DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

GRANT APPLICATION

SECTION I

FORM APPROVED
O.W.B. 66-R0249

TYPE PROGRAM LEAVE BLANK

REVIEW GROUP FORMERLY

COUNCIL (Month. Year) DATE RECEIVED

TO BE COMPLETED BY PRINCIPAL INVESTIGATOR (Items 1 through 7 and 15A)

1. TITLE OF PROPOSAL (Do not exceed 53 typewriter spaces)
   Resource-Related Research - Computer in Chemistry (RR-00612 renewal)

2. PRINCIPAL INVESTIGATOR
   2A. NAME (Last, First, Initial)
       Djerassi, Carl
   2B. TITLE OF POSITION
       Professor of Chemistry

3. DATES OF ENTIRE PROPOSED PROJECT PERIOD (This application)
   FROM May 1, 1980 THROUGH April 30, 1985

4. TOTAL DIRECT COSTS REQUESTED FOR PERIOD IN ITEM 3
   $1,611,719

5. DIRECT COSTS REQUESTED FOR FIRST 12-MONTH PERIOD
   $511,400

6. PERFORMANCE SITE(S) (See Instructions)
   Stanford University

7. RESEARCH INVOLVING HUMAN SUBJECTS (See Instructions)
   A. NO B. YES Approved:
      1. YES - Pending Review Date
   C. YES - Previously reported

8. INVENTIONS (RENEWAL APPLICANTS ONLY - SEE INSTRUCTIONS)
   A. NO B. YES - NOT PREVIOUSLY REPORTED
   C. YES - PREVIOUSLY REPORTED

9. APPLICANT ORGANIZATION(S) (SEE INSTRUCTIONS)
   Stanford University
   Stanford, CA 94305
   IRS No. 94-1156365
   Congressional District 12

10. NAME, TITLE, AND TELEPHONE NUMBER OF OFFICIAL(S)
     SIGNING FOR APPLICANT ORGANIZATION(S)
     Larry J. Lollar
     Sponsored Projects Officer
     Telephone Number (415) 497-2883

11. TYPE OF ORGANIZATION (CHECK APPLICABLE ITEM)
    Private, non-profit university

12. NAME, TITLE, ADDRESS, AND TELEPHONE NUMBER OF OFFICIAL IN BUSINESS OFFICE WHO SHOULD ALSO BE NOTIFIED IF AN AWARD IS MADE
    K. D. Creighton
    Assoc. Vice President-Controller
    Stanford University
    Stanford, CA 94305
    Telephone Number (415) 497-2251

13. IDENTIFY ORGANIZATIONAL COMPONENT TO RECEIVE CREDIT FOR INSTITUTIONAL GRANT PURPOSES (SEE INSTRUCTIONS)

14. ENTITY NUMBER (FORMERLY PHS ACCOUNT NUMBER)
    IRS No. 94-1156365

15. CERTIFICATION AND ACCEPTANCE. We, the undersigned, certify that the statements herein are true and complete to the best of our knowledge and accept, as to any grant awarded, the obligation to comply with Public Health Service terms and conditions in effect at the time of the award.

SIGNATURES
   (Signatures required on original copy only. Use "Per" signatures not acceptable)
   A. SIGNATURE OF PERSON NAMED IN ITEM 2A
   B. SIGNATURE(S) OF PERSON(S) NAMED IN ITEM 10

NIM 398 (FORMERLY PHS 398)
Rev. 1/73
Our proposed research concerns computer-assisted structure elucidation of organic compounds of biological importance. We propose to make a quantum jump in both performance of existing and new programs and their availability to a nationwide community of biomedical scientists. We will build more powerful programs (basing our efforts on the solid foundation of programs developed under earlier grant support by: a) assembling a Semi-Automated Structure Elucidation System (SASES) which will act as a computer-based "laboratory" for carrying out experiments involving computer representation and manipulation of chemical structures, including structure elucidation, spectral data interpretation and prediction and conformational analysis to establish relationships between three-dimensional structures and their biological and chemical properties (structure/property relationships); b) developing at the heart of SASES the GENOA program, a method for structure Generation with Overlapping Atoms, which will include as a component our existing CONGEN program; c) developing a method for constrained generation of molecular conformations; and d) extending our topological structure representations to include both configurational and conformational stereochemistry and infusing proper treatment of stereochemistry throughout our computer programs. We will increase the availability of our programs to the outside community through resource sharing in the following ways: a) through a dedicated computer system which will exploit the proposed relationship of our work to the SUMEX-AIM computer resource; b) by continuing to develop exportable versions of our programs; and, c) by holding intensive workshops to introduce other research groups to our techniques.
## SECTION II - PRIVILEGED COMMUNICATION

**BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE**

**DIRECT COSTS ONLY (Omit Cents)**

<table>
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<th>DESCRIPTION</th>
<th>1ST PERIOD (SAME AS OF TAILED BUDGET)</th>
<th>ADDITIONAL YEARS SUPPORT REQUESTED (This application only)</th>
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<td>PERSONNEL COSTS</td>
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<td>PATIENT COSTS</td>
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<td>ALTERATIONS AND RENOVATIONS</td>
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<td>TOTAL DIRECT COSTS</td>
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<td>258,282</td>
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<td>TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD (Enter on Page 1, Item 4)</td>
<td>$1,611,719</td>
<td></td>
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</tbody>
</table>

**REMARKS:** Justify all costs for the first year for which the need may not be obvious. For future years, justify equipment costs, as well as any significant increases in any other category. If a recurring annual increase in personnel costs is requested, give percentage. (Use continuation page if needed.)

Salary increases, and increases in other categories figured at 7% per year.

Staff benefits determined according to the following:

- 5/1/80 - 8/31/80: 21.6%
- 9/1/80 - 8/31/81: 22.4%
- 9/1/81 - 8/31/82: 23.2%
- 9/1/82 - 8/31/83: 24.0%
- 9/1/83 - 8/31/84: 24.8%
- 9/1/84 - 4/30/85: 25.6%

(see attached)
Budget Remarks

Personnel

Professor Djerassi will continue in his role as principal investigator, providing overall scientific direction to the project. Dr. Smith acting as co-investigator. Drs. Smith, Nourse, Gray and Buchanan will be responsible for the design, implementation and application of the programs which we propose to develop, including representing the scientific interface to the outside community of collaborators.

Two programmers, Mr. Terry and a person to be appointed, will provide scientific programming support for the project including the following responsibilities. Mr. Terry will have primary responsibility for maintenance and documentation of application programs, with the assistance of other members of the scientific and technical staff. He will share responsibility for design and programming of new algorithms with the scientific staff. Together with the second programmer, he will provide technical support for collaborators and be responsible for developing versions of CONGEN and newer programs for other computer systems. The second programmer, to be named, will have primary responsibility for the dedicated computer system (the DEC VAX) requested in this proposal, including interfaces to the SUMEX PDP-10 system, and all other necessary system support functions including obtaining and implementing new languages, text editors and so forth.

The pre- and postdoctoral fellows supported by the grant will be involved in applications of the programs to chemical problems in our own laboratories or in research involving development of new computer techniques in collaboration with the professional staff.

The secretarial responsibilities (105 percent of a full time person) are distributed among three persons, reflecting our best estimates of actual time spent on this grant and other grants, to myself or Prof. Feigenbaum, which support the remainder of their salaries (Ms. Learned-Driscoll is supported for the remainder of her time by the Chemistry Department).

Equipment

A Dedicated Computer System - the DEC VAX-11/780

We have requested funds in the first year of the proposal to purchase a dedicated computer system for our project. The reasons for this approach are discussed in detail in Section A.2.c, Relationship to the SUMEX-AIM Resource, and in Section C.5.a. Briefly, the implementation of this machine as an adjunct to the SUMEX resource is a research study in itself, namely, how best to provide access to computational resources in a computing environment where heavy demands are being made on both development and application of software tools for solving biomedical problems. We intend to make the dedicated system available for production use of our applications programs, assuring high quality interactive service to our collaborators. We cannot get such additional capacity for this work from SUMEX which is already overcrowded and committed to new program development rather than production use. We will exploit our close relationship with SUMEX for the development of new programs, for continued close contact with the AI community centered there, as a gateway to communication facilities allowing remote terminal
access and for sharing of peripheral equipment and operations support so far as is possible. At the end of this section we comment on our situation were the dedicated machine not approved as part of this proposal.

In considering the type of machine which could provide the needed, additional capacity, we have focussed our attention on the qualities we would require in a machine, letting these considerations guide our choice. We require high quality, interactive service to support our programs in a reasonable way. An interactive program must provide rapid response to the scientist using it. This means we need a system with a good time-sharing operating system. Our programs tend to be larger than can fit comfortably on mini-computers, and certainly the more complex programs which we propose to develop will only grow larger. This requirement suggests a system which possesses a large address space, large enough that space is not a limiting factor. The combination of time sharing and large address space suggests a virtual memory machine with demand paging. Finally, we want a machine that will maximize long-term compatibilities with the SUMEX AI community and other biochemical and chemical computing resources and laboratory systems.

We have considered several alternative computers which might meet the above qualities and would provide the needed computational power to support our community. We have rejected all 16-bit (or fewer) mini-computers on the basis of address space limitations which are too restrictive for the size of our programs. Although it is possible in principle to fit our new programs such as the exportable version of CONGEN into such a small machine using extensive overlays, the programming effort would be prohibitive.

One plausible alternative is to purchase a computer compatible with the existing DEC-10 or DEC-20 systems at SUMEX and Rutgers on which our new software such as CONGEN will run without change. There are only two reasonable alternatives here, the DEC-20 family or the Poonly F-2 (a DEC-10 compatible machine being developed by a Bay-area company). The higher end of the DEC line is prohibitively expensive (e.g., the 2040 or 2050), leaving the DEC-2020 as the only reasonable choice. These systems have the advantage of running the highly developed interactive monitors (TENEX or TOPS-20) now used at SUMEX and other AI resources. This would maximize near-term compatibility and minimize operational costs. The 2020 (and the F-2) are computationally quite slow, however, particularly for arithmetic processing since they do not have a floating point processor. We expect our new research will make significant demands in this area.

There are several other negative factors about selecting either the 2020 or the F-2. The current price-performance index of the DEC-2020 is quite poor; no price advantage per user is achieved over the much more complex (and expensive) DEC-20's. Poonly is a very small company whose future is insecure. Only a few laboratories to which we might export software and collaborate on program developments and applications operate DEC-10 or -20 compatible machines. Finally, this class of machines is rapidly becoming obsolete. DEC appears to be directing their future developments toward VAX-like machines.

In parallel with this, the ARPANET AI community has been investigating long-term alternatives for INTERLISP support given the address space limitations of the DEC-10. A number of alternatives are under consideration including a "personal" LISP machine being developed at MIT, a PRIME system being considered by BB and N (Bolt Beranek and Newman Inc.) and the DEC-VAX. It appears that a consensus is developing around VAX given its attractive architecture, good interactive operating systems (UNIX or perhaps VMS) and vendor support. The DEC-VAX also appears to be
increasingly popular in scientific laboratories, including labs of several of our workshop attendees (see Annual Report, Appendix I). As another example, the National Resource for Computation in Chemistry will soon take delivery of a VAX system, meaning that additional, chemistry related software will soon become available on the VAX. (We note that similarly configured VAX’s and 2020’s have similar prices; the VAX will deliver considerably more computational power, however).

In summary, purchase of a 2020 or similar machine would be an expedient, short-term option to pursue in terms of our compatibility with ourselves. We feel strongly, however, that this would be short sighted. We must look further into the future in our proposal to make the best estimate possible on the trends in computer developments followed by both manufacturers and users. We are already seeing shifts in DEC, the AI community and, most importantly, computational chemists with whom we interact, toward VAX and similar machines. It is becoming clear that VAX or its equivalent is the machine to obtain, especially as a medium for providing high quality, interactive service to our collaborators, whether by network access to Stanford or programs exported to other sites. We have, therefore, tentatively decided to purchase a VAX as the dedicated machine to support applications of our programs. The configuration of the VAX as we propose it would include:

1) Basic system, including 512 KByte memory, one RP06 disc drive, one TE16 tape drive, VMS operating system, LA120 operator console, DE-11A for eight terminal lines ($185,000);

2) 1 MByte additional memory ($35,000);

3) Either 1 Mbyte additional memory ($35,000) or one additional RP06 disc drive ($34,000) ($35,000 figured in the total appearing on the budget);

4) FORTRAN compiler ($3,300);

5) Floating point accelerator ($9,900).

Item (2) is strongly recommended by DEC in order to support more than two or three concurrent users. The choice in item (3) remains to be made. The tradeoff here is whether or not support for a larger complement of users (8 - 12) is best handled by a separate disc system for paging, or by additional memory. Further discussions with other VAX users will be required to reach a final conclusion. The final budget figure ($254,214) was obtained by summing the above figures, taking an 11 percent educational discount and adding 6-1/2 percent California State sales tax.

We are currently evaluating the various operating systems available for the VAX, including VMS from DEC, UNIX from Bell Laboratories or the Interactive Systems Corp. UNIX version which couples both VMS and UNIX in one package. Choice of one of the non-DEC operating systems will add an additional increment to our budget. In addition, new software from DEC, such as new compilers, will represent additional costs. Given the price of the FORTRAN compiler, we can estimate other languages to cost about the same. We have requested funds in the budget to cover software purchases, with the greatest expense in year one.

We have also budgeted, as a one-time cost, our best estimates of the expense required to implement the SUMEX/VAX link (see Section C.5). This figure, $15,000, will cover communications interfaces, circuit boards, cabling and integrated circuits.
As a final note, the rapidly changing situation with respect to new machines and cheaper prices for existing machines may allow us to reduce these estimates in the coming months. We are making every effort to find more cost-effective ways to meet our basic goals for the dedicated computer.

We believe that a DEC maintenance contract to support the hardware is the most cost-effective way to ensure maximum computer availability for our outside collaborators. Based on the hardware cited above and DEC's standard contract prices, the cost for year one (nine-month basis, three months covered under warranty) is $13,450, including a maintenance contract on the existing GT40.

If this proposal is approved and funded without the proposed computer, we will be forced to provide access to our programs, for both development and applications, to SUMEX alone, i.e., perpetuate the current situation. Not only will an important experiment in resource access and resource sharing be lost, but our collaborators (see Section F) will become increasingly impatient at the slow response time of SUMEX. We know from past experience that if response time in a highly interactive program becomes too long, scientists will simply find more productive uses for their time and will cease to use the computer. It also must be recognized that, because SUMEX is funded separately from our grant, we must also try to ensure long-term computational support for our research. The machine configuration requested is, alone, insufficient to meet our needs in the absence of SUMEX, but would do so with augmentation (additional peripheral equipment, memory, network interface, additional terminal ports and perhaps additional personnel).

Graphics Terminals

The goals of our proposed research are heavily involved with stereochemical representations of molecular structure. The requirements for visualizing these structures plus our desires to seek improvements in the interactive capabilities of our programs (most of our collaborators have requested some form of graphic input and output) have led us to propose a low-cost alternative to expensive graphics systems (Evans and Sutherland, Vector-General) or even expensive graphics terminals like the DEC GT-40. We are currently examining alternative display systems which represent new technology and provide graphics capabilities together in some instances with capabilities for input of graphic (in our case structural) information.

We have examined several display systems so far, including those manufactured by Grinnel Systems (Santa Clara, CA), DeAnza Systems (Santa Clara, CA) and Tektronix. At this time, the Tektronix 4025 appears to have a better set of desirable features, including capacity for pseudo-rotation of structures based on sequential display of stored images, programmable functions for special graphics such as automatic construction of ring systems, and cursor control for structure input. The budget figure requested includes the basic terminal plus additional display and graphics memory (to a total of 32K and 64K bytes, respectively) to allow storage of sufficient multiple images for pseudo-rotation (to add three-dimensional characteristics to the visualized structures). We will continue to search for other low-cost graphics terminal which would meet our needs together with the needs of our collaborators.

A second terminal has been requested in the second year of the budget. By that time we should be heavily involved in representation and manipulation of three-dimensional representations of structure and would require additional graphics terminal support for program development and application.
**NAME**
Carl Djerassi

**TITLE**
Professor of Chemistry

**BIRTHDATE (Mo, Day, Yr.)**
10/29/23

**PLACE OF BIRTH (City, State, Country)**
Vienna, Austria

**PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)**
U.S. Citizen

**EDUCATION (Begin with baccalaureate training and include postdoctoral)**

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<tr>
<th>INSTITUTION AND LOCATION</th>
<th>DEGREE</th>
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<tr>
<td>Kenyon College</td>
<td>A.B. (summa cum laude)</td>
<td>1942</td>
<td>Chemistry, Biology</td>
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<td>University of Wisconsin</td>
<td>Ph.D.</td>
<td>1945</td>
<td>Organic Chemistry, Biochemistry (minor)</td>
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**HONORS**
National Medal of Science ('73); Perkin Medal ('75); Am. Chem. Soc. Awards; Pure Chemistry ('58), Baekeland Medal ('59), Fritzsche Award ('60), Award for Creative Invention ('73); Freedman Foundation Patent Award ('71) and Chem. Pioneer Award ('73) of Am. Inst.Chem.; Hon. Member and Centenary Lecturer, Chem. Soc. (London); Member of National Academy of Sciences, American Academy of Arts and Sciences, Royal Swedish Academy of Sciences, Leopoldina, Bulgarian Academy of Sciences. Honorary D. Sc. Kenyon College, Nat. Univ. of Mexico, Federal Univ. of Rio de Janeiro, Worcester Polytechnic Inst., Wayne State, Columbia, Uppsala, Coe College, University of Geneva.

**RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)**

**Academic Experience**
Professor of Chemistry, Stanford University, 1959 - present
.Assoc. Professor ('52-'54) and Professor ('54-'59); Wayne State University

**Industrial Experience**
Zocon Corp., Palo Alto, CA, Chairman of the Board and Chief Exec. Officer, '68 - present.
Syntex Corp.: Various positions in Mexico City ('49-'52, '57-'60) and Palo Alto, CA ('60-'72) ranging from Assoc. Director of Chemical Research to President of Syntex Research.

**Miscellaneous**
Chairman of AAAS Gordon Res. Conf. on Steroids and Nat. Prod. ('52-'54); Member Amer. Pugwash Comm. ('58-'75); Chairman, Latin American Science Board of National Academy of Sciences ('66-'68); Member ('68-'72) and Chairman ('73-'75) of Board on Science and Technology for International Development of National Academy of Sciences; Member, President's Advisory Group on Contributions of Technology to Economic Strength ('75-'76); Comm. on National Medal of Science; NAS Institute of Medicine (Member of Membership Comm. or Comm. on International Health).

**Publications**
Author or co-author of six books (four dealing with organic mass spectrometry) and over 930 scientific publications. The most recent publications (since January 1978) are listed here, with papers Nos. 927, 925, 924, 915, 907 and 906 being particularly relevant to this application.
RESEARCH SUPPORT: CARL DJERASSI

Since essentially all of my research is supported by the NIH, it is important for the reviewers to understand what each grant actually covers in terms of personnel, equipment, etc., and how the present renewal application of RR-00612 fits into this overall picture. Therefore, I am going into somewhat more detail than is generally required for this section.

GM-06840 (20-23): "Marine Chemistry with Special Emphasis on Steroids" 5/1/78 - 4/30/82. Current annual budget $133,042. This grant supports the bulk (equivalent to three predoctorate and five postdoctorate fellows) of my collaborators who are working on the isolation, structure elucidation, biosynthesis and possible biological function of marine steroids.


RR-00612 (09-10): "Resource Related Research - Computers in Chemistry" 5/1/78 - 4/30/80. Current budget $144,051 (5/1/79 - 11/30/79). The current application is for renewal of this project. The renewal represents a significant change in emphasis from the current proposal in that the SUMEX-AIM computer resource is the resource to which our research will be related in the future, rather than the mass spectrometry laboratory. For this reason, the following two (partially overlapping) applications were submitted (and are pending) for support of personnel and supplies and purchase of new equipment to maintain and upgrade the mass spectrometry laboratory. Because of this shift in emphasis, the current proposal requests no funds for support of the laboratory and does not overlap in any way with the following two proposals.

AM-04257: "Mass Spectrometry in Organic and Biochemistry" 12/1/76 - 11/30/79. Current annual budget $74,800. This grant currently supports one mass spectrometer, a senior technician to operate the instrument, one postdoctoral fellow and three predoctoral fellows, who are engaged in isolation and synthetic work related to interpretation of fragmentation patterns of known and unknown molecular structures.

A renewal application has been submitted for this grant and is currently pending. This renewal is designed to support the mass spectrometer, personnel and supplies currently supported under RR-00612. In addition funds were requested to upgrade the mass spectrometer facilities. No action has as yet been taken on this application.

Pending Application: A NIGMS Shared Instrumentation Resource proposal entitled "A Shared Mass Spectrometry Resource" has been submitted for the period 9/1/79 to 8/30/82. The first year budget is $145,046, including $130,850 of capital equipment. This proposal requests support for equipment similar to that requested in the renewal of AM-04257, with some differences reflecting the resource sharing aspects of the NIGMS program. The only personnel for whom support is requested under this proposal include 10 percent of Dr. Smith and 10 percent of a senior technician. No action has yet been taken on this application. If AM-04257 is approved then only $18,500 is requested from NIGMS for a chemical ionization accessory.
Pending Application: An application entitled "Circular Dichroism of Cyclic Ketones - Conformational Isotope Effects" with an annual budget of $55,782 for the period 4/1/79 to 3/31/81 has been submitted to the National Science Foundation. In terms of personnel, it covers the salaries of one postdoctorate and two predoctorate fellows for synthetic work on chiral ketones, whose chirality is only due to $^{13}\text{C}$ or deuterium. No action has as yet been taken on this application.

RECENT PUBLICATIONS


909. Optical Rotatory Dispersion Studies CXXIV. Synthesis and Circular Dichroism of 3(S)\(\alpha\) - and 3(R)\(\alpha\) -Deuterio-4(R) -t-Butyl-cyclohexanone and 2(R)\(\alpha\) - and 2(S)\(\alpha\) -Deuterio-4(R) -Isopropyl-cyclohexanone. Tetrahedron Letters, 2457 (1978) by P. Sundararaman and C. Djerassi


913. Terpenoids LXXIV. The Sesquiterpenes from the Soft Coral *Sinularia mayi*. Tetrahedron 34, 2503 (1978) by C. M. Beechan, C. Djerassi and H. Eggert

915. Applications of Artificial Intelligence for Chemical Inference
XXVIII. Computer-Assisted Simulation of Chemical Reaction
Sequences. Applications to Problems of Structure Elucidation.
by T.H. Varkony, R.E. Carhart, D.H. Smith and
C. Djerassi

Bull. Amer. Acad. of Arts and Sciences 32, No. 1,
(1978)
by C. Djerassi

917. Determination of the Absolute Configuration of Stelliferasterol
and Strongylosterol - Two Marine Sterols with "Extended"
Side Chains.
Tetrahedron Letters, 4369 (1978)
by N. Theobald and C. Djerassi

918. Minor and Trace Sterols in Marine Invertebrates IX.
Verangulasterol - a Marine Sterol with a Novel Side Chain
Alkylation Pattern.
Tetrahedron Letters, 4373 (1978)
by W.C.M.C. Kokke, W. H. Fenical, C. S. Pak
and C. Djerassi

919. Optical Rotatory Dispersion Studies CXXVI. Synthesis and
Chiroptical Properties of Cyclohexanones with Chirality Solely
Due to Isotopic Substitution: 12CH₃ vs 13CH₃ and CH₃ vs
CD₃
Tetrahedron Letters, 4377 (1978)
by C. S. Pak and C. Djerassi

920. Isolation and Structure of 26,27-Cycloaplysterol (Petrasterol): A
Cyclopropane-Containing Marine Sterol.
Tetrahedron Letters, 4379 (1978)
by B. N. Ravi, W.C.M.C. Kokke, C. Delseth and
C. Djerassi
   J. Amer. Chem. Soc., 100, 7677 (1978)
   by N. Theobald, R.J. Wells and C. Djerassi

   J. Amer. Chem. Soc., 100, 8010 (1978)
   by S.F. Lee, G. Barth and C. Djerassi

   Analytical Biochemistry, 90, 474 (1978)
   by R. E. Linder, R. Records, G. Barth, E. Bunnenberg, C. Djerassi, B. E. Hedlund, A. Rosenberg, E. S. Benson, L. Seamans and A. Moscowitz

924. Minor and Trace Sterols in Marine Invertebrates VI. Occurrence and Possible Origins of Sterols Possessing Unusually Short Hydrocarbon Side Chains
   Bioorganic Chemistry, 7, 453 (1978)
   by R.M.K. Carlson, S. Popov, I. Massey, C. Delseth, E. Ayanoglu, T.H. Varkony and C. Djerassi
925. A Novel Role of Computers in the Natural Products Field.  
Naturwissenschaften, 66, 9 (1979)  
by C. Djerassi, D. H. Smith and T. H. Varkony

926. The Synthesis of Demethylgorosterol.  
Tetrahedron Letters, 767 (1979)  
by R. D. Walkup, G. D. Anderson and C. Djerassi

927. Applications of Artificial Intelligence for Chemical Inference XXIX. Exhaustive Generation of Stereoisomers for Structure Elucidation.  
by J. G. Nourse, R. E. Carhart, D. H. Smith and C. Djerassi

by C. Delseth, L. Toleala, P. J. Scheuer, R. J. Wells and C. Djerassi
**BIOGRAPHICAL SKETCH**

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

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<th>NAME</th>
<th>TITLE</th>
<th>BIRTHDATE (Mo., Day, Yr.)</th>
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<tr>
<td>Dennis H. Smith</td>
<td>Research Associate</td>
<td>11-12-42</td>
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<th>PLACE OF BIRTH (City, State, Country)</th>
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<td>New York</td>
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**EDUCATION** (Begin with baccalaureate training and include postdoctoral)

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<td>Massachusetts Institute of Technology</td>
<td>S.B.</td>
<td>1964</td>
<td>Chemistry</td>
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<td>Cambridge, MA</td>
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<tr>
<td>University of California</td>
<td>Ph.D.</td>
<td>1967</td>
<td>Chemistry</td>
</tr>
<tr>
<td>Berkeley, CA</td>
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</table>

**HONORS**
- Alfred P. Sloan Foundation Scholarship, NASA Predoctoral Traineeship, Phi Lambda Upsilon, Sigma Xi, Editorial Board of *Journal of Chemical Information and Computer Science*.

**MAJOR RESEARCH INTEREST**
- Mass Spectrometry and Computer Applications in Chemistry

**ROLE IN PROPOSED PROJECT**
- Senior Research Associate

**RESEARCH SUPPORT** (See instructions)

n/a

**RESEARCH AND/OR PROFESSIONAL EXPERIENCE** (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 2 pages for each individual.)

- 1971-present: Research Associate, Stanford University, Stanford, CA
- 1970-1971: Visiting Scientist, University of Bristol, Bristol, England
- 1967-1970: Assistant Research Chemist, University of California at Berkeley, Berkeley, CA
- 1965-1967: NASA Pre-Doctoral Traineeship, University of California at Berkeley, Berkeley, CA

**Publications**: See attached list.
RECENT PUBLICATIONS - Dennis H. Smith


RECENT PUBLICATIONS - Dennis H. Smith


RECENT PUBLICATIONS - Dennis Smith


**BIOGRAPHICAL SKETCH**

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
<th>BIRTHDATE (Mo. Day, Yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buchanan, Bruce G.</td>
<td>Adjunct Professor of Computer Science</td>
<td>7/7/40</td>
</tr>
</tbody>
</table>

PLACE OF BIRTH (City, State, Country)  
St. Louis, Missouri

PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)  
U.S.

SEX  
XX Male  □ Female

**EDUCATION** (Begin with baccalaureate training and include postdoctoral)

<table>
<thead>
<tr>
<th>INSTITUTION AND LOCATION</th>
<th>DEGREE</th>
<th>YEAR CONFERRED</th>
<th>SCIENTIFIC FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio Wesleyan University, Delaware, Ohio</td>
<td>B.A.</td>
<td>1961</td>
<td>Mathematics</td>
</tr>
<tr>
<td>Michigan State University</td>
<td>M.A.</td>
<td>1966</td>
<td>Philosophy</td>
</tr>
<tr>
<td></td>
<td>Ph.D.</td>
<td></td>
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</tbody>
</table>

HONORS  

**MAJOR RESEARCH INTEREST**  
Artificial Intelligence

**ROLE IN PROPOSED PROJECT**  
Principal Investigator

**RESEARCH SUPPORT (See instructions)**

NIH 5R24 RR 00612-09  
Resource Related Research: Computers and Chemistry 5/1/77 to 9/30/79  
Time presently committed: 20%

Dept. of Defense MDA 903-77-C-0322: Heuristic Programming 8/1/77 to 9/30/79. Time presently committed: 45%

National Science Foundation MCS 7702712: Knowledge-Based Intelligent Systems 6/1/77 to 5/30/79. Time presently committed: 10%

National Science Foundation MCS 78-02717: MOLGEN: A Computer Science Application to Molecular Genetics. Time presently committed: 25%

**RESEARCH AND/OR PROFESSIONAL EXPERIENCE** (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1976 - present  
Adjunct Professor; Computer Science Department, Stanford University, Stanford, CA 94305.

1972-1976  
Research Computer Scientist, Computer Science Department, Stanford University.

1966-1971  
Research Associate, Artificial Intelligence Project, Stanford University.

Selected Publications - See attached
Recent Honors

Chairman of IJCAI-79 Program Committee (International Joint Conference on Artificial Intelligence, Tokyo, 1979).
Invited Speaker, Workshop on The Logic of Discovery & Diagnosis in Medicine (Pittsburgh, October 1978).
Invited Speaker, Douglass College Seminars for Faculty, (Rutgers University, 1978).

Selected Publications


**BIOGRAPHICAL SKETCH**

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
<th>BIRTHDATE (Mo., Day, Yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James G. Nourse</td>
<td>Research Associate</td>
<td>December 14, 1947</td>
</tr>
</tbody>
</table>

**PLACE OF BIRTH (City, State, Country)**

Buffalo, NY

**PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)**

U.S. citizen

**SEX**

- Male
- Female

**EDUCATION (Begin with baccalaureate training and include postdoctoral)**

<table>
<thead>
<tr>
<th>INSTITUTION AND LOCATION</th>
<th>DEGREE</th>
<th>YEAR CONFERRED</th>
<th>SCIENTIFIC FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia University, New York, NY</td>
<td>B.S.</td>
<td>1969</td>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>California Inst. of Tech., Pasadena, CA</td>
<td>Ph.D.</td>
<td>1974</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>UCLA, Los Angeles, CA</td>
<td>Post Doc</td>
<td>1973-74</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>Princeton University, Princeton, NJ</td>
<td>Post Doc</td>
<td>1974-76</td>
<td>Organic Chemistry</td>
</tr>
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</table>

**HONORS**

Sigma Xi, Invited Lecturer 1978 Conference on the Permutation and its Application to Chemistry and Physics, Bielefeld, Germany

**MAJOR RESEARCH INTEREST**

Stereochemistry, Computer Applications

**ROLE IN PROPOSED PROJECT**

Research Associate

**RESEARCH SUPPORT (See instructions)**

n/a

**RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)**

Research Associate, Department of Chemistry, Stanford University, 5/79 - 8/79

Research Affiliate, Department of Computer Science, Stanford University, 8/76 to 4/79

Postdoctoral Research Associate, Department of Chemistry, Princeton University, 2/74 to 7/76

Postdoctoral Research Associate, Department of Chemistry, UCLA, 10/73 to 1/74
Publications - James C. Mourse


NAME: Neil A. B. Gray

TITLE: Research Associate

BIRTHDATE (Mo., Day, Yr.): September 5, 1947

PLACE OF BIRTH (City, State, Country): Edinburgh, Scotland, UK

PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date): British (currently on J-1 visa, applying for H-1)

SEX: Male

EDUCATION (Begin with baccalaureate training and include postdoctoral)

<table>
<thead>
<tr>
<th>INSTITUTION AND LOCATION</th>
<th>DEGREE</th>
<th>YEAR CONFERRED</th>
<th>SCIENTIFIC FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperial College, London</td>
<td>B. S.</td>
<td>1968</td>
<td>Chemistry</td>
</tr>
<tr>
<td>University of Cambridge</td>
<td>M. S.</td>
<td>1970</td>
<td>Theoretical Chemistry</td>
</tr>
<tr>
<td></td>
<td>M. S.</td>
<td>1971</td>
<td>Computer Science</td>
</tr>
<tr>
<td></td>
<td>Ph. D.</td>
<td>1977</td>
<td>Computer Science</td>
</tr>
</tbody>
</table>

HONORS:

MAJOR RESEARCH INTEREST: Applications of Computers to Chemistry

ROLE IN PROPOSED PROJECT:

RESEARCH SUPPORT (See instructions):

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

Science Research Council/NATO research fellow. Development of programs for structure generation and analysis including new approaches to the processing of high and low resolution mass spectral data and to handling magnetic resonance data. Stanford University, 1977-1979.

Junior Research Fellowship at King's College. Work on various computer-assisted approaches to chemical structure elucidation including both rule-based and pattern-recognition methods. Part of this work being incorporated into a Ph.D. thesis for the Computer Science Department. University of Cambridge, 1973-1977.


Publications:

"Justifiability of the ZDO Approximation in Terms of a Power Series Expansion."

"Computational Study of the Reactions between CH4 and CH4+.

"Geochemical and environmental applications of a compound classifier based on computer analysis of low resolution mass spectra."
Advances in Organic Geochemistry 1971.
H.R.V. Gaertner and H. Wehner (Eds).
Pergamon (1972).

"Computer based search and retrieval system for rapid mass spectral screening of samples."

"Programs for spectrum classification and screening of gas-chromatographic/mass-spectrometric data on a laboratory mini-computer."

N.A.B. Gray.
"A program for generating empirical spectrum classification schemes."

"Automatic classification of mass spectra by a laboratory computer system."

N.A.B. Gray.
"Structural Interpretation of spectra."

N.A.B. Gray.
"Similarity measures for binary coded mass spectral data."
N.A.B. Gray.
"Constraints on learning machine classification methods."

and B.G. Buchanan.
"Use of a Computer to Identify Unknown Compounds:
The Automation of Scientific Inference."
Biochemical Applications of Mass Spectrometry.
G.R. Waller (Ed).
Interscience (1979 ?).