1949).

7) The reason for the higher frequency of polyploidy in the arctic-alpine flora on Mount Washington is partly a higher frequency of monocotyledons and partly a generally higher frequency of polyploids in both monocotyledon and dicotyledon species than in the boreal-temperate flora. This is probably because polyploids have a generally wider tolerance amplitude than diploids (Löve and Löve, 1949), can withstand more severe climate and ecology, and are more agressive in colonizing areas (Stebbins, 1950).

XI. Annotated list of the taxa found above 1,370 m. (4,500 ft.) altitude on Mount Washington (155 pages, 169 maps)

This chapter, which does not have a summary in the manuscript, is an annotated list of all species growing above continuous forest on Mount Washington. Each taxon is treated separately, its history, nomenclature, taxonomy and distribution discussed both from local and general points of view. Maps are provided for the worldwide distribution of all these taxa as well as, when so required for the discussion, of related taxa.

This chapter makes up the main portion of the book.

XII. List of Literature (43 pages)

XIII. Appendix to the list of literature (12 pages)

An extensive bibliography concludes the book, including all works on alpine floras and vegetation known to the author from other areas and all literature on the taxa occurring on Mount Washington, concerning their characteristics, history and evolution. The appendix lists all works utilized exclusively for the compilation of the distribution maps, but not otherwise for the text.

XIV. Index to Latin names (35 pages)

There will be indexes and the one to Latin names is already compiled. If the publisher thinks it necessary a glossary may also be made.

In addition to tables, graphs and maps, there are numerous illustrations, both photographic and black and white drawings. Legends to these have been compiled.

Conclusion: It can be seen from the above summary, that the book thus presented ought to be of interest to a very wide audience. It should appeal not only to botanists, and among them to botanists of all kinds, but also to historians, geographers, geologists, pedologists, climatologists, geneticists and cytologists, etc. We think it will find a good market easily, and it may stimulate further research along similar lines in our own country as well as abroad because of its very general interest. We hope the National Science Foundation will find the work worthy of support for publication.

Löve, Doris

Born: January 2, 1918

Position: Professor, Institute of Arctic and Alpine Research, University of Colorado, Boulder, Colorado.

Education:

B.A., Kristianstad College, Sweden, 1937

M.S., in Cytogenetics, Botany, Geomorphology, University of Lund, Sweden, 1941.

Ph.D. In Cytogenetics and Botany, University of Lund, Sweden, 1943.

D. Sc. in Cytogenetics, University of Lund, Sweden, 1944.

Employment record:

Instructor (amanuensis), Institute of Genetics, University of Lund, 1940-1943.

Research Associate, Institute of Genetics, University of Lund, 1943-1945.

Geneticist, University of Iceland Research Institute, Reykjavik, 1945-1951.

Herbarium Curator, University of Manitoba, Winnipeg, Canada, 1951-1956.

Associate professor (research), Institute Botanique, Université de Montréal, Montreal, Canada, 1956-1963.

Faculty Research Associate, Department of Biology, Institute of Arctic and Alpine Research, and University Museum, University of Colorado 1964-.

Professor, Institute of Arctic and Alpine Research, University of Colorado, 1968-.

Fellowships and Professional Honors:

Fellow, Mendelian Society of Lund, Sweden, since 1941.

Several research scholarships and awards from the Royal Physiographic Society of Lund, Lund Botanical Society, and the Swedish Academy of Sciences, 1941-1945.

Research Fellowships from the Icelandic Cultural Fund, 1945-1950.

British Council invitation to visit British institutions in genetics and plant breeding, summer of 1949.

Research grants from the National Research Council of Canada, 1956-1964.

and from the National Science Foundation, 1967-

Publications:

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Papaver kluanense D. Löve and P. pygmaeum Rydb. in the Rocky Mountains. - Manuscript, ca. 20 pages.

BUDGET

The manuscript has been completed. The only expense for which support is requested is connected with the publication of the book which is estimated to be approximately 575 pages in a trim size 6 5/8 x 9 3/4. Columbia Press estimates the following listed costs:

Composition	$ 7,200
Paper	1,100
Binding	1,655
Jackets	200
Index	400
Reproduction Proofs	375
Alterations	825
Freight	105
Halftones	537
Promotion	1,600
Warehousing, shipping and billing	8,500
Copyediting	1,233
Design	600
General Overhead	3,108
TOTAL	$27,438

The Columbia University Press plans an initial printing of 2000 copies at a list price of $15.00 each. They require a subvention of approximately $10,500. There will be no royalties paid to the author.

COPY

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D. C. 20550

Reference:
P2B3962 (SYST)

OCT 6 1972

Dr. Askell Love
Department of Biology
University of Colorado
Boulder, Colorado 80302

Dear Dr. Love:

We regret to inform you that the National Science Foundation is unable to support your research proposal.

In evaluating each proposal submitted to the Foundation, a number of factors are considered. They include the following: the scientific merit of the proposal and its merit in relation to other proposals received by the Foundation in the same general field of sciences; the relation of the proposal to contemporary research support in the field; the distribution among fields of science within the program of the Foundation; the geographical distribution of research support by the Foundation; and, finally the funds available for research support. Thus, many excellent proposals cannot be supported for reasons aside from intrinsic merit, although this is an important consideration.

Even though we are unable to support this proposal, we would be pleased to consider other research proposals which you might wish to submit.

Sincerely yours,

Harve J. Carlson
Division Director for
Biological and Medical Sciences

Copy to: Business Office, University of Colorado

"Biosystematic and Evolutionary Studies on Critical Taxa of the Gentianinae"

April 27, 1972

U.S.-Japan Cooperative Science Program
National Science Foundation
Washington, D. C. 20550

In Reply Refer to CU Proposal No. 72.5.192

Gentlemen:

Enclosed are twenty (20) copies of a proposal for the support of "Biosystematic and Evolutionary Studies on Critical Taxa of the Gentianinae." This proposal is in the amount of $75,005 for the period of two years. Dr. Askell Löve, Professor, and Dr. Doris Löve, Research Associate, both of the Department of Biology, are the Co-Principal Investigators.

The University represents that it has not employed or retained a company, other than a full-time employee, to solicit or secure this contract and agrees to furnish information thereto as requested by the Contracting Officer. The proposal has been examined by and has the approval of this administration. We hope that it may receive your favorable consideration.

Since the forwarding of mail invariably incurs some delays, we would be grateful if, as in the past, you would direct all correspondence concerning contract negotiation and administration to this office for handling.

Sincerely,

Howard D. Roark
Operating Manager

ljk

Enclosures

NSF-20
PI-5
Bio 1
OPS 1

CU Proposal No. 72.5.192
4/72

A Proposal to the

NATIONAL SCIENCE FOUNDATION

U.S.-JAPAN COOPERATIVE SCIENCE PROGRAM

for support of

Biosystematic and Evolutionary Studies on Critical Taxa of the Gentianinae

Name and Address of Institution: The Regents of the
University of Colorado
Boulder, Colorado 80302

Desired Starting Date: September 1, 1972

Amount Requested from NSF: $75,005

Time Period for Which Support is Requested: Two Years

Co-Principal Investigators: Áskell Löve, Professor
Department of Biology
University of Colorado
Boulder, Colorado 80302
Telephone: 303-443-2211, ext. 7086
Social Security No. 522-68-5805

Doris Löve, Research Associate
Department of Biology
Telephone: 303-443-2211, ext. 7086
Social Security No. 522-68-5806

Áskell Löve
Co-Principal Investigator

Doris Löve
Co-Principal Investigator

Hobart M. Smith
Hobart Smith, Chairman
Department of Biology

I certify that the distribution of costs between the direct and indirect categories as shown in the proposal conforms to the usual accounting practices of the institution and to the distribution used by the cognizant Federal audit agency.

Lawson Crowe
Lawson Crowe
Provost and Vice President
for Research

ABSTRACT

This is a proposal for intense and cooperative research into the biosystematic and evolutionary basis for a revised classification of the tribe Gentianinae of the family Gentianaceae, which the Co-Principal Investigators have been studying with the aid of classical and cytotaxonomical methods for two decades. The study will use morphological, geographical, cytotaxonomical, palynological, and mathematical methods and will employ the modern techniques of the computer and electron scanning microscope, and various chemical techniques, in order to find a satisfactory basis for a firm evolutionary classification of this important tribe. Considerable herbarium and cytological material collected in various countries during the past two decades will be used, augmented by new collections of some important taxa and by collections from the past available in the major herbaria in America. The work will be in cooperation with Dr. Hideo Toyokuni and Dr. Yanagi Toyokuni, Professors at the Asahikawa University in Hokkaido in Japan, who have applied for support from the U.S.-Japan Cooperative Program in Japan for an almost two years' stay in Boulder. It is expected that for the last stages of the completion of the study the cooperative work may have to be moved to a Japanese institution for some few months, though presently it is not possible to make plans so far into the future.

I. Background of the Project

The family Gentianaceae includes about 800 described species, which in the past have been classified into a various number of tribes and genera depending upon the point of approach of each monographer. Traditionally and conservatively it includes about sixty genera, some of which are large and heterogenous, although most are limited to smaller and more homogenous groups. Many of these genera have been cultivated as ornamentals, and some have been well known for their pharmaceutical properties since time immemorial.

The name-giving and typical genus Gentiana was accepted by Linnaeus (1753 and earlier) in the same meaning as given to it by Tournefort in 1700. Tournefort, in turn, had adapted it from Celsus and Scribonius Largus. The family is represented by many genera in the Balkan peninsula, but it is not certain that the plant so named from the ancient area of Illyria by Scribonius Largus in commemoration of the ancient King Gentius really was a Gentiana in the present sense.

Of the presently known genera of Gentianaceae, Linnaeus (1753) accepted only Gentiana and Swertia, both in a very wide sense. Necker (1790), in Elementa Botanica, proposed the division of the former into Gentiana, Pneumonanthe, Anthopogon, Spirogyne, and Thyrophora, all but Gentiana invalid names, according to the present Code of Botanical Nomenclature, except when they have later been validated by others. A few years later, Moench (1794) separated the genus Gentianella from Gentiana proper, whereas two years after that, Borckhausen (1796) and Schmidt (1796) independently divided the Linnaean Gentiana into thirteen and six smaller genera respectively, on the basis of morphological differences alone. The Gentianella of Moench included the species related to G. campestris, which Link (1829) later named as the genus Amarella, but Moench's genus also comprised the fringed gentians, which Froelich (1796), the first real monographer of the group, described as the group Crossopetalum of Gentiana s.str.; this group was later given sectional status by Grisebach in Hooker's Flora Boreali-Americana in 1837, whereas Roth (1827) regarded it as wiser to accept it as a distinct genus Crossopetalum. Since this is a homonym previously proposed for a genus of Celastraceae, the fringed gentians are presently included in the genus Gentianopsis, described by Ma (1951).

Conceptual and nomenclatural confusion dominated most of the treatments of the family during the entire nineteenth century, so when Gilg (1895) and Kusnetzov (1896-1904) monographed the genera involved, they accepted a conservative point of view and tried to accommodate the immense diversity in sections of large and collective genera, rather than to split them into perhaps disputable genera of more limited size. Kusnetzov (1896) divided Gentiana into the subgenera Eugentiana and Gentianella, each of which was subdivided into a number of sections. Most authors of flora manuals published during the first half of the twentieth century accepted the opinion of Kusnetzov, frequently with the addition of the section Comastoma proposed by Wettstein (1896) to accommodate Gentiana tenella and three related species.

Around and after the passing of the first quarter of the present century, and especially after the first half of the century had been reached, so much new morphological, cytological, and palynological evidence on the diversity of Gentianaceae had accumulated that the need for a drastic revision of the conservative generic limits became increasingly evident. Although other taxa were critically evaluated and cautiously divided by some authors, most of the studies that resulted in splitting were made on the extremely heterogenous Gentiana in the Kusnetzov sense. This started by the resurrection of Gentianella Moench by Schuster (1923), a procedure generally accepted after Smith (1936 and later) demonstrated the occurrence of numerous characteristics that differentiate these taxa.

Smith (in Nilsson, 1967) has revised the variation of the important subtribe Gentianinae, which in his opinion is best accommodated as the following genera: Ixanthus Griseb., Jaeschkea Kurz, Crawfurdia Wall. (with the two sections Crawfurdia and Protocrawfurdia H. Sm.), Tripterospermum Blume, Gentiana L. (with the sections Coelanthe Ren.; Kusnetzov = Gentiana; Pneumonanthe Neck., Otophora Kusn., Stenogyne Franch.; Kusn., Frigida Kusn. Aptera Kusn., Chondrophylla Bg., Thylacites Ren., and Cyclostigma Griseb.), Gentianella Moench (with the sections Crossopetalum Froel., Arctophila Griseb., Amarella Griseb., Comastoma Wettst., Antarctophila Griseb., and Andicola Griseb.), Lomatogonium A. Br., Swertia L. (with the sections Euswertia C.B. Clarke = Swertia, and Ophelia Benth. and Hook.), Latouchea Franch., Veratrilla Baill., Megacodon H.Sm., and Halenia Borckh. This system clearly goes as far as morphological studies alone could reach, and it ignores considerable evidence on cytology, palynology, and chemotaxonomy of the various groups that had been collected during the past generation.

After detailed cytological studies of Gentianaceae by Favarger (1949), Rork (1949), Skalińska (1951), and D. Löve (1953), it was argued by D. Löve (1953), reviewing all the then available cytological knowledge of the Gentianinae, that especially the genera Gentiana and Gentianella in the Kusnetzov and Smith sense are collective taxa which seem to be made up of several natural units that are characterized by distinct karyotypes and different basic chromosome numbers. She advised a division of these collective genera into smaller genera, or at least closer investigations that might keep that possibility in mind. Studies by later authors heeding this advice, and especially studies by Löve and Löve (1956, 196la,b, 1972), Gillett (1957, 1963), Fabris (1958, 1960), Toyokuni (1961, 1963, 1965, 1967, 1968), Iltis (1965), Mayer (1954, 1968, 1969), Holub (1967, 1968), and Ikonnikov (1970), have resulted in the acceptance of the more strict genera Gentianopsis, Hippion, Ericala, Pneumonanthe, Dasystephana, Comastoma, Favargera, and Gentianodes, for numerous of the sections of Gentiana and Gentianella of previous authors, although this still seems to leave certain parts of these two last more collective genera in some state of evolutionary heterogeneity.

Similar problems are involved in some of the other genera of Gentianinae, but although H. and Y. Toyokuni have investigated some of these, the more or less intensive studies by A. and D. Löve during the past two decades have mainly been concerned with the cytotaxonomy and morphological distinction of the collective genera Gentiana and Gentianella in the alpine regions of the world. The cytological methods have proven of immense value in determining generic boundaries, since there is, in these taxa, a distinct connection between clusters of morphological characteristics and the basic number of chromosomes; in addition, karyotypic variations have been found to be of value for specific demarcations. Nevertheless, cytological characteristics are not a sufficient additional background for a thorough revision of such a complex into fully natural genera, as shown among others by our experience from the section Comastoma of Gentiana which Wettstein (1896) originally described on the basis of morphology alone and found to be closely related to the genus Lomatogonium. We confirmed that observation by aid of macro-characteristics, and also found the basic chromosome number to be the same in both groups and the karyotype similar or close to identical. On this basis, we united both groups in the genus Lomatogonium (Löve and Löve 1956). However, Toyokuni (1961) investigated both groups in greater detail, putting stronger emphasis on micro-characteristics. He came to the conclusion that although these groups are related,

their differences are clear evidence of separate evolutionary history that warrants an acceptance of both at the generic level. That conclusion has later been confirmed with the aid of palynological evidence by Nilsson (1967), and we have added preliminary and still unpublished observations with the aid of paper chromatography, detailed studies of hairs and pollen morphology, and a computerized comparison of numerous details that all clearly substantiate the conclusion by Toyokuni.

Although both we and Toyokuni have accumulated considerable material of Gentianinae during the past two decades, both herbarium plants and cytological preparations, it has become evident to all of us that a concerted effort utilizing every available method is needed to solve the classificatory problems of the Gentianinae in a satisfactory way. The methods which we visualize as necessary for this work must include classical and modern herbarium techniques strengthened by modern computer techniques, which D. Löve has studied and worked with in great detail. Cytological techniques have proven indispensible for this kind of work, but palynological studies are clearly of no less importance, especially when augmented with the techniques of the electron scanning microscope, which also ought to be used for detailed comparisions of hairiness, of epidermal characteristics of various organs, and of the seed coat, which has long been recognized as an important characteristic of this group. In addition, preliminary investigations with the aid of various chemotaxonomical methods clearly indicate the importance of isoenzyme studies and observations of various other chemical attributes for the understanding of sectional and higher categories of this taxon, so such methods ought also to be employed.

Since the material and apparatus for such an approach are already available at Boulder, along with the University's excellent computer center, an electron scanning microscope in the Department of Molecular, Cellular and Developmental Biology, and good chemical and biochemical facilities at the Department of Chemistry, Dr. Toyokuni has proposed that the era of piecemeal investigations by various more or less isolated workers who cooperate only through letters ought to be replaced by intense cooperation characterized by well-planned teamwork that would be best located at Boulder. Therefore, he has applied for support from the Japan Society for the Promotion of Science for such a cooperative project requiring an almost two years' stay for H. and Y. Toyokuni at the University of Colorado, with shorter visits to the best herbaria in America. The present proposal is designed to match the Japanese one, in order to

make this highly promising cooperation possible, although we and our students would be able to add considerable contributions towards the solution of the problems in question even without such a long visit by the Japanese investigators.

Although we plan to synthesize the results with close cooperation among all four investigators, we expect that the cytological and computer work will mainly be taken care of by Y. Toyokuni and D. Löve, perhaps aided by one graduate research assistant if available, and that the morphological, taxonomical, and geographical viewpoints will be worked out by H. Toyokuni and Á. Löve, perhaps aided by one student who would employ scanning electron microscope and chemical methods on some of the problems. The entire team will take part in other approaches, discuss theoretical viewpoints, and draw taxonomical conclusions as to generic and specific delimitations.

It ought to be emphasized that the significance of this teamwork will be taxonomic and evolutionary, since the results will demonstrate the possibilities of an evolutionarily sound monographing even of the taxonomically most difficult families of angiosperms, with the aid of such a concerted effort employing numerous available modern methods in addition to the classical ones. At the same time, we expect the work to be of significance also for pharmaceutical plant breeding work, because although the gentians are medicinally important, faulty taxonomy in the past has caused great difficulties in their improvement. Preliminary studies indicate that the drug content can be greatly increased by aid of polyploidy, and then especially alloploidy between species that may be most correctly placed in different genera. The role of polyploidy in the speciation within some of these genera is considerable, whereas in others it is negligible as far as our experience goes, and the evolutionary significance of some of the variations described at specific or subspecific levels from North America and eastern Asia needs to be evaluated on the basis of new methods.

We expect to publish some of the results of these studies in several journal articles during the investigations, but they will all be synthesized in a modern monograph of the group when all details have been collected and evaluated.

II. Summary of Procedure

1) The aim of the work proposed is to synthesize modern knowledge and understanding of the Gentianinae in a monograph in which all categories will be as exactly defined as possible on basis of their evolutionary history.

2) Material to be used for this work is in part herbarium plants collected during the past two decades on three continents by the four cooperating botanists, augmented with older and newer collections from official herbaria, in part cytological material and pickled plant organs collected during the same period, and in part fresh and living material grown from seeds in experimental plots and growth chambers for various kinds of cytogenetical and other experiments.

3) Ordinary morphological observations and measurements will be made on this extensive material in order to ascertain similarities and differences at various levels.

4) Observations on detailed morphology of hairs, epidermis, seed coats, and other minor characteristics of importance will be made with the aid of the scanning electron microscope, in addition to the ordinary microscope.

5) Cytological studies will concentrate on chromosome morphology and number, relations between different basic numbers and their possible phylogeny, karyotypes, meiotic pairing, and sterility of populations and their hybrids at various levels, and on general observations of other meiotic and mitotic characteristics that could be of value for the understanding of the evolutionary history and status of the taxa.

6) Palynological methods, including the use of the scanning electron microscope, will be employed in every case where such approaches seem necessary or promising.

7) The chemical similarities and dissimilarities of the different taxa will be investigated with the aid of modern chemotaxonomical methods, especially by aid of paper chromatography.

8) The distribution of the taxa will be studied with the aid of literature and herbarium material, and will be used as a basis for an interpretation of the possible evolutionary history and dispersal of the taxa in light of modern theories of continental drift.

9) During the work, and especially during the final synthesis of all these observations, computer methods and modern taximetrics will be utilized.

10) Although details observed during the process of the studies will be published separately in journal articles during the investigation, and some

of these used for thesis work of graduate students, all our observations and those of previous workers will in the end be synthesized into a thoroughly modern taxonomical monograph on the entire tribe.

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IV. Facilities

All major equipment needed for these studies is available in the Department of Biology or in other departments of the University where it can be made available for those concerned. The same applies to herbarium and library facilities in Boulder.

V. Personnel Data

The Japanese Investigators are:

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Vitae of the American investigators are found on the following pages.

VI. Current Support and Pending Applications

Current Support:

Smithsonian Institution Grant SFG-1-5484, "Cooperative Studies on the Cytotaxonomy of the Yugoslavian Flora," 6/1/71 to 5/31/72, $50,720; Co-Principal Investigators' time-commitments: 100 percent, three months summer. A proposal for renewal of this grant is currently under review.

Pending Applications:

None.

No other support is currently available for the proposed research. This proposal is being submitted only to NSF.

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B.A., Reykjavik College, 1937
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Research Associate, Institute of Genetics, University of Lund, 1942-45
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Associate Professor of Botany, University of Manitoba, Winnipeg, 1951-56
Research Professor of Biosystematics, Institut Botanique, Université de Montréal, 1956-63
Associate Professor, Department of Biology, Unierstiy of Colorado, 1964-66
Chairman, Department of Biology, University of Colorado, 1966-1970
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Fellowships and Professional Honors:

Fellow, Icelandic Academy of Learning since 1946; corresponding member since 1951
Permanent member of the Board of the International Association of Plant Geographers since 1953
Rapporteur and Vice President, Section of Cytology, VIIIth International Botanical Congress, Paris, 1954
Member, International Committee for Genetical Nomenclature and Symbolization (I.U.B.S.), 1956-58
Member of the Editorial Board of the journal Nucleus since 1958
Technical Consultant on Cytotaxonomy for Flora Europaea since 1955
President, International Organization of Biosystematists, 1960-64
Honorary Foreign Member, Swedish Phytogeographical Society since 1960
President, Symposium on North Atlantic Biota and their History, Reykjavik, July 1962
Vice President, International Committee on Chemotaxonomy, 1964-1969, President 1969-
John Simon Guggenheim Memorial Fellow, 1963-64.
Honorary Foreign Member, Czechoslovak Botanical Society since 1968

Selected Publications,

Cytogenetic studies in Rumex. Botaniska Notiser, 157-169 (1940).

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Íslenzk ferdaflora. (Icelandic Excursion flora).-Reykjavík 1970, 428 pages.

Cytotaxonomy of Rocky Mountain Ranunculus.- Cariologia 23:575-594, 1970 with B.M. Kapoor.

Cytotaxonomy of a century of Rocky Mountain orophytes.- Arctic and Alpine Research 3:139-165, 1976 with D. Löve and B.M. Kapoor.

Polyploidie et géobotanique.-Naturaliste Canadien 98:489-494, 1971, with D. Löve.

115 chromosome numbers from Yugoslavia.-Taxon 20:788-791, 1971, (with D. Löve, M. Lovka and F. Susnik.

Cytotaxonomical indication of the genus Conosilene.- Journal of the Indian Botanical Society. Jubilee Volume 1971, with E. Kjellqvist.

Cytotaxonomy of Spanish plants. I. Introduction, Pteridophyta and Gymnospermae.- Lagascalia 2, 1972. with E. Kjellqvist.

Cytotaxonomy of Yugoslavian plants. I. Introductory remarks.-Scopolia 1, 1972, with D. Löve, E. Mayer, and F. Susnik.

Favargera and Gentianodes. Two new genera of Alpine Gentianaceae.- Bot. Notizer 125, 1972, with D. Löve.

As comprehensive computerized chromosome atlas of the world. I. Pteridophyta.- 1972, with D. Löve and R.E.G. Pichi-Sermollia.

A computerized chromosome checklist of the flora of Slovenia.- 1972, with D. Löve.

B. LÖVE, Doris

Born: 2 January 1918

Position: Faculty Research Associate, Department of Biology, University of Colorado

Education:

B.S., Kristianstad College, Sweden, 1937
M.S., Cytogenetics, Botany, Geography, University of Lund, Sweden, 1941
Ph.D., Cytogenetics, Botany, University of Lund, Sweden, 1943
D.Sc., Cytogenetics, University of Lund, Sweden, 1944

Employment Record:

Instructor (amanuensis), Institute of Genetics, University of Lund, 1940-43
Research Associate, Institute of Genetics, University of Lund, 1943-45
Geneticist, University of Iceland Research Institute, Reykjavik, 1945-51
Herbarium Curator, University of Manitoba, Winnipeg, Canada, 1951-56
Associate Professor (research), Institut Botanique, Université de Montréal, Canada, 1956-63
Faculty Research Associate, Department of Biology, Institute of Arctic and Alpine Research, and University Museum, University of Colorado, 1964-

Fellowships and Professional Honors:

Fellow, Mendelian Society of Lund, Sweden since 1941
Several research scholarships and awards from the Royal Physiographic Society of Lund, Lund Botanical Society, and the Swedish Academy of Sciences, 1941-45
Research Fellowship from the Icelandic Cultural Fund, 1945-50
British Council invitation to visit British institutions in genetics and plant breeding, Summer 1949
Research grants from the National Research Council of Canada, 1956-64, and the National Science Foundation, 1967

Selected Publications:

Some contributions to the cytology of Silenoideae. Svensk Botanisk Tidsskrift 36, 262-270 (1940).

Cytotaxonomic studies on boreal plants. I. Some observations on Swedish and Icelandic plants. Kungliga Fysiografiska Sällskapets i Lund Förhandlingar 12 (6), 1-19 (1942), with Á. Löve.

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Cytogenetic studies on dioecious Melandrium. Botaniska Notiser 1944, 125-213 (1944).

Cytotaxonomical studies on boreal plants. II. Some notes on the chromosome numbers of Juncaceae. Arkiv för Botanik 31B (1), 1-6 (1944), with Á. Löve.

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Studies on the origin of the Icelandic flora. I. Cyto-ecological investigations on Cakile. Iceland University Institute of Applied Sciences, Department of Agriculture, Reports B, 2, 1-29 (1947), with Á. Löve.

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Studies on the origin of the Icelandic flora. II. Saxifragaceae. Svensk Botanisk Tidsskrift 45, 368-399 (1951), with Á. Löve.

The geobotanical significance of polyploidy. Proceedings of the VIth International Grassland Congress, State College, Pennsylvania (1952), 240-246 (1953), with Á. Löve.

Cytotaxonomical remarks on Gentianaceae. Hereditas 39, 225-235 (1953).

Studies on Bryoxiphium. Bryologist 56, 73-94, 183-203 (1953), with Á. Löve.

Cirsium Flodmanii (Rydb.) Arth.f. albiflora, forma nova. Rhodora 55, 362-363 (1953).

Cytotaxonomical studies on the northern bedstraw. American Midland Naturalist 52, 88-105 (1954), with Á. Löve.

A plant collection from SW Yukon. Botaniska Notiser 109, 153-211 (1956), with N.J. Freedman.

Cytotaxonomical conspectus of the Icelandic flora. Acta Horti Gotoburgensis 20, 65-291 (1956), with Á. Löve.

Chromosomes and taxonomy of eastern North American Polygonum. Canadian Journal of Botany 34, 501-521 (1956), with Á. Löve.

Rumex stenophyllus in North America. Rhodora 60, 54-57 (1958), with J.P. Bernard.

Cytotaxonomy of Carex section Capillares. Canadian Journal of Botany 35, 715-761 (1957), with Á. Löve and M. Raymond.

Drug content and polyploidy in Acorus. Proceedings of the Genetics Society of Canada 2, 14-17 (1957), with Á. Löve.

Arctic polyploidy. Proceedings of the Genetics Society of Canada 2, 23-27 (1957), with Á. Löve.

A plant collection from interior Quebec. Naturaliste Canadien 85, 25-69 (1958), with G. Johnston and J. Kucyniak.

The American element in the flora of the British Isles. Botaniska Notiser 111, 376-388 (1958), with Á. Löve.

An unusual polyploid series in Triglochin maritimum agg. Proceedings of the Genetics Society of Canada 3, 2, 19-21 (1958), with Á. Löve.

Cytotaxonomy and classification of Lycopods. Nucleus 1, 1-10 (1958), with Á. Löve.

Biosystematics of Triglochin maritimum agg. Naturaliste Canadien 85, 156-165 (1958), with Á. Löve.

Biosystematic studies in Xanthium: Taxonomic appraisal and ecological status. Canadian Journal of Botany 37, 173-208 (1959), with P. Dansereau.

The post-glacial development of the flora of Manitoba: a discussion. Canadian Journal of Botany 37, 547-585 (1959).

Biosystematics of the black crowberries in America. Canadian Journal of Genetics and Cytology 1, 34-38 (1959), with Á. Löve.

Flora and vegetation of Otterburne, Manitoba, Canada. Svensk Botanisk Tidsskrift 53, 335-461 (1959), with J.P. Bernard.

The red-fruited crowberries in North America. Rhodora 62, 265-292 (1960).

Some nomenclatural changes in the European flora. I. Species and supraspecific categories. Botaniska Notiser 114, 33-47 (1961), with Á. Löve.

Some nomenclatural changes in the European flora. II. Subspecific categories. Botaniska Notiser 114, 48-56 (1961), with Á. Löve.

Some chromosome numbers of Icelandic ferns and fern-allies. American Fern Journal 51, 127-128 (1961), with Á. Löve.

Chromosome numbers of Central and Northwest European plant species. Opera Botanica 5, I-VIII, 1-581 (1961), with Á. Löve.

The Hutchinson polygraph, a method for simultaneous expression of multiple and variable characters. Canadian Journal of Genetics and Cytology 3, 289-294 (1961), with L. Nadeau.

Triglochin gaspense, a new species of arrowgrass. Canadian Journal of Botany 39, 1261-1272 (1961), with H. Lieth.

Quelques mots sur la flore alpine de Mt. Washington, N.H. Annales de l'ACFAS 28, 38 (1962).

North Atlantic Biota and their History. Pergamon Press, Oxford (1963), editor with Á. Löve.

Dispersal and survival of plants. North Atlantic Biota and their History, 189-205 (1963).

Streptopus oreopolus Fern., a hybrid taxon. Rhodora 56, 310-317 (1963), with H. Harries.

The North Atlantic flora - its history and late evolution. Tenth International Botanical Congress (1964), Abstracts, 139-140 (1965), with Á. Löve.

Taxonomic remarks on some American alpine plants. University of Colorado Studies, Series in Biology 17, 1-43 (1965), with Á. Löve.

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Vaccinium gaultherioides Bigel. - an arctic-alpine species. Revue Roumaine de Biologie, Série Botanique 11, 295-305 (1966), with N. Boşcaiu.

The variations of Blechnum Spicant. Botanisk Tidsskrift 62, 186-196 (1966), with Á. Löve.

Íslenski dílaburkninn (Dryopteris assimilis S. Walker in Iceland). Flóra, Journal of Icelandic Botany 4, 5-9 (1966), with Á. Löve.

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Evolution and the Linnaean species. Univ. Babes Bolayi din Cluj, Grad. Bot. Contrib. Bot. 1967, 203-210 (1967), with Á. Löve.

The origin of the North Atlantic flora. Aquilo, Ser. Bot. 6, 52-66 (1967) with Á. Löve.

New combinations in Carpogymnia.-Taxon 16:191-192, 1967, with Á. Löve.

Cytotaxonomy of Blechnum Spicant. Collectanea Botanica 7, 665-676 (1968), with Á. Löve.

The diploid perennial Anthoxanthum. Science in Iceland 1968, 26-30 (1968), with Á. Löve.

Papaver at high altitudes in the Rocky Mountains. Brittonia 21, 1-10 (1969).

Remarks on the cytotaxonomy of Mediterranean plants.-Publ. Univ. Sevilla 1969:285-291, with Á. Löve.

Subarctic and subalpine - where and what? - Journal of Arctic and Alpine Research 2:63-73, 1970.

Coumarin and coumarin derivatives in various growth-types of Engelmann Spruce.-with Svenik Bot. Tidskrift 64: 284-295, 1970. with C. McLellan and I. Gamow.

Reflections around a mutilated tree - Biol. Conservation 3:274-278, 1971.

Cytotaxonomy of a century of Rocky Mountain orophytes. - Arctic and Alpine Research 3: 139-165, 1971, with Á. Löve and B.M. Kapoor.

Polyploidie et géobotanique.- Naturaliste Canadien 98:469-494, 1971, with Á. Löve.

115 chromosome numbers from Yugoslavia.- Taxon 20:788-791, 1971, with Á. Löve, M. Lovka, and F. Susnik.

Cytotaxonomy of Yugoslavian plants. I. Introductory remarks.- Scopolia, 1972, with A. Löve, E. Mayer, and F. Susnik.

Favargera and Gentianodes, two new genera of alpine Gentianaceae.- Bot. Notiser 125, 1972, with Á. Löve.

A comprehensive computerized chromosome atlas of the world. I. Pteridophytes. 1972, with Á. Löve and R.E.G. Pichi-Sermolli.

A computerized chromosome checklist of the flora of Slovenia.-1972, with Á. Löve.

CU Proposal No. 72.5.192
4/72

NATIONAL SCIENCE FOUNDATION

Research Grant Budget

Institution: The Regents of the University of Colorado Boulder, Colorado 80302

Title: Biosystematic and Evolutionary Studies on Critical Taxa of the Gentianinae

Starting Date: September 1, 1972

Duration: Two Years

Co-Principal Investigators: Áskell Löve
Doris Löve

	1st year	2nd year
A. Salaries and Wages		
Co-Principal Investigators:		
Áskell Löve		
25% time, 9 mos. A.Y.	$ -0-	$ -0-
100% time, 3 mos. summer	6,675(3MM)	7,210(3MM)
Doris Löve		
33 1/3% time, 9 mos. A.Y.	6,000(3MM)	6,480(3MM)
Graduate Research Assistants (2)		
50% time, 9 mos. A.Y.	6,400(9MM)	6,400(9MM)
100% time, 3 mos. summer	4,260(6MM)	4,260(6MM)
Total Salaries and Wages	23,335	24,350
B. Fringe Benefits		
TIAA: 7% of faculty salaries	465	505
C. Permanent Equipment		
None	-0-	-0-
D. Expendable Supplies and Equipment		
Chemicals, film, etc.	700	700
E. Travel		
Domestic: to herbaria and for field collection	700	700
F. Publication Costs		
Page costs and reprints	600	1,000
G. Other Direct Costs		
Mailing of herbarium material	200	200

Budget Continued

	1st year	2nd year
Other Direct Costs Continued:		
Computer costs: CDC 6400 @ $60/hr. peripheral time, $300/hr. central processing, plus keypunching costs	$ 1,000	$ 1,000
Total Other Direct Costs	1,200	1,200
H. Total Direct Costs	$ 27,000	$ 28,455
I. Indirect Costs		
On campus: 41% of Salaries and Wages	9,565	9,985
J. Total Costs	$36,565	$38,440

TOTAL REQUESTED FROM NSF FOR TWO YEARS: $75,005

This institution will cost-share in compliance with NSF policy.

Budget Justification

The Japanese investigators will have separate finances. The budget proposed for the American investigators assumes that Doris Löve, who is most essential for this study since her work on the family actually initiated the wave of studies of the group almost two decades ago, will be paid for one-third time during the academic year and nothing during the summers, although she certainly will work considerably more on the project. Áskell Löve, however, plans to spend 25 percent of his research time on the project during the academic year, with salary contributed by the University, and three months summers salaried through the project.

Salaries are also asked for for two graduate research assistants. Although both will be required to assist in various phases of the project, one is supposed to work intensely with cytological and computer work, whereas the other will spend more time on scanning electron microscopy and on chemotaxonomy. It is assumed that both will use some of the material for their Ph.D. theses on some problems in the Gentianaceae pertinent to the project.

The need for expendable supplies and equipment in form of chemicals, films, etc. is self-explanatory, and so also is the request for funds for page charges and reprints and for computer costs (including keypunching). Mailing costs for herbarium material are necessary because of the policy of herbaria to require the payment of such costs by the borrower, especially when large quantities of material are involved. The cost for field collections and visits to herbaria is the minimum visualized, although the main cost of such visits will be carried by the Japanese investigators.

UNIVERSITY OF COLORADO PARTICIPATION

	1st year	2nd year
A. Salaries and Wages		
Co-Principal Investigator: Á. Löve 25% time, 9 mos. A.Y.	$ 5,005(2MM)	$ 5,405(2MM)
B. Fringe Benefits		
TIAA: 7% of faculty salaries	350	380
C. Tuition Waiver*		
Graduate Research Assistants (2)	940	940
D. Indirect Costs		
On campus: 41% of Salaries and Wages	2,050	2,215
TOTALS	$8,345	$8,940

TOTAL C.U. PARTICIPATION FOR TWO YEARS: $17,285

*The University waives the difference between out-of-state and in-state tuition for research assistants. The average cost of such waivers for all research assistants is $470 per research assistant per year, which is shown as a University contribution. This amount will be adjusted periodically to reflect actual experience.