BUDGET - PART D

APPLICATIONS OF CARBON(13) NUCLEAR MAGNETIC RESONANCE SPECTROMETRY TO ASSIST IN CHEMICAL STRUCTURE DETERMINATION

PRIVILEGED COMMUNICATION | SECTION II | SUBSTITUTE THIS PAGE FOR DETAILED BUDGET PAGE

SUBSTITUTE
DETAILED BUDGET FOR FIRST 12-MONTH PERIOD

PERIOD COVERED: FROM 5/1/74 THROUGH 4/30/75

GRANT NUMBER:

1. PERSONNEL (List all personnel engaged on project) NAME (Last, first, initial)		TITLE OF POSITION	TIME OR EFFORT %/HRS.	AMOUNT REQUESTED (Omit cents) TOTAL
Djerassi, Carl (1)	Ch	Principal Investigator or Program Director	3	
Carhart, Ray (2)	Ch	Post Doctoral Fellow	100	
Unnamed	Ch	Post.Doc.Res.Assoc.	100	
Van Antwerp, Craig	Ch	Research Assistant	50	

PART D

(1) See budget notes
(2) Covers 9/1/74-4/30/75 in year 1

TOTAL →		$ 33,592
2. CONSULTANT COSTS (Include Fees and Travel)		$ –
3. EQUIPMENT (Itemize)		$ –
4. SUPPLIES: Chemical supplies		$ 900
5. STAFF TRAVEL (See Instructions) a. DOMESTIC: 1 east coast trip		$ 500
5. STAFF TRAVEL (See Instructions) b. FOREIGN		$
6. PATIENT COSTS (Separate Inpatient and Outpatient)		$ –
7. ALTERATIONS AND RENOVATIONS		$ –
8. OTHER EXPENSES (Itemize per instructions): Publication costs and reproduction services	$ 100	
NMR instrument usage (25 hrs/month @ $25/hour)	7,500	
Computer usage	10,800	
		$ 18,400
9. Subtotal – Items 1 thru 8 →		$ 53,392

FOR TRAINING GRANTS ONLY

10. TRAINEE EXPENSES (See Instructions)				
a. STIPENDS	PREDOCTORAL	No. Proposed ____	$	
	POSTDOCTORAL	No. Proposed ____	$	
	OTHER (Specify)	No. Proposed ____	$	
	DEPENDENCY ALLOWANCE		$	
	TOTAL STIPEND EXPENSES →			$
b. TUITION AND FEES				$
c. TRAINEE TRAVEL (Describe)				$
11. Subtotal – Trainee Expenses →				$
12. TOTAL DIRECT COST (Add Subtotals, Items 9 and 11, and enter on Page 1) →				$ 53,392

P2/02

GPO 930-791

SECTION II – PRIVILEGED COMMUNICATION

BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE
DIRECT COSTS ONLY (Omit Cents)

DESCRIPTION		1ST PERIOD (SAME AS DETAILED BUDGET)	ADDITIONAL YEARS SUPPORT REQUESTED *(This application only)*					
			2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
PERSONNEL COSTS		33,592	53,178	56,176				
CONSULTANT COSTS *(Include fees, travel, etc.)*		–	–	–				
EQUIPMENT		–	–	–				
SUPPLIES		900	1,000	1,100				
TRAVEL	DOMESTIC	500	500	500				
	FOREIGN							
PATIENT COSTS		–	–	–				
ALTERATIONS AND RENOVATIONS		–	–	–				
OTHER EXPENSES		18,400	20,000	22,200				
TOTAL DIRECT COSTS		53,392	74,678	79,976				

TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD *(Enter on Page 1, Item 4)* → $ 208,046

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.)*

See attached budget justification notes.

COMPOSITE BUDGET -

PARTS A + B + C + D

PRIVILEGED COMMUNICATION | SECTION II | SUBSTITUTE THIS PAGE FOR DETAILED BUDGET PAGE

SUBSTITUTE
DETAILED BUDGET FOR FIRST 12-MONTH PERIOD

PERIOD COVERED: FROM 5/1/74 THROUGH 4/30/75

GRANT NUMBER

1. PERSONNEL (List all personnel engaged on project) NAME (Last, first, initial)		TITLE OF POSITION	TIME OR EFFORT %/HRS.	AMOUNT REQUESTED (Omit cents) TOTAL
Lederberg, Joshua	G	Principal Investigator or Program Director	10	COMPOSITE BUDGET
Feigenbaum, Edward	CS	Co-Principal Inves.	20	
Djerassi, Carl	Ch	Co-Principal Inves.	3	
Buchanan, Bruce	CS	Associate Inves.	100	
Duffield, Alan	Ch	Associate Inves.	50	
Smith, Dennis	Ch	Research Associate	100	
Sridharan Natesa	CS	Research Associate	100	
Hammerum, Steen	Ch	Research Associate	100	
Pereira, Wilfred	Ch	Research Associate	50	
Rindfleisch, Thomas	E	Research Associate	100	
Carhart, Ray	Ch	Post Doctoral Fellow	100	
Summons, Roger	Ch	Post Doctoral Fellow	100	
Unnamed	Ch	Post Doc.Res.Assoc.	100	
See attached sheet				

TOTAL →	$ 302,567
2. CONSULTANT COSTS (Include Fees and Travel)	$ 1,100
3. EQUIPMENT (Itemize) Computer Terminal	$ 3,000
4. SUPPLIES See attached sheet	$ 22,000
5. STAFF TRAVEL (See Instructions) a. DOMESTIC	$ 4,300
5. STAFF TRAVEL (See Instructions) b. FOREIGN	$ –
6. PATIENT COSTS (Separate Inpatient and Outpatient)	$ –
7. ALTERATIONS AND RENOVATIONS Mass spectrometer laboratory air conditioning and power modifications	$ 2,500
8. OTHER EXPENSES (Itemize per instructions)	
Telephone, data communications, postage, etc. $ 1,600	
Publication costs $ 2,500	
Mini-computer maintenance contract $ 4,600	
NMR Instrument usage $ 7,500	
Computer terminal rental $ 4,800	
Computer usage (ACME follow-on, Campus 360/67, and ARPANET) $131,800	$ 152,800
9. Subtotal – Items 1 thru 8 →	$ 488,267

FOR TRAINING GRANTS ONLY

10. TRAINEE EXPENSES (See Instructions)			
a. STIPENDS	PREDOCTORAL	No. Proposed ____	$
	POSTDOCTORAL	No. Proposed ____	$
	OTHER (Specify)	No. Proposed ____	$
	DEPENDENCY ALLOWANCE		$
TOTAL STIPEND EXPENSES →			$
b. TUITION AND FEES			$
c. TRAINEE TRAVEL (Describe)			$
11. Subtotal – Trainee Expenses →			$ –
12. TOTAL DIRECT COST (Add Subtotals, Items 9 and 11, and enter on Page 1) →			$ 488,267

PERSONNEL (Continued)

Name		Title of Position	Time or Effort
Veizades, Nicholas	E	Research Engineer	100
Reynolds, Walter	E	Research Engineer	20
Steed, Ernest	E	Research Engineer	10
White, William	CS	Computer Programmer	50
Tucker, Robert	CS	Computer Programmer	75
Reiss, Steve	CS	Computer Programmer	50
Wegmann, Annemarie	Ch	Senior Research Assistant	100
Pearson, Dale	E	Electronics Technician	60
Hjelmeland, Larry	CS	Research Assistant	100
Masinter, Larry	CS	Research Assistant	50
Stefik, Mark	CS	Research Assistant	50
Farrell, Carl	CS	Research Assistant	100
Van Antwerp, Craig	Ch	Research Assistant	50
Wyche, Margaret		Laboratory Technician	50
DeFrancisci, Richard		Machinist	20
Wharton, Kathy		Administrative Assistant	50
Larson, Dee		Secretary	50
Allan, Muriel		Secretary	25

SUPPLIES

Office supplies	$ 1,450
Chemicals, glassware, and laboratory apparatus	3,400
GC supplies (gases, phases, columns, etc.)	950
Dry ice and liquid nitrogen	1,500
Electronic supplies and parts	3,500
GC/MS data recording media (chart paper, Calcomp, etc.)	2,100
Mini-computer supplies (paper, ribbons, tapes, disks, etc.)	1,500
Mass spectrometer repairs and replacement parts	7,600
	$22,000

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SECTION II – PRIVILEGED COMMUNICATION

BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE
DIRECT COSTS ONLY (Omit Cents)

DESCRIPTION		1ST PERIOD (SAME AS DETAILED BUDGET)	ADDITIONAL YEARS SUPPORT REQUESTED *(This application only)*					
			2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
PERSONNEL COSTS		302,567	357,613	377,926				
CONSULTANT COSTS *(Include fees, travel, etc.)*		1,100	1,200	1,300				
EQUIPMENT		3,000	3,000	3,000				
SUPPLIES		22,000	22,850	24,250				
TRAVEL	DOMESTIC	4,300	4,700	5,100				
	FOREIGN	–	–	–				
PATIENT COSTS		–	–	–				
ALTERATIONS AND RENOVATIONS		2,500	–	–				
OTHER EXPENSES		152,800	168,100	182,150				
TOTAL DIRECT COSTS		488,267	557,463	593,726				

TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD *(Enter on Page 1, Item 4)* → $ 1,639,456

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.)*

BUDGET DETAIL AND JUSTIFICATION

The budgets for the DENDRAL Project are presented in four parts, corresponding to the four proposal sections; A, B(i) and (ii), C, and D. Parts A and C represent the portions concerned with Heuristic and Meta-DENDRAL; Part B deals with the data system automation and instrument maintenance functions as well as the development aspects of GC/MS analysis of body fluids; and Part D is an extension of DENDRAL methodology to Carbon(13) nuclear magnetic resonance spectrometry.

As a general note, Professor Lederberg will devote a total of 10% of his time to this research as the Principal Investigator. His time is budgeted as follows: 4% on Part A, 3% on Part B, and 3% on Part C.

The narrative comments on Parts A and C have been combined below because the personnel and computer resources overlap to a large extent.

BUDGET EXPLANATION - PARTS A & C

PERSONNEL:

a) The personnel on the DENDRAL staff constitute its most valuable resource. All of the people listed in the proposal are now working on the DENDRAL Project. All are necessary to support the high level of scientific activity in Chemistry (A. Duffield, D. Smith, S. Hammerum, and L. Hjelmeland) and Computer Science (E. Feigenbaum, B. Buchanan, N. Sridharan, W. White, S. Weiss, M. Stefik, L. Masinter, and C. Farrell).

Mr. Mark Stefik's status will have changed to Research Assistant for Part A from his current status as Computer Programmer on Part B.

Mr. Steve Weiss' salary has been increased in order to properly compensate him for the duties he performs. Recent changes in draft board policies allow Conscientious Objectors to receive higher compensation to reflect actual job duties. Specific University approval has been requested for this increase but has not yet been received.

Mr. Larry Masinter has previously been paid from other funds, but is essential to the NIH-related work.

Rec'd

b) Salary figures are increased annually by 5% for merit increases and promotions. Fringe benefits are budgeted at the standard University rates of 17% through 8/74 and are increased annually per University projections to 18.3% in 9/74, 19.3% in 9/75, and 20.4% in 9/76.

No new personnel are added in Year 2. However, the salary budget increases by more than the rates noted above because all of Dr. Buchanan's salary is covered (see c) below) and Professor Feigenbaum returns from his leave of absence (see d) below).

c) Bruce Buchanan currently has an NIH Career Development Award through 8/31/76. However, because of recent NIH budget cutbacks, there is a strong probability that this award will be cancelled before that date. Dr. Ferguson of NIH stated on 2/8/73 that the award could only be guaranteed through 8/74.

d) As noted in the Introduction to this proposal, Dr. Feigenbaum will be on leave of absence with ARPA for a period of two years. This overlaps the term of this grant application such that no salary is budgeted for Dr. Feigenbaum during the first grant year. His salary is budgeted starting in the second grant year when he will formally return to his position in this research project.

EQUIPMENT:

No equipment purchases are required for Parts A and C.

SUPPLIES AND TRAVEL:

Office supplies are budgeted based on our experience over the past year. The travel budget covers expected costs for attending professional meetings and maintaining contact with related work at other locations. Because Artificial Intelligence is a rapidly expanding field, it is essential to maintain a high degree of personal interaction in order to assimilate new developments. These budget items are increased and rounded at 10% per year.

OTHER EXPENSES:

Telephone costs include connections and usage for computer terminals. Publication costs are budgeted at a nominal rate based on past experience and are increased by 10% per year. In the category of Computer Terminal Rent, the budget for Part A includes the lease cost of 2 portable Texas Instruments terminals. An additional terminal is added in 5/75 to accommodate increased use of the programs by personnel and a larger community of Stanford users. The Part C budget covers the continued lease of one T.I. terminal and an additional terminal starting in 5/75.

Computer time is budgeted according to current rate structures based on our on-going experience in utilizing the Stanford (SCC) 360/67 and machines available via the ARPANET. We will not make use of the ACME follow-on machine (370/158) for Parts A and C because of the availability of superior LISP facilities on these other machines. Instrument data will be communicated from the 370/158 (see Part B) to the LISP programs for analysis.

BUDGET EXPLANATION - PARTS B(i) AND B(ii)

This budget covers instrumentation maintenance, data system development, and research into applications of GC/MS analysis of body fluids as described in Parts B(i) and B(ii) of this proposal. This budget represents a significant increase over that submitted for Part B of the DENDRAL grant currently in-progress (current budget $80,000 per year). The major reasons for this increase are twofold: a) Increases in required personnel support because of corresponding decreases in support from other sources and b) The need to implement our computing support from a source other than the ACME 360/50 for which NIH funding is terminating. We have rigorously attempted to keep these increases to an absolute minimum consistent with maintaining the viability of our unaugmented research program.

We have previously received substantial support for our GC/MS research from NASA. Because of shifting federal priorities, however, NASA support has declined substantially and we project will terminate in the first year of this renewal. At the same time, our research has been moving to emphasize more and more heavily GC/MS applications in clinically related aspects of metabolic indicators of disease. Thus it is reasonable, as well as necessary, that support for this continued research shift to NIH.

As mentioned in the Introduction to this proposal, we have an application pending with NIH-GMS for support in applying these techniques to aspects of genetic disease. These proposals are complementary in goals and it is assumed in this budget that the Genetics Center proposal will provide support for a major fraction (approximately 50%) of the low resolution GC/MS laboratory (Finnigan 1015 instrument) including personnel, supplies, etc. There is, however, a small amount of operational manpower overlap between the two proposed efforts. If both proposals are funded, a savings will result through common operational support which will be negotiated with NIH at the appropriate time.

As discussed under future plans for Part B(i) of this proposal, we have had to plan an alternative source of computing to support this research because NIH subsidy of the ACME facility terminates in July 1973. We have chosen to use the Stanford-sponsored follow-on to ACME, mounted on an IBM 370/158, since our computer programs will operate with a minimum of modification. This facility will operate on a fee-for-service basis. Whereas its rate structure is still evolving, we have estimated, on the basis of available information, the cost of transferring our computing to that facility as reflected in our budget ($64,000 per year). It should be noted that this rate structure does not include indirect charges at this time. As the rate structure becomes better defined, the indirect cost may be

included in the usage rates. This would necessitate a slight modification of the budget as will be negotiated with NIH as appropriate.

The following gives a detailed description of the various components of the Part F budget:

PERSONNEL:

The personnel budgeted for GC/MS applications, laboratory operations, and data system development are necessary to achieve our research goals and are currently active in the GC/MS programs. Chemistry support for the interpretation of body fluid analyses in cooperation with our clinical collaborators include Drs. A. Duffield (25%), W. Periera (50%), and R. Summons (100%). M. Wyche provides laboratory and instrument operation support for the low resolution GC/MS laboratory. Messers Rindfleisch, Veizades, Reynolds, and Tucker are essential to the data system development effort and provide hardware and software maintenance support as well. Messers Rindfleisch (100%) and Tucker (75%) are primarily responsible for the software system design, implementation, and maintenance. Mr. Veizades (100%) is primarily concerned with the hardware maintenance and development aspects of the high resolution MAT-711 instrument and Mr. Reynolds (20%) with the Finnigan 1015 low resolution instrument. Ms. A. Wegmann (100%) is responsible for the operation of the high resolution GC/MS instrument (MAT-711). Mr. Steed (10%) provides necessary glasswork development and maintenance, Mr. Pearson (60%) supports the fabrication and repair of electronic hardware for both instruments, and Mr. DeFrancisci (20%) provides necessary machinist support for mechanical repairs and fixtures. Ms. Allan (25%) provides required secretarial support for the above Instrumentation Research Laboratory personnel.

This manpower complement is carried into the future years as shown. Salaries are increased by 5% per year and staff benefits are applied at standard University rates. These start at 17% in fiscal year 1974 (9/73 - 8/74) and increase to 18.3% in 9/74, 19.3% in 9/75, and 20.4% in 9/76 based on University projections.

EQUIPMENT:

Our request for additional equipment is minimal. We budget for the purchase of a computer terminal in the first year for $3,000. This replaces a currently rented terminal integral to the GC/MS data system and saves $5,280 over the three year

grant period by purchasing instead of continued rental.

In the second year we budget for an event counter necessary for proper equipment maintenance for which we are assuming responsibility. We already maintain the Finnigan 1015 instrument and will take over the MAT-711 because of progressively poorer performance by VARIAN Associates in maintaining that instrument over the past year. This equipment is also needed to implement experimental control functions on the mass spectrometer.

In the third year, replacement of outdated test equipment will be required. $3,000 are budgeted for this purpose.

SUPPLIES:

Supplies are budgeted based on our actual operating experience and are minimized consistent with a viable research effort. Office supplies include stationery supplies, postage, reproduction services, etc. and are budgeted at $63 per month. The budget for chemicals, glassware, and laboratory apparatus ($2,500) provides the necessary materials for derivatizing and analyzing body fluid samples. GC supplies ($950) and dry ice and liquid nitrogen ($1,500) are necessary for instrument operation and are based on past experience. The largest part of the liquid nitrogen budget is used for the high resolution instrument. Electronics supplies and parts ($3,500) include circuit boards, semi-conductors, etc. needed for mass spectrometer control electronics such as for the metastable acquisition system as well as for maintaining our existing test equipment (oscilloscopes, voltmeters, power supplies, etc.). GC/MS data recording media ($2,100) include chart and Calcomp plotter papers of various types (including UV-sensitive paper for the MAT-711) for the purpose of recording mass spectrometer and gas chromatograph effluent data. The budgeted amount reflects our usage over the past year. Similarly, mini-computer supplies ($1,500) include Teletype and line printer paper and ribbons, magnetic tapes (DEC tape and IBM compatible tape), and disk cartridges based on previous usage history. The budget for mass spectrometer repairs and replacement parts ($7,600) covers our maintenance of these instruments based in part on predictable replacements (filaments, multipliers, etc.) and in part on an estimate from previous experience of unscheduled problems (power supplies, valves, pumps, etc.).

The supplies budget for future years covers these same items with 6% added for increased usage and inflation.

TRAVEL:

We have budgeted for travel to attend professional meetings and to visit other GC/MS laboratories on the basis of 1 east coast trip ($560), 1 mid-west trip ($350), and 1 west coast trip ($150).

ALTERATIONS AND RENOVATIONS:

We have had problems with thermal overloads on the high resolution mass spectrometer instrument and associated electronics during the summer months. In addition, because of the modified computing configuration required by the ACME transition, we will locate a disk and printer equipment in the same laboratory to support the mini-computer interfacing the MAT-711. These conditions require an augmentation to existing air-conditioning and power facilities in the laboratory estimated at $2,500.

OTHER EXPENSES:

We budget for telephone and data communications service based on our current experience ($100 per month). In addition, $1,000 is budgeted for publication costs and $4,600 for mini-computer maintenance. This maintenance is an extension of our current contract with Digital Equipment Corporation and includes the prevailing 10% discount in the Stanford/DEC contract.

We budget for data reduction and storage computing costs on the ACME follow-on machine (370/158) as follows, based on our ACME experience and current information on the follow-on system rate structure. We consume approximately 300,000 page-minutes of computing per month on ACME for development and production computing. At a rate of $.02 per page-minute, this comes to $6,000 per month. In addition, we use approximately $2,000 per month for data storage (20,000 blocks at $.10 per block per month). This gives a total of $96,000 per year and applying a projected 30% discount rate for high volume usage, leaves an estimated net cost of $64,000 per year.

These estimates are increased by 6% in succeeding years for increased usage and inflation.

BUDGET EXPLANATION - PART D

This budget covers the portion of the research program which extends the DENDRAL methodology to Carbon(13) Nuclear Magnetic Resonance Spectrometry.

PERSONNEL:

The personnel budget includes a salary for Dr. R. Carhart after the expiration of his NIH Fellowship in 6/74, one Post Doctoral Research Associate (to be added to the staff), and one half-time Research Assistant (Mr. Van Antwerp). No funding is requested for Dr. Carl Djerassi's time (3%). A Computer Programmer (to be added to the staff) is budgeted in 1975 to assume the additional anticipated programming duties.

Salaries are increased by 5% per year and staff benefits are applied at standard University rates. These start at 17% in fiscal year 1974 (9/73 - 8/74) and increase per University projections to 18.3% in 9/74, 19.3% in 9/75, and 20.4% in 9/76.

SUPPLIES:

We budget $900 for chemical supplies for the preparation of test samples.

TRAVEL:

We budget $500 to cover one east coast trip.

OTHER EXPENSES:

Other expenses include $100 for publication and reproduction costs and $7,500 for usage of the existing NMR instrument in the Department of Chemistry. This NMR usage is budgeted at standard rates covering 25 hours of usage per month at $25 per hour. In addition, we budget for use of the Stanford (SCC) 360/67 computer where CMR analysis programs, at the current level of development, are run. These costs are computed on the

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basis of 1.5 hours of usage per month at approximately $600 per hour.

BIOGRAPHIES

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
LEDERBERG, JOSHUA	Professor and Executive Head, Department of Genetics	5-23-25
PLACE OF BIRTH (City, State, Country)	**PRESENT NATIONALITY** (If non-U.S. citizen, indicate kind of visa and expiration date)	**SEX**
Montclair, New Jersey	U.S.A.	☒ Male ☐ Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Columbia College, New York	B.A.	1944	
College of Physicians & Surgeons, Columbia University, New York (1944-46)			
Yale University	Ph.D.	1947	Microbiology

HONORS

1957 - National Academy of Sciences
1958 - Nobel Prize in Medicine

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Molecular Genetics; Artificial Intelligence	PRINCIPAL INVESTIGATOR

RESEARCH SUPPORT (See instructions)

SEE ATTACHMENTS:

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.)

1961-	Stanford University Director, Kennedy Laboratories for Molecular Medicine
1959-	Professor, Genetics and Biology, and Executive Head, Department of Genetics, Stanford University
1957-1959	University of Wisconsin Chairman, Department of Medical Genetics
1957	Melbourne University, Australia Fullbright Visiting Professor of Bacteriology
1950	University of California, Berkeley Visiting Professor of Bacteriology
1947-1959	University of Wisconsin Professor of Genetics
1946-1947	Yale University. Research Fellow of the Jane Coffin Childs Fund for Medical Research
1945-1946	Columbia University. Research Assistant in Zoology

Professional Activities:

1967-	NIMH: National Mental Health Advisory Council
1961-1962	President (Kennedy)'s Panel on Mental Retardation
1960-	NASA Committees: Lunar and Planetary Missions Board
1958-	National Academy of Sciences: Committees on Space Biology
1950-	President's Science Advisory Committee panels. National Institutes of Health, National Science Foundation study sections (genetics)

RESEARCH SUPPORT SUMMARY FOR JOSHUA LEDERBERG

	Grant Number	Grant Title	Current Year	Total Award	Grant Term	Budgeted % Time
1)	NASA:NGR-05-020	Cytochemical Studies of Planetary Micro-organisms	$ 180,000	$3,800,000	9/60-8/73 (Future support dubious)	4%
2)	NIH:AI-05160	Genetics of Bacteria	60,000	280,000	9/68-8/73 (Renewal pending)	15%
3)	NIH:RR-00311	Advanced Computer for Medical Research (ACME) Stanford Medical School Facility	362,632	2,612,632 (yrs 4-7)	1966-7/73 (see #5)	25%
4)	NIH:GM-	Genetics Research Center (J. Lederberg,Principal Investigator	547,035	2,609,383	9/73-8/78 (Pending)	10%
5)	NIH:RR-00785	Stanford University Medical Experimental Computer Facility (SUMEX) Successor to #3	884,660	5,960,417	9/73-8/78 (Pending)	20%
6)	NIH: Computer Laboratory Health Care Resource Program	Large Scale Screening of Body Fluids for Metabolic Signs of Disease with Computer-managed Gas Chromatography and Mass Spectrometry	159,881	900,238	9/73-8/78 (Pending,Program funds impounded)	10%
7)	NIH:GM00295	Training Grant in Genetics	143,964	756,650	7/69-6/73 (Renewal pending)	15%

SELECTED LIST OF PUBLICATIONS

Lederberg, J., 1959
A View of Genetics
Les Prix Nobel en 1958: 170-89.

Buchs, A., A. B. Delfino, A. M. Duffield, C. Djerassi, B. G. Buchanan, E. A. Feigenbaum, and J. Lederberg, 1970.
Applications of Artificial Intelligence for Chemical Inference. VI. Approach to a general method of interpreting low resolution mass spectra with a computer. Helvitia Chimica Acta 53 (6): 1394-1417.

Feigenbaum, E. A., B. G. Buchanan, J. Lederberg, 1971
On generality and problem solving: a case study using the DENDRAL program in Machine Intelligence 6, (B. Meltzer and D. Michie, eds.), Edinburgh University Press, P. 165-190.

Reynolds, W. E., V. A. Bacon, J. C. Bridges, T. C. Coburn, B. Halpern, J. Lederberg, E. C. Levinthal, E. Steed, R. B. Tucker, 1970
A Computer Operated Mass Spectrometer System.
Analytical Chem. 42:1122-1129, September 1970.

Lederberg, J.
"Use of Computer to Identify Unknown Compounds: The Automation of Scientific Inference" in Biochemical Applications of Mass Spectrometry (G. R. Waller, ed.). John Wiley & Sons, New York (in press).

SECTION II – PRIVILEGED COMMUNICATION

Principal Investigator: Carl 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.)

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
Carl DJERASSI	Professor of Chemistry	October 29, 1923
PLACE OF BIRTH *(City, State, Country)*	**PRESENT NATIONALITY** *(If non-U.S. citizen, indicate kind of visa and expiration date)*	**SEX**
Vienna, Austria	U.S.A.	☒ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Kenyon College	A.B. (summa cum laude)	1942	Chemistry, Biology
University of Wisconsin	Ph.D.	1945	Organic chemistry, Biochemistry (minor)

HONORS Hon. D.Sc., Natl. Univ. of Mexico (1953), Kenyon College (1958), Worcester Polytechnic Institute (1972); Hon. Prof., Fed. Univ. Rio de Janeiro (1969). Member U.S. National Academy of Sciences, American Academy of Arts and Sciences, foreign member, Royal Swedish Academy of Sciences German Academy of Natural Scientists (Leopoldina), Brazilian Academy of Sciences, (cont. below)

MAJOR RESEARCH INTEREST Nat. prod. chemistry (steroids, alkaloids, terpenoids, antibiotics) and chem. applications of physical methods (mass spec., optical rotatory dispersion, circular dichroism).

ROLE IN PROPOSED PROJECT: Principal Investigator

RESEARCH SUPPORT *(See instructions)*

Grant	Title	Period	Current Year	Total Budgeted	% Time Effort
NIH AM 04257	Mass Spectrometry in Organic and Biochemistry	10/1/70 to 9/30/75	$56,833	$316,016	10%
NIH GM AM 06840-15	Marine Chemistry with special emphasis on steroids	1/1/73 to 12/31/77	112,550	578,180	18%

This is a pending application which, if approved, will represent a renewal of my current NIH Grants No. GM 06840 and No. AMCA-12785, both of which expire in 1973.

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.
Associate Professor (1952-1954) and Professor (1954-1959), Wayne State University.

Industrial Research Experience:
Ciba Pharmaceutical Co., Summit, N.J.: Research Chemist, 1942-1943 and 1945-1949.
Syntex Corporation: Associate Director of Chemical Research (Mexico City) 1949-1952, Research Vice President (Mexico City) 1957-1960; (Palo Alto, California) 1960-1968, President, Syntex Research 1968-present.

Editorial Boards:
(Current) Journal of the American Chemical Society, Steroids, Tetrahedron, Organic Mass Spectrometry.

(continued on next page)

Honors (cont.)
Mexican Academy for Scientific Investigation. Hon. Fellow of Phi Lambda Upsilon. Amer. Academy of Pharmaceutical Sciences, British Chemical Society and Mexican Chemical Society, Phi Beta Kappa. Numerous hon. lectureships including 1964 Centenary Lecturer (The British Chemical Society) and 1969 Annual Chemistry Lecturer, Royal Swedish Academy of Engineering. American Chemical Society Award in Pure Chemistry (1958), Baekeland Medal (1959), Fritzsche Award (1960). Intra-Science Research Foundation Award (1969). Freedman Patent Award of American Institute of Chemists (1971). Foreign Member, Royal Swedish Academy of Sciences (1972). D.Sc. (hon.), Worcester Polytechnic Institute (1972). Scheele-Lecturer, Pharmaceutical Society of Sweden (1972); American Chemical Society's Award for Creative Invention (1973).

U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 451-736

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (cont.)

Miscellaneous:
Chairman of the AAAS Gordon Research Conferences on Steroids and Natural Products (1952-1954); Member of American Pugwash Committee (1968 to present); Chairman of Latin America Science Board of National Academy of Sciences (1966-1968); Chairman of National Academy's Board on Science and Technology for International Development.

PUBLICATIONS

Author or co-author of 750 publications and six books. Approximately 150 papers and one book deal with various applications of chiroptical methods in organic and biochemistry.

GPO : 1969 O - 350-360

SECTION II – PRIVILEGED COMMUNICATION

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.)

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
Feigenbaum, Edward A.	Principal Investigator, DENDRAL Project	1-20-36
PLACE OF BIRTH *(City, State, Country)*	**PRESENT NATIONALITY** *(If non-U.S. citizen, indicate kind of visa and expiration date)*	**SEX**
Weehawken, New Jersey	U.S. Citizen	☒ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Carnegie Institute of Technology Pittsburgh, Pennsylvania	B.S. Ph.D.	1956 1959	Electrical Engineering Behavioral Sciences.

HONORS and memberships:
American Psychological Association; Association for Computing Machinery (Member of the National Council 1966-68); American Association for the Advancement of Science.

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Artificial Intelligence	Principal Investigator

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.)*

1965- Stanford University, Computer Science Department Faculty
1965-1968 Stanford University, Director, Computation Center
1963 Summer Research Training Institute in Computer Simulation of Cognitive Processes (National Science Foundation)
1962 Carnegie Corporation. Summer Research Training Institute in Heuristic Programming. Faculty member.
1960-1964 University of California, Berkeley
Research-Center for Research in Management Science, 1960-1964
Research-Center for Human Learning, 1961-1964
Assistant and Associate Professor, School of Business Administration, 1960-64
1957-1960 The RAND Corporation, Santa Monica, California
1956 IBM Scientific Computing Center, New York

Selected Publications:

"Applications of Artificial Intelligence for Chemical Inference I. The Number of Possible Organic Compounds. Acyclic Structures Containing C, H, O and N", J. Am. Chem. Soc., 91, 2973 (1969). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference II. Interpretation of Low Resolution Mass Spectra of Ketones", J. Am. Chem. Soc., 91, 2977 (1969). (Co-Author).

Publications of Edward Feigenbaum

"Applications of Artificial Intelligence for Chemical Inference III. Aliphatic Ethers Diagnosed by their Low Resolution Mass Spectra and Nuclear Magnetic Resonance", J. Am. Chem. Soc., 91, 7440 (1969). (Co-Author).

"Heuristic DENDRAL: A Program for Generating Explanatory Hypotheses in Organic Chemistry", in Machine Intelligence 4, Edinburgh University Press, 1969. (Co-Author).

"Toward an Understanding of Information Processes of Scientific Inference in the Context of Organic Chemistry", in Machine Intelligence 5, Edinburgh University Press, 1970. (Co-Author).

"A Heuristic Program for Solving a Scientific Inference Problem: Summary of Motivation and Implementation", Stanford Artificial Intelligence Project Memo No. 104, November 1969. (Co-Author).

"Applications of Artificial Intelligence For Chemical Inference IV. Saturated Amines Diagnosed by Their Low Resolution Mass Spectra and Nuclear Magnetic Resonance Spectra", Journal of the American Chemical Society, 92, 6831 (1970). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference V. An Approach to the Computer Generation of Cyclic Structures. Differentiation Between All the Possible Isomeric Ketones of Composition C6H10O", Organic Mass Spectrometry, 4, 493 (1970). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference VI. Approach to a General Method of Interpreting Low Resolution Mass Spectra with a Computer", Chem. Acta Helvetica, 53, 1394 (1970). (Co-Author).

"On Generality and Problem Solving: A Case Study Using the DENDRAL Program", in Machine Intelligence 6, Edinburgh University Press (1971). (Co-Author).

"A Heuristic Programming Study of Theory Formation in Science", in proceedings of the Second International Joint Conference on Artificial Intelligence, Imperial College, London (September 1971). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference VIII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidation of Estrogenic Steroids", Journal of the American Chemical Society, 94, 5962-5971 (1972). (Co-Author).

"Heuristic Theory Formation: Data Interpretation and Rule Formation", in Machine Intelligence 7, Edinburgh University Press (1972). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference X. Datsum. A Data Interpretation Program as Applied to the Collected Mass Spectra of Estrogenic Steroids", to be submitted. (Co-Author).

SECTION II – PRIVILEGED COMMUNICATION

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.)

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
Buchanan, Bruce G.	Research Computer Scientist	7-7-40
PLACE OF BIRTH *(City, State, Country)*	**PRESENT NATIONALITY** *(If non-U.S. citizen, indicate kind of visa and expiration date)*	**SEX**
St. Louis, Missouri	U.S.Citizen	☒ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Ohio Wesleyan University	B.A.	1961	Mathematics
Michigan State University	M.A., Ph.D.	1966	Philosophy

HONORS

Recipient of National Institutes of Health Career Development Award (1971-1976)
Invited Speaker at 1972 National Institutes of Health Symposium on Numerical Methods in Chemistry (Washington)

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
	Associate Investigator

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.)*

1972-present Research Computer Scientist, Stanford University
1966-1971 Research Associate, Stanford Artificial Intelligence Project

Publications:

"On the Design of Inductive Systems: Some Philosophical Problems". British Journal for the Philosophy of Science 20 (1969), 311-323. (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference II. Interpretation of Low Resolution Mass Spectra of Ketones". Journal of the American Chemical Society, 91, 2977-2981 (1969). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference I. The Number of Possible Organic Compounds: Acyclic Structures Containing C, H, O and N". Journal of the American Chemical Society, 91, 2973-2976 (1969). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference III. Aliphatic Ethers Diagnosed by Their Low Resolution Mass Spectra and NMR Data". Journal of the American Chemical Society, 91, 7440-45 (1969). (Co-Author).

"Heuristic DENDRAL: A Program for Generating Explanatory Hypotheses in Organic Chemistry". Machine Intelligence 4, Edinburgh University Press (1969). (Co-Author).

Publications of Bruce Buchanan:

"Toward an Understanding of Information Processes of Scientific Inference in the Context of Organic Chemistry". Machine Intelligence 5, Edinburgh University Press (1969). (Co-Author).

"On Generality and Problem Solving: A Case Study Using the DENDRAL Program". Machine Intelligence 6, Edinburgh University Press (1969). (Co-Author).

"Some Speculation About Artificial Intelligence and Legal Reasoning". Stanford Law Review, Vol. 23, No. 1, November 1970. (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference VI. Approach to a General Method of Interpreting Low Resolution Mass Spectra with a Computer". Chemica Acta Helvetica, 53, 1394 (1970). (Co-Author).

"An Application of Artificial Intelligence to the Interpretation of Mass Spectra". Mass Spectrometry Techniques and Appliances (1970).

"Applications of Artificial Intelligence for Chemical Inference IV. Saturated Amines Diagnosed by Their Low Resolution Mass Spectra and Nuclear Magnetic Resonance Spectra". Journal of the American Chemical Society, 93, 6831 (1970). (Co-Author).

"The Heuristic DENDRAL Program for Explaining Empirical Data". Proceedings of IFIP Congress 1971, Ljubljana, Yugoslavia. (Co-Author).

"A Heuristic Programming Study of Theory Formation in Science". Proceedings of Second International Joint Conference on Artificial Intelligence, Imperial College, London (1971). (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference VIII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidation of Estrogenic Steroids". Journal of the American Chemical Society, 1972. (Co-Author).

"Heuristic Theory Formation: Data Interpretation and Rule Formation". Machine Intelligence 7, Edinburgh University Press (1972). (Co-Author).

"Review of Hubert Dreyfus' 'What Computers Can't Do: A Critique of Artificial Reason'", Computing Reviews (January, 1973).

"Applications of Artificial Intelligence for Chemical Inference IX. Analysis of Mixtures Without Prior Separation as Illustrated for Estrogens". Submitted to the Journal of the American Chemical Society. (Co-Author).

"Applications of Artificial Intelligence for Chemical Inference X. Datsum. A Data Interpretation Program as Applied to the Collected Mass Spectra of Estrogenic Steroids". To be submitted. (Co-Author).

Memberships

Association for Computing Machinery (ACM)
Philosophy of Science Association
American Association for Advancement of Science (AAAS)

Use continuation pages and follow this general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Alan M. DUFFIELD	Research Associate	December 16 1936

PLACE OF BIRTH (City, State, Country)	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)	SEX
Perth, Western Australia	Australian, Permanent resident Immigrant Visa	☒ Male ☐ Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
University of Western Australia	B. Sc(1st Class Hons)	1958	Organic Chemistry
University of Western Australia	Ph.D.	1962	Organic Chemsitry

HONORS

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Applications of mass spectrometry to Biology and Biomedical Problems	Organic Chemist/mass spectroscopist

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.)

1970 -	Research Associate, Department of Genetics, Stanford University School of Medicine
1969 -	Head of the Mass Spectrometry Laboratory, Chemistry Department Stanford University
1965 - 69	Research Associate, Department of Chemistry, Stanford University
1963 - 65	Postdoctoral Fellow, Department of Chemistry, Stanford University
1962 - 63	Postdoctoral Fellow, Department of Biochemistry, Stanford University School of Medicine.

PUBLICATIONS SINCE 1971

1. An Application of Artificial Intelligence to the Interpretation of Mass Spectra. Mass Spectrometry, B.W.G. Milne, Ed., John Wiley and Sons, New York, 1971, pp. 121-178
By B. G. Buchanan, A. M. Duffield and A. V. Robertson

2. Mass Spectrometry in Structural and Stereochemical Problems. CCIV. Spectra of Hydantoins.II. Electron Impact Induced Fragmentation of some Substituted Hydantoins.
Org. Mass Spectr., 5, 551 (1971)
By R. A. Corral, O. O. Orazi, A. M. Duffield and C. Djerassi

3. Electron Impact Induced Hydrogen Scrambling in Cyclohexanol and Isomeric Methylcyclohexanols.
Org. Mass Spectr., 5, 383 (1971)
By R. H. Shapiro, S. P. Levine and A. M. Duffield

4. Derivatives of 2-Biphenylcarboxylic Acid.
Rev. Roumain. Chem., 16, 1095 (1971)
By A. T. Balaban and A. M. Duffield

5. Alkaloide aus Evonymus europaea L.
Helv. Chim. Acta, 54, 2144 (1971)
By A. Klásek, T. Reichstein, A. M. Duffield and F. Santavý

6. Studies on Indian Medicinal Plants. XXVIII. Sesquiterpene Lactones of Enhydra Fluctuans Lour. Structures of Enhydrin, Fluctuanin and Fluctuadin.
Tetrahedron, 28, 2285 (1972).
By E. Ali, P. P. Ghosh Dastidar, S. C. Pakrashi, L. J. Durham and A. M. Duffield

7. The Electron Impact Promoted Fragmentation of Aurone Epoxides.
Org. Mass Spectr., 6, 199 (1972)
By B. A. Brady, W. I. O'Sullivan and A. M. Duffield

8. The Determination of Cyclohexylamine in Aqueous Solutions of Sodium Cyclamate by Electron Capture Gas Chromatography.
Anal. Letters, 4, 301 (1971)
By M. D. Soloman, W. E. Pereira and A. M. Duffield

9. Computer Recognition of Metastable Ions. Nineteenth Annual Conference on Mass Spectrometry, Atlanta, 1971, p. 63
By A. M. Duffield, W. E. Reynolds, D. A. Anderson, R. A. Stillman, Jr. and C. E. Carroll

10. Spectrometrie de Masse. VI. Fragmentation de Dimethyl-2,2-dioxolanes-1,3-Insatures.
Org. Mass Spectr., 5, 1409 (1971)
By J. Kossanyi, J. Chuche and A. M. Duffield

11. Chlorpromazine Metabolism in Sheep. II. In vitro Metabolism and Preparation of 3H-7-Hydroxychlorpromazine.
Journees D'Agressologie, 12, 333 (1971)
By L. G. Brooks, M. A. Holmes, I. S. Forrest, V. A. Bacon, A. M. Duffield and M. D. Solomon

12. Mass Spectrometry in Structural and Stereochemical Problems. CCXVII. Electron Impact Promoted Fragmentation of O-Methyl Oximes of Some α,β-Unsaturated Ketones and Methyl Substituted Cyclohexanones.
Canadian J. Chem., 50, 2776 (1972)
By Y. M. Sheikh, R. J. Liedtke, A. M. Duffield and C. Djerassi

Use continuation pages and follow the same general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Wilfred E. PEREIRA	Research Associate	June 23 1936
PLACE OF BIRTH (City, State, Country)	**PRESENT NATIONALITY** (If non-U.S. citizen, indicate kind of visa and expiration date)	**SEX**
Madras, S. India	Indian, Permanent Resident Immigrant Visa	☒ Male ☐ Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Madras Medical College, Madras, India	B. Pharm	1960	Pharmaceutical Chemistry
Saugar Univ, Madhya Pradesh, India	M. Pharm	1962	Pharm. Chem & Chem of Natur
U.C. Med. Center, San Francisco, Calif	Ph.D.	1968	Pharm. Chem & Pharmacology

HONORS

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Identification of Metabolites & drug metabolites in Biological fluids	Organic chemist

RESEARCH SUPPORT (See instructions)

RESEARCH AND OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List 15 or most representative publications. Do not exceed 3 pages for each individual.)

1968 - 1970 Post Doctoral Fellow, Dept. of Genetics Stanford University Med. School
1970 - present Research Associate same institution

During these four years I have been involved with peptide synthesis, amino acid analysis and synthetic organic chemistry. I helped develop methods for the separation of diasterioisomers by gas chromatography and have been involved with the routine use of gas chromatography mass spectrometry for the identification of urinary metabolites in normal and pathological urine and serum samples. My applications of mass spectrometry have included the deveolpment of mass fragmentography for the determination of the amino acid contents of soil and ~~xxxxxx~~ serum. My present project involves the screening of urine from leukemic patients for abnormal metabolites and to investigate the metabolic fate of anti-leukemic chemotheropeutic agents in the body.

PUBLICATIONS

1. Transesterification with an Anion-exchange Resin;
   W. Pereira, V. Close, W. Patton and B. Halpern,
   J. Org. Chem. 34:2032 (1969).

2. Alcoholysis of the Merrifield-type Peptide-polymer Bond with an Anion Exchange Resin;
   W. Pereira, V. A. Close, E. Jellum, W. Patton and B. Halpern,
   Australian J. of Chem. 22:1337 (1969).

13. Thermal Fragmentation of Quinoline and Isoquinoline N-Oxides in the Ion Source of a Mass Spectrometer.
Acta Chem. Scand., 26, 2423 (1972).
By A. M. Duffield and O. Buchardt

14. Applications of Artificial Intelligence for Chemical Inference. VII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidation of Estrogenic Steroids.
J. Amer. Chem. Soc., 94, 5962 (1972)
By D. H. Smith, B. G. Buchanan, R. S. Englemore, A. M. Duffield, A. Yeo, E. A. Feigenbaum, J. Lederberg and C. Djerassi

15. Mass Spectrometry in Structural and Stereochemical Problems. CCXIX. Identification of a Unidirectional Quadruple Hydrogen Transfer Process in 7-Phenyl-hept-3-en-2-one O-Methyl Oxime Ether.
Org. Mass Spectr., 6,1271 (1972).
By R. J. Liedtke, Y. M. Sheikh, A. M. Duffield and C. Djerassi

16. An Automated Gas Chromatographic Analysis of Phenylalanine in Serum.
Clinical Biochem., 5, 166 (1972)
By E. Steed, W. Pereira, B. Halpern, M. D. Solomon and A. M. Duffield

17. Pyrrolizidine Alkaloids. XIX. Structure of the Alkaloid Erucifoline.
Coll. Czech. Chem. Commun., (1972)
By P. Sedmera, A. Klásek, A. M. Duffield and F. Santavý.

18. Mass Spectrometry in Structural and Stereochemical Problems. CCXXII. Delineation of Competing Fragmentation Pathways of Complex Molecules from a Study of Metastable Ion Transitions of Deuterated Derivatives.
Org. Mass Spectr., 7, (1973)
By D. H. Smith, A. M. Duffield and C. Djerassi

19. Chlorination Studies I. The Reaction of Aqueous Hypochlorous Acid with Cytosine.
Biochem. Biophys. Res. Commun., 48, 880 (1972)
By W. Patton, V. Bacon, A. M. Duffield, B. Halpern, Y. Hoyano, W. Pereira and J. Lederberg

20. A Study of the Electron Impact Fragmentation of Promazine Sulphoxide and Promazine using Specifically Deuterated Analogues.
Austral. J. Chem., 26, (1973).
By M. D. Solomon, R. Summons, W. Pereira and A. M. Duffield

21. Spectrometric de Masse. VIII. Elimination d'eau Induite par Impact Electronique dans le Tetrhydro-1,2,3,4-naphtalenediol-1,2.
Org. Mass. Spectrom., 7 (1973).
By P. Perros, J. P. Morizui, J. Kossanyi and A. M. Duffield

22. The Determination of Phenylalanine in Serum by Mass Fragmentography
Clinical Biochem., submitted for publication (1973).
By W. E. Pereira, V. A. Bacon, Y. Hoyano, R. Summons and A. M. Duffield

3. The Action of Nitrosyl Chloride on Phenylalanine Peptides;
W. Patton, E. Jellum, D. Nitecki, W. Pereira and B. Halpern,
Australian J. of Chem. 22:2709 (1969).

4. Abnormal Circular Dichroism of α-Amino Acid Esters;
J. Cymerman Craig and W. E. Pereira,
Tet. Let. 18:1563 (1970).

5. The Use of (+)-2,22-Trifluoro-1-Phenylethylhydrazine in the Optical Analysis of Asymmetric Ketones by Gas Chromatography;
W. E. Pereira, M. Solomon and B. Halpern,
Australian J. of Chem. 24:1103 (1971).

6. The Microsomal Oxygenation of Ethyl Benzene. Isotopic, Stereochemical, and Induction Studies;
R. E. McMahon, H. R. Sullivan, J. Cymerman Craig and W. E. Pereira,
Arch. Biochem. Biophys. 132:575 (1969).

7. The Steric Analysis of Aliphatic Amines with Two Asymmetric Centers by Gas-liquid Chromatography of Diastereoisomeric Amides,
W. E. Pereira and B. Halpern,
Australian J. Chem. 25:667 (1972).

8. Optical Rotatory Dispersion and Absolute Configuration -XVII. α-Alkylphenylacetic Acids;
J. Cymerman Craig, W. E. Pereira, B. Halpern and J. W. Westley,
Tetrahedron 27:1173 (1971).

9. The Optical Rotary Dispersion and Circ dar Dichroism of α-Amino and α-Hydroxy Acids;
J. Cymerman Craig and W. E. Pereira
Tetrahedron 26:3457 (1970).

10. The Determination of Cyclohexylamine in Aqueous Solutions of Sodium Cyclamate by Electron-capture Gas Chromatography;
M. D. Solomon, W. E. Pereira and A. M. Duffield,
Anal. Let. 4:301 (1971).

Publications continued-

11. Chlorination Studies. I. The Reaction of Aqueous Hypochlorous Acid with Cytosine;
W. Patton, V. Brown, A. M. Duffield, B. Halpern, Y. Hoyano, W. Pereira and J. Lederberg,
Biochem. Biophys. Res. Commun. 48:880 (1972).

12. The Use of R-(+)-1-Phenylethylisocyanate in the Optical Analysis of Asymmetric Secondary Alcohols by Gas Chromatography;
W. Pereira, V. A. Bacon, W. Patton, B. Halpern, and G. E. Pollock,
Anal. Let. 3:23 (1970).

13. A Rapid and Quantitative Gas Chromatographic Analysis for Phenylalanine in Serum;
B. Halpern, W. E. Pereira, M. D. Solomon and E. Steed,
Anal. Biochem. 39:156 (1971).

14. Electron-impact Promoted Fragmentation of Alkyl-N-(1-Phenylethyl)-Carbamates of Primary, Secondary and Tertiary Alcohols;
W. E. Pereira, B. Halpern, M. D. Solomon and A. M. Duffield,
Org. Mass Spectrometry 5:157 (1971).

15. Peptide Sequencing by Low Resolution Mass Spectrometry;
V. Bacon, E. Jellum, W. Patton, W. Pereira and B. Halpern,
Biochem. Biophys. Res. Commun. 37:878 (1969).

16. A Gas Liquid Chromatographic Method for the Determination of Phenylalanine in Serum;
E. Jellum, V. A. Close, W. Patton, W. Pereira and B. Halpern,
Anal. Biochem. 31:227 (1969).

17. Quantitative Determination of Biologically Important Thiols and Disulfides by Gas Liquid Chromatography;
E. Jellum, W. Patton, V. A. Bacon, W. E. Pereira and B. Halpern,
Anal. Biochem. 31:339 (1969).

18. A Study of the Electron Impact-promoted Fragmentation of Promazine Sulfoxide and Promazine Using Specifically Deuterated Analogues;
M. D. Solomon, R. Summons, W. Pereira and A. M. Duffield,
Australian J. Chem. (1973, in press).

19. The Determination of Phenylalanine in Serum by Mass Fragmentography;
W. Pereira, V. A. Bacon, Y. Hoyano, R. Summons and A. M. Duffield,
Clin. Biochem. (In press).

20. Chlorination Studies II. The Reaction of Aqueous Hypochlorous Acid with α-Amino Acids and Dipeptides;
W. E. Pereira, Y. Hoyano, R. Summons, V. A. Bacon and A. M. Duffield,
Biochem. et Biophys. Acta (In press).

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.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
Thomas C. Rindfleisch	Research Associate	12-10-41
PLACE OF BIRTH (City, State, Country)	**PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)**	**SEX**
Oshkosh, Wisconsin, USA	USA	☒ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Purdue University, Lafayette, Ind.	B.S	1962	Physics
California Institute of Technology, Pasadena, CA	M.S	1965	Physics
	Ph.D	Thesis to be completed. All course work and examinations completed.	

HONORS

Purdue University, Graduated with Highest Honors, Sigma Xi.

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Space sciences, computer science and image processing	Technical Support

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.)*

1971-Present Stanford University Medical School, Department of Genetics, Stanford, CA.
Research Associate - Mass Spectrometry, Instrumentation research.

1962-1971 Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA.
Relevant Experience:

- **1969-1971:** Supervisor of Image Processing Development and Applications Group.
- **1968-1969:** Mariner Mars 1969 Cognizant Engineer for Image Processing
- **1962-1968:** Engineer - design and implement image processing computer software.

1. Rindfleisch, T. and Willingham, D., "A Figure of Merit Measuring Picture Resolution," JPL Technical Report 32-666, September 1, 1965.

2. Rindfleisch, T. and Willingham, D., "A Figure of Merit Measuring Picture Resolution," Advances in Electronics and Electron Physics, Volume 22A, Photo-Electronic Image Devices, Academic Press, 1966.

Thomas C. Rindfleisch
PUBLICATIONS (cont'd)

3. Rindfleisch, T., "A Photometric Method for Deriving Lunar Topographic Information," JPL Technical Report 32-786, September 15, 1965.

4. Rindfleisch, T., "Photometric Method for Lunar Topography," Photogrammetric Engineering, March 1966.

5. Rindfleisch, T., "Generalizations and Limitations of Photoclinometry," JPL Space Science Summary Volume III, 1967.

6. Rindfleisch, T., "The Digital Removal of Noise from Imagery," JPL Space Science Summary 37-62 Volume III, 1970.

7. Rindfleisch, T., "Digital Image Processing for the Rectification of Television Camera Distortions," Astronomical Use of Television-Type Image Sensors, NASA Special Publication SP-256, 1971.

8. Rindfleisch, T., Dunne, J., Frieden, H., Stromberg, W., and Ruiz, R., "Digital Processing of the Mariner 6 and 7 Pictures," Journal of Geophysical Research, Volume 76, Number 2, January 1971.

9. Rindfleisch, T., "Digital Image Processing," To be published, IEEE Special Issue, July 1972.

SECTION II – PRIVILEGED COMMUNICATION

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.)

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
Dennis H. Smith	Research Associate	11/12/42
PLACE OF BIRTH *(City, State, Country)*	**PRESENT NATIONALITY** *(If non-U.S. citizen, indicate kind of visa and expiration date)*	**SEX**
New York	USA	X ☐ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Massachusetts Inst. of Technology Cambridge, Mass.	S.B.	1964	Chemistry
University of California, Berkeley Berkeley, California	Ph.D.	1967	Chemistry

HONORS
Alfred P. Sloan Foundation Scholarship
NASA Predoctoral Traineeship
Phi Lambda Upsilon, Sigma Xi

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Mass Spectrometry and A.I. in Chemistry	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.)*

1971-Present Research Associate, Stanford University, Stanford,Ca.
1970-1971 Visiting Scientist, University of Bristol, Bristol, England
1967-1970 Assistant Research Chemist, University of Calif.at Berkeley, Berkeley, Ca.
1965-1967 NASA Pre-Doctoral Traineeship, University of Calif.at Berkeley,Berkeley, Ca.

Publications: See attached list.

Publications:

1. H. G. Langer, R. S. Gohlke, and D. H. Smith, "Mass Spectrometric Differential Thermal Analysis," Anal. Chem., 37, 433 (1965).

2. S. M. Kupchan, J. M. Cassady, J. E. Kelsey, H. K. Schnoes, D. H. Smith, and A. L. Burlingame, "Structural Elucidation and High Resolution Mass Spectrometry of Gaillardin, a New Cytotoxic Sesquiterpene Lactone," J. Amer. Chem. Soc. 88, 5292 (1966).

3. D. H. Smith, Ph.D. Thesis, "High Resolution Mass Spectrometry: Techniques and Applications to Molecular Structure Problems," Dept. of Chemistry, University of California, Berkeley, California (1967).

4. H. K. Schnoes, D. H. Smith, A. L. Burlingame, P. W. Jeffs, and W. Döpke, "Mass Spectra of Amaryllidaceae Alkaloids: The Lycorenine Series," Tetrahedron, 24, 2825 (1968).

5. A. L. Burlingame, D. H. Smith, and R. W. Olsen, "High Resolution Mass Spectrometry in Molecular Structure Studies, XIV. Real-time Data Acquisition, Processing and Display of High Resolution Mass Spectral Data," Anal. Chem., 40, 13 (1968).

6. A. L. Burlingame and D. H. Smith, "High Resolution Mass Spectrometry in Molecular Structure Studies II. Automated Heteroatomic Plotting as an Aid to the Presentation and Interpretaiton of High Resolution Mass Spectra Data," Tetrahedron, 24, 5749 (1968).

7. W. J. Richter, B. R. Simoneit, D. H. Smith, and A. L. Burlingame, "Detection and Identification of Oxocarboxylic and Dicarboxylic Acids in Complex Mixtures by Reductive Silylation and Computer-Aided Analysis of High Resolution Mass Spectral Data," Anal. Chem., 41, 1392 (1969).

8. The Lunar Sample Preliminary Examination Team, "Preliminary Examination of Lunar Samples from Apollo 11," Science, 165, 1211 (1969).

9. S. M. Kupchan, W. K. Anderson, P. Bollinger, R. W. Doskotch, R. M. Smith, J. A. Saenz Renauld, H. K. Schnoes, A. L. Burlingame, and D. H. Smith, "Tumor Inhibitors, XXXIX. Active Principles of Acnistus arborescens. Isolation and Structural and Spectral Studies of Withaferin A and Withacnistin," J. Org. Chem., 34, 3858 (1969).

10. A. L. Burlingame, D. H. Smith, T. O. Merren, and R. W. Olsen, "Real-time High Resolution Mass Spectrometry," in Computers in Analytical Chemistry (Vol. 4 in Progress in Analytical Chemistry series), C. H. Orr and J. Norris, Eds., Plenum Press, New York, 1970, pp. 17-38.

11. The Lunar Sample Preliminary Examination Team, "Preliminary Examination of Lunar Samples from Apollo 12," Science, 167, 1325 (1970).

12. D. H. Smith, R. W. Olsen, F. C. Walls, and A. L. Burlingame, "Real-Time Mass Spectrometry: LOGOS--A Generalized Mass Spectrometry Computer System for High and Low Resolution, GC/MS and Closed-Loop Applications," Anal. Chem., 43, 1796 (1971).

13. A. L. Burlingame, J. S. Hauser, B. R. Simoneit, D. H. Smith, K. Biemann, N. Mancuso, R. Murphy, D. A. Flory, and M. A. Reynolds, "Preliminary Organic Analysis of the Apollo 12 Cores," Proceedings of the Apollo 12 Lunar Science Conference, E. Levinson, Ed., M.I.T.Press, Cambridge, Mass. 1971, p. 1891.

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14. D. H. Smith, "A Compound Classifier Based on Computer Analysis of Low Resolution Mass Spectral Data," Anal. Chem., 44, 536 (1972).

15. D. H. Smith and G. Eglinton, "Compound Classification by Computer Treatment of Low Resolution Mass Spectra-Application to Geochemical and Environmental Problems,"Nature, 235, 325 (1972).

16. D. H. Smith, N. A. B. Gray, C. T. Dillinger, B. J. Kimble, and G. Eglinton, "Complex Mixture Analysis - Geochemical and Environmental Applications of a Compound Classifier Based on Computer Analysis of Low Resolution Mass Spectra," "Advances in Organic Geochemistry 1971," M. R. v.Gaertner and M. Weher, Ed., Pergammon Press, Oxford, New York, Toronto, Sydney and Braunschweig, 1972, p.249.

17. D. H. Smith, B. G. Buchanan, R. S. Engelmore, A. M. Duffield, A. Yeo, E. A. Feigenbaum, J. Lederberg, and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference, VIII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidation of Estrogenic Steroids," J. Amer. Chem. Soc., 94, 5962 (1972).

18. D. H. Smith, A. M. Duffield, and C. Djerassi, "Mass Spectrometry in Structural and Stereochemical Problems, CCXXII. Delineation of Competing Fragmentation Pathways of Complex Molecules from a Study of Metastable Ion Transitions of Deuterated Derivatives," Org. Mass. Spectrom., in press.

19. B. R. Simoneit, D. H. Smith, G. Eglinton, and A. L. Burlingame, "Applications of Real-Time Mass Spectrometric Techniques to Environmental Organic Geochemistry, II. San Francisco Bay Area Waters," Arch. Env. Contam. and Tox., in press.

20. D. H. Smith, B. G. Buchanan, R. S. Engelmore, H. Adlercreutz, and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference, IX. Analysis of Mixtures Without Prior Separation as Illustrated for Estrogens," J. Amer. Chem. Soc., submitted for publication.

21. D. H. Smith, B. G. Buchanan, W. C. White, E. A. Feigenbaum, J. Lederberg, and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference X, INTSUM. A Data Interpretation and Summary Program as Applied to the Collected Mass Spectra of Estrogenic Steroids," Tetrahedron, submitted.

22. D. H. Smith, "Mass Spectrometry," Chapter X in Guide to Modern Methods of Instrumentatl Analysis, T. H. Gouw, Ed., Wiley-Interscience, New York, 1972.

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SECTION II – PRIVILEGED COMMUNICATION

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.)

NAME	TITLE	BIRTHDATE *(Mo., Day, Yr.)*
Sridharan, Natesa S.	Research Associate	10-2-46
PLACE OF BIRTH *(City, State, Country)*	**PRESENT NATIONALITY** *(If non-U.S. citizen, indicate kind of visa and expiration date)*	**SEX**
Madras, India	India; pending permanent residence	☒ Male ☐ Female

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

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Indian Institute of Technology, Madras, India	Bachelor of Technology	1967	Electrical Engineering
State University of New York, Stony Brook	M.S.	1969	Computer Science
	Ph.D.	1971	Computer Science

HONORS

University Fellow 1968-1971 SUNY Stony Brook
Graduate Assistant 1967-1968 SUNY Stony Brook
Siemens Award (awarded for top rank in Electrical Engineering 1967 ITT Madras
National Merit Scholarship 1963-1967 ITT Madras

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Computer Applications in Chemistry and Medicine	Research Associate

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.)*

1971-present Research Associate, Heuristic Programming Project, Stanford University
1970-1971 Consultant, IAC Computer Company, Long Island, N.Y.

"Heuristic Theory Formation: Data Interpretation and Rule Formation". Machine Intelligence, Volume VII, 1972. (Co-Author).

"An Application of Artificial Intelligence to Organic Chemical Synthesis" Doctoral Dissertation, SUNY StonyBrook, August, 1971.