8th International Radiocarbon Dating Conference
October 1972, Lower Hutt New Zealand

1971

12/22/71

THE ROYAL SOCIETY OF NEW ZEALAND

International Radio Carbon Dating Conference, Lower Hutt City, Wellington, New Zealand
18-25 October, 1972

ADVANCE INFORMATION

Assoc. Dir.

Name (block letters) ELIZABETH K. RALPH Title MASCA
(Professor, Dr, Mr, Mrs, Miss)

Address UNIVERSITY MUSEUM
33rd and Spruce Streets
Philadelphia, Penna. 19104, U.S.A.

My attendance is certain ☒ probable ☐ improbable ☐ (Tick appropriate box)
My wife will ☐ will not ☐ accompany me.
I will ☒ will not ☐ present a paper entitled:
Relationship between Changes in the Magnetic Intensity and the Atmospheric Carbon-14 Inventory

Author(s) Name(s) Elizabeth K. Ralph

I will ☐ expect to ☒ will not ☐ take the North Island ☒ a South Island Tour ☐
I will require Twin ☐ Single ☒ Nil ☐ accommodation.
I am ☐ am not ☒ interested in an INCLUSIVE TOUR (see 2nd Circular).

Elizabeth K. Ralph
Signature.

I may be coming from Iran

D.F.J.

THE ROYAL SOCIETY OF NEW ZEALAND

International Radio Carbon Dating Conference, Lower Hutt City, Wellington, New Zealand
18-25 October, 1972

ADVANCE INFORMATION

Name (block letters) HENRY N. MICHAEL Title DR.
(Professor, Dr, Mr, Mrs, Miss)

Address MASCA, UNIVERSITY MUSEUM, 33RD & SPRUCE STS., PHILADELPHIA, PA., 19104, U.S.A.

My attendance is certain ☑ probable ☐ improbable ☐ (Tick appropriate box)
My wife will ☐ will not ☐ accompany me.
I will ☑ will not ☐ present a paper entitled: DISCUSSION OF RADIOCARBON DATES OBTAINED FROM PRECISELY DATED SEQUOIA AND BRISTLECONE (PINE SAMPLES)

Author(s) Name(s) HENRY N. MICHAEL

I will ☐ expect to ☑ will not ☐ take the North Island ☑ a South Island Tour ☐
I will require Twin ☐ Single ☑ Nil ☐ accommodation.
I am ☑ am not ☐ interested in an INCLUSIVE TOUR (see 2nd Circular).

Henry N. Michael
Signature.

D.F.J.

May 30, 1972

Dr. T. A. Rafter, Director
Department of Scientific and Industrial Research
Private Bag, Lower Hutt
New Zealand

Ref: INS-11/9/1/1-TAR

Dear Dr. Rafter:

Thank you very much for your letter of 11th May 1972. I do hope that your second operation was a complete success.

I have enclosed two copies of my paper entitled "A Cyclic Solution for the Relationship Between Magnetic and Atmospheric Changes." I have included full-size and half-size copies of my figures because our machine cannot produce the intermediate size as specified. I hope that yours is more clever. If not, the half-sizes might do.

Henry Michael plans to send his paper about mid-June.

With best regards,

R/rs
Encl.

Elizabeth K. Ralph

SIR(INS) 10

TELEPHONE 699 199
All correspondence to be addressed to Director

In replying, please quote these numbers
INS 11/9/1/1-TAR

NEW ZEALAND

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
THE INSTITUTE OF NUCLEAR SCIENCES

PRIVATE BAG, LOWER HUTT
NEW ZEALAND

12 June 1972

Dr Elizabeth K. Ralph,
The University Museum,
University of Pennsylvania,
33rd and Spruce Streets,
Philadelphia 4,
Pennsylvania,
U.S.A.

Dear Beth,

Thank you for your letter of May 30th, and as I can walk now without a stick at least for some of the time, I feel the second operation was successful.

Thank you for your paper, incidentally the first to arrive, and if we have any troubles with the figures I feel confident they can be solved.

It is a magnificent day in Wellington today, I hope you see Wellington like this next October. We had a visit for publicity purposes from the Mayor and Councillors of Lower Hutt last Wednesday evening and one Councillor, Mrs Donald said you stayed with her when you were in New Zealand. She was delighted to know you were coming again.

Kindest regards,

Athol Rafter

(T.A. Rafter)
Director

BY AIR MAIL

AEROGRAMME

If anything is enclosed,
this form will be surcharged
at rate for Air Mail Letters.

Dr Elizabeth K. Ralph,
The University Museum,
University of Pennsylvania,
33rd and Spruce Streets,
Philadelphia 4,
Pennsylvania, U.S.A.

First fold here

Second fold here

SENDER'S NAME AND ADDRESS

THE DIRECTOR
INSTITUTE OF NUCLEAR SCIENCES
PRIVATE BAG, LOWER HUTT, N.Z.

Crawley AEROGRAMME

To open cut here

Approved For Posting in New Zealand to Oversea Addresses
New Zealand Post Office Authority No. 17

To open cut here

THE ROYAL SOCIETY OF NEW ZEALAND

CABLE ADDRESS:
ROYALSOC, WELLINGTON.

P.O. BOX [redacted] 12249
WELLINGTON,
NEW ZEALAND.

10 July 1972

Dr E.K. Ralph,
University Museum,
33rd and Spruce Streets,
Philadelphia,
Penn. 19104,
U.S.A.

Dear Dr Ralph,

Just a brief note to acknowledge receipt of your abstract and paper entitled "A Cyclic Solution for the Relationship between Magnetic and Atmospheric C-14 Changes."

Yours sincerely,

G.K. Nevill
Executive Officer

GKN:DS

PAR AVION
AIR MAIL
CORREO AEREO

If anything is enclosed, this form will be surcharged at rate for Air Mail Letters.

AEROGRAMME

Dr E.K. Ralph,
University Museum,
33rd and Spruce Streets,
Philadelphia, Penn. 19104,
U.S.A.

First fold here

Second fold here

SENDER'S NAME AND ADDRESS

The Royal Society of New Zealand
P.O. Box 196 12249
Wellington, New Zealand

To open cut here

Cradley AEROGRAMME

Approved For Posting in New Zealand to Oversea Addresses
New Zealand Post Office Authority No. 17

To open cut here

September 20, 1972

Dr. G. K. Nevill, Executive Officer
The Royal Society of New Zealand
P.O. Box 12249
Wellington, New Zealand

Dear Dr. Nevill:

Please forgive me for sending the registration form after the deadline -- it was misplaced in my files. Now, I find that I should have waited two more days, for I have received an invitation from Mrs. J. E. Donald to stay at her home in Lower Hutt.

I am accepting her invitation tentatively with the hope that my hotel reservation can be cancelled.

Sincerely yours,

Elizabeth K. Ralph

EKR/ek

Scint. -
Teflon top
Trying teflon
both ends

E R RALPH

PROGRAMME

FOR THE

8th INTERNATIONAL RADIOCARBON DATING CONFERENCE

SUCCESSOR TO THE
NEW ZEALAND INSTITUTE
1867-1933

Organised by

THE ROYAL SOCIETY OF NEW ZEALAND

Venue:

LITTLE THEATRE, CIVIC CENTRE
LOWER HUTT, NEW ZEALAND
18-25 OCTOBER
1972

CO-OPERATING BODIES:

International Union of Pure and Applied Chemistry
International Union of Biological Sciences
International Union of Geological Sciences
International Union of Quaternary Research
Scientific Committee on Oceanic Research
International Atomic Energy Agency

Graham McCallum
Inst. Nucl. Sciences
(Backscattering for isotope ratios)

OFFICERS

The Honorary President of the Conference

Professor W. F. Libby, University of California, U.S.A.

The President, The Royal Society of New Zealand

Dr R. W. Willett, Assistant Director-General, Department of Scientific and Industrial Research of New Zealand.

The Conference Chairman

Dr T. A. Rafter, Director, Institute of Nuclear Sciences, D.S.I.R. New Zealand

ROYAL SOCIETY OFFICERS

Mr G. K. Nevill, Executive Officer
Mrs M. E. Marsh, General Secretary

ORGANISING COMMITTEE

Dr T. A. Rafter (Chairman)
Director, Institute of Nuclear Sciences, D.S.I.R., Lower Hutt

Dr R. K. Dell
Director, Dominion Museum, Wellington

Dr R. S. Duff
Director, Canterbury Museum, Christchurch

Mr T. L. Grant-Taylor
N.Z. Geological Survey, D.S.I.R., Lower Hutt

Mr L. Lockerbie
Education Department, Otago Museum, Dunedin

Mr J. T. O'Leary
N.Z. Atomic Energy Committee, Institute of Nuclear Sciences, D.S.I.R., Lower Hutt

Dr J. Stout
Soil Bureau, D.S.I.R., Lower Hutt

Dr R. P. Suggate
N.Z. Geological Survey, D.S.I.R., Lower Hutt

DAVID F. JONES LTD.

VENUE

The conference will be held in the Little Theatre, Civic Centre, Lower Hutt City. Lower Hutt is located in the Hutt Valley about nine miles from Wellingon. The conference venue is in pleasant surroundings adjacent to modern hotel accommodation. Banking, postal and shopping facilities are located within 200 yards of the Conference hall. For the location of the Little Theatre, Civic Centre, hotels/motels, Institute of Nuclear Sciences and N.Z. Geological Survey, see enclosed map.

ROYAL SOCIETY OFFICES

6 Halswell Sreet, Thorndon, Wellington.

CONFERENCE ADDRESSES AND TELEPHONES

Mail—
8th International Radiocarbon Dating Conference
c/o The Royal Society of New Zealand, P.O. Box 12249
Wellington, New Zealand

Cables—
Royalsoc, Wellington, New Zealand

Conference Telephone Numbers

(1)	Conference Chairman	Home	793-539
	T. A. Rafter	Work	699-199
(2)	Programme Chairman	Home	699-985
	T. Grant-Taylor	Work	699-059
(3)	Executive Officer Royal Society	45-516	63-896
(4)	Conference Office Little Theatre (9 a.m. to 5.30 p.m.)		63-896
(5)	Royal Society Office, Wellington	45-516,	45-215

REGISTRATION

All participants are requested to complete registration on the **Wednesday evening, 18 October,** at the Institute of Nuclear Sciences, Gracefield, Lower Hutt, when the Conference Chairman, Dr Rafter, will welcome participants at an informal social evening. Buses will collect participants from their hotel/motels at 7.30 p.m. and return them later that evening.

Note: Tickets for the Buffet Dinner on 24 October should be purchased when registering—cost $3.50 per person.

ACCOMMODATION

Accommodation has been reserved at hotels/motels in Lower Hutt. Participants have already been advised the name of their hotel/motel.

NORTH ISLAND TOUR

The tour bus will collect participants from the Intercontinental Hotel at 8 a.m. on Sunday morning, 15 October, and proceed to Rotorua overnight.

SOUTH ISLAND TOURS

The tour bus will collect participants from their hotel/motels at 8.45 a.m. on Thursday morning, 26 October, and take them to Wellington airport.

MAIL AND TELEPHONES

Posting and telephone facilities will be available in the foyer of the Little Theatre, Lower Hutt Civic Centre. For incoming mail and toll calls enquire at the Conference Office, Little Theatre.

SOCIAL FUNCTIONS

Informal dress will be worn at all social functions.

MEDICAL SERVICES

Medical and Dental Services will be available but under social security regulations are not free to overseas visitors. If these services are required consult the Executive Officer, Mr G. K. Nevill.

NAME CARDS

Name cards will be issued on registration. Participants are asked to wear cards at all Conference sessions and social functions.

LUNCHEONS

These are readily available in Lower Hutt City adjacent to the Civic Centre. See enclosed map.

MORNING AND AFTERNOON TEAS

Morning and afternoon teas will be served in the rooms adjacent to the Little Theatre. There is no charge.

DIPLOMATIC AND CONSULAR REPRESENTATION

Overseas participants wishing to visit their country's embassies should consult the Executive Officer.

CIVIC RECEPTION, 19 OCTOBER

The Mayor and Councillors of Lower Hutt City are holding a Civic Reception and buffet dinner for participants in the Town Hall at 6.00 p.m. Individual invitations have been issued.

PUBLIC LECTURE, 19 OCTOBER

After the Civic Reception a Public Lecture by Professor W. F. Libby on "Radiocarbon Dating, Memories and Hopes", will be held in the Little Theatre, Civic Centre, at 8.00 p.m.

WEEKEND ACTIVITIES

The following activities are available—

Saturday 21 October

Wellington Racing Club Meeting at Trentham—starts 10 a.m.—easy public transport.
Visit the Marlborough Sounds leaving Wellington 10.00 a.m.— Picton Ferry—returning from Picton that day.

Note: It is not possible to make prior bookings. Tickets can only be purchased on the day of the excursion at the Ferry Terminal.

Sightseeing Marine Drive bus tours of Wellington 2.00 p.m.—4.30 p.m. Special nightlights tour could be arranged.

Sunday 22 October

Visit the Marlborough Sounds. (as for Saturday).
Sightseeing Marine Drive Tour. (as for Saturday).
Sightseeing tour through native forest to beach resort. Leaving Civic Centre at 2 p.m. returning early evening.

Participants were asked to advise their intentions on the travel arrangements form. If you have not already done so, please advise the Executive Officer.
The Organising Committee is arranging visits to private homes on Friday evening, 20 October.

ROYAL SOCIETY OF NEW ZEALAND RECEPTION AND DINNER, 23 OCTOBER

The President and Council of the Royal Society will entertain Conference participants at a Reception and Dinner at 7.30 p.m. in the lounge of the Overseas Passenger Terminal, Clyde Quay. Buses will collect those attending from their hotel/motels at 7.00 p.m. and at 7.10 p.m. from the Civic Centre for the Overseas Terminal and will be available to take participants back to their Lower Hutt accommodation.

VISITS TO SCIENTIFIC INSTITUTIONS, 24 OCTOBER

In the afternoon, visits to scientific institutions will be arranged. For details see programme following. Transport will be available from the Little Theatre at 2 p.m.

BUFFET DINNER, INSTITUTE OF NUCLEAR SCIENCES, 24 OCTOBER

A buffet dinner will be held at the Institute of Nuclear Sciences on Tuesday evening, 24 October, commencing at 5.00 p.m. Tickets should be purchased when registering on October 18 (see "Registration"). Transport will be arranged to the Institute and will take participants from the dinner to the public lecure at the Civic Centre at 8.00 p.m.

PUBLIC LECTURE, 24 OCTOBER

Professor N. W. G. Macintosh, Department of Anatomy, the University of Sydney, will give the second public lecture at 8.00 p.m. in the Little Theatre, Civic Centre, on "Radiocarbon Dating, a Pointer in Time to the Evolution of Man in Australia and Islands to the North West."

LADIES PROGRAMME

Mrs T. A. Rafter and Mrs M. E. Marsh, General Secretary, will meet the ladies at the informal gathering for registration and a programme will be arranged.

LECTURE FACILITIES

There is provided—

(1) Blackboards.
(2) Provision for display of figures and diagrams.
(3) 35 mm slide projector
(4) 16 mm motion film projector.
(5) Overhead projector.

NO provision can be made for the projection of slides or films of any other size.

Note: Speakers are requested to hand in their slides to Mr C. McGill in the foyer of the Little Theatre 15 minutes before the commencement of each session.

PUBLICATION

All papers accepted for presentation have been published by the Royal Society of New Zealand prior to the Conference and will be issued free of charge to all registered participants. The volumes will be on sale during and after the Conference and will be publicised through international journals.

Total price is $NZ4.00 ($US5.00). Copies may be obtained from the General Secretary.

PROGRAMME

Note: There is a very full programme to be completed in a brief time. Speakers attention is drawn to the allotted times, which must be adhered to. Discussion time is **not** available for extension of presentation of the paper.

WEDNESDAY, 18 OCTOBER 1972

Evening from 7.30 p.m.

Informal welcome social evening and registration at New Zealand Institute of Nuclear Sciences, Gracefield Road, Lower Hutt.

THURSDAY, 19 OCTOBER 1972

Time

9.00-10.00 a.m.

Opening of the Conference in the Little Theatre, Civic Centre, Lower Hutt, by Dr. R. W. Willett, President of the Royal Society of New Zealand

Speakers:

Professor W. F. Libby, Honorary President of the Conference
Dr T. A. Rafter, Conference Chairman
His Worship, Mr J. Kennedy-Good, Mayor of Lower Hutt

10.30 a.m. Morning Tea.

Belmour Le Marsh - Paleo climatic interests - Above timberline chronology - 5500 yrs. - checked within 2 yrs. w. Fergusson's 8300 yrs.

THURSDAY, 19 OCTOBER 1972

SESSION A

SECULAR VARIATIONS OF CARBON-14

Bannister instead

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
1100	C. W. Fergusson	Dendrochronology of Bristlecone Pine Prior to 4000 B.C.	A1	10	
1110-1130	H. N. Michael, and Elizabeth K. Ralph	Discussion of Radiocarbon Dates Obtained from Precisely Dated Sequoia and Bristlecone Pine Samples.	A11	20	
		Discussion			10
1140-1200	P. E. Damon, A. Long, and E. I. Wallick	Dendrochronology Calibration of the Carbon-14 Time Scale.	A28	20	
		Discussion			10
1210-1225	Albert In Che Yang, and A. W. Fairhall	Variations of Natural Radiocarbon During the Last 11 Millenia and Geophysical Mechanisms for Producing Them.	A44	15	
		Discussion			10
1235-1250	H. E. Suess	Bristlecone Pine Calibration Measurements.		15	
		Discussion			10
1300		LUNCH		One hour	
1400-1415	L. M. Libby, and W. F. Libby	Vulcanism and Radiocarbon Dates	A72	15	
		Discussion			5
1420-1435	Elibabeth K. Ralph	A Cyclic Solution for the Relationship Between Magnetic and Atmospheric Carbon-14 Changes.	A76	15	
		Discussion			5
1440-1455	K. E. Zimen	The Future CO_2 Burden of the Atmosphere and Carbon-14 in the Ethanol from Wines.	A88	15	
		Discussion			10
1505-1520	J. G. Farmer, and M. S. Baxter	Short-term Trends in Natural Radiocarbon.	A58	15	
1530		Discussion			10
		AFTERNOON TEA		30 minutes	

Look up Cox's thesis - that reversals occur at min. int.

			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
1600-1615	J. Houtermans, and H. E. Suess	Are There Cycles in the Variations of the Radiocarbon Level?		15	
		Discussion			5
1620-1635	M. Barbetti	Geomagnetic Field Behaviour Between 25,000 and 35,000 years B.P. and its Effect on Atmospheric Radiocarbon Concentration.		15	
		Discussion			5
1640-1655	W. F. Cain, and H. E. Suess	Carbon-14 in the Air of Big Cities.		15	
		Discussion			
1700	A. G. Smith	Dendrochronology at Queens University		5	
		Discussion			5
1710		GENERAL DISCUSSION			
1725		END OF SESSION			10

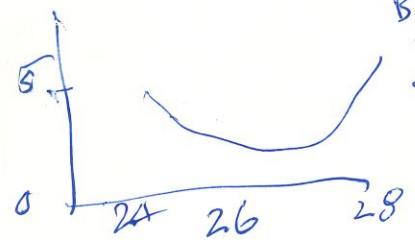
Dr. Berger - T-R Calib. of C14 Dates

EVENING:

1800 The Mayor and Councillors of the City of Lower Hutt are holding a Civic Reception for the Conference Delegates. This will be followed by a Public Lecture, delivered by:

Professor W. F. Libby, Honorary President of the Conference

2000 RADIOCARBON DATING, MEMORIES and HOPES



Dipole Moment

Bet. 28K + 10K, very low field, of C14 - 30-100‰ higher - maybe

Indicate Field of 1,100

~ 31K - N at SW

28K - chg. but off

Ky C14

~ 30° away from true reversal ~ 1K yrs.

FRIDAY, 20 OCTOBER 1972

SESSION B

RADIOCARBON DATING TECHNIQUES

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
0900-0910	R. Burleigh	Bomb Combustion of Radio-Carbon Samples.	B–1	10	
		Discussion			5
0915-0925	V. R. Switsur	Combustion Bombs for Radio-carbon Dating.	B–11	10	
		Discussion			5
0930-0940	J. C. Freundlich and M. ~~Rutick~~ Rutlah	Radiocarbon Dating by Car-bon-dioxide Method: Influ-ence and Removal of Known Impurities.	B–24	10	
		Discussion			5
0945-0955	H. Polach, J. Gower, and I. Fraser	Synthesis of High Purity Ben-zene for Radiocarbon Dating	B–36	10	
		Discussion			5
1000-1010	D. D. Coleman, C. L. Liu, D. R. Dickerson, and R. R. Frost	Improvement in Trimerization of Acetylene to Benzene for Radio-carbon Dating with a Commercially Available Van-adium Oxide Catalyst.	B–50	10	
		Discussion			5
1015-1025	H. S. Jansen	Transfer of Carbon from Sol-vents to Samples.	B–63	10	
		Discussion			5
1030		MORNING TEA		30 minutes	
1100-1110	S. Gulliksen	Low Cost Electronics and a Twin Counter Assembly.	B–69	10	
		Discussion			5
1115-1125	M. A. Geyh	A Comparison: Proportional Counter and Liquid Scintil-lation Spectrometer for Radiocarbon Dating.	B–81	10	
		Discussion			5
1130-1145	J. E. Noakes, K. A. Schneider, and B. L. Brandau	A Mobile Archaeological Lab-oratory: Microsample Ex-traction and Radiocarbon Dating.	B–94	15	5
1150-1200	D. D. Harkness and H. W. Wilson	Some Application in Radio carbon Measurement at the Scottish Research Reactor Centre.	B–101	10	
		Discussion			5
1205		GENERAL DISCUSSION			10
1215		LUNCH			

not present — Summarized by Polach

FRIDAY, 20 OCTOBER 1972

SESSION C

CARBON-14 VARIATIONS IN THE OCEAN

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
1400-1410	H. G. Ostlund	The Geosecs Oceanic C-14 Programme	C1	10	
		Discussion			5
1415-1430	A. W. Fairhall, A. W. Young, and P. A. Bradford	Radiocarbon in the Sea.	C2	15	5
		Discussion			5
1435-1450	T. A. Rafter, and B. J. O'Brien	14C Measurements in the Atmosphere and in the South Pacific Ocean. A Re-calculation of the Exchange Rates Between the Atmos-phere and the Ocean.	C17	15	
		Discussion			5
1455-1510	J. C. Vogel	Radiocarbon in the Surface Waters of the Atlantic Ocean.	C43	15	
		Discussion			5
1515-1530	T. W. Linnick, and H. E. Suess	Bomb Produced Radiocarbon in the Surface Water of the Pacific Ocean.		15	
		Discussion			5
1535		AFTERNOON TEA		25 minutes	
1600-1615	S. Gulliksen, and R. Nydal	Further Calculations on the C-14 Exchange Between the Ocean and the Atmosphere.	C58	15	
		Discussion			5
1620-1635	R. W. Buddemeier, H. S. Okamoto; D. C. Hurd, and T. H. Hufen	Effects of Solution and Ex-change on the Radiocarbon Dating of Sediments and Natural Waters.	C73	15	
		Discussion			10
1645-1700	H. Willkomm, and H. Erlenkeuser	C-14 Investigations on Surface Sediments and Macroben-thos in the Western Baltic Sea.	C56	15	
		Discussion			5
1705		GENERAL DISCUSSION			10
1715		END OF SESSION			

MONDAY, 23 OCTOBER 1972

SESSION D

RADIOCARBON IN FRESHWATER

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
0900-0915	H. Willkomm, and H. Erlenkeuser	C14 Measurements of Water, Plants and Sediments of Lakes.	D1	15	
		Discussion			5
0920-0935	M. Rubin, and E. Spiker	C14 Activity as an Indicator of Source of Dissolved Organic Carbon in Rivers and Lakes.	D13	15	
		Discussion			5
0940-0955	F. J. Pearson, M. S. Bedinger, and B. F. Jones	Carbon-14 Ages of Water from the Arkansas Hot Springs.	D19	15	
		Discussion			5
1000-1015	W. G. Mook	On the Reconstruction of the Initial 14C Content of Groundwater from the Chemical and Isotopic Composition.	D31	15	
		Discussion			10
1025		MORNING TEA		35 minutes	
1100-1115	M. L. Leamy, and T. A. Rafter	Isotope Ratios Preserved in Pedogenic Carbonate and Their Application in Palaeopedology.	D42	15	
		Discussion			10
1125-1140	Mebus Geyh	On the Determination of the Dilution Factor of Groundwater.	D58	15	
		Discussion			10
1150-1205	C. H. Hendy, T. A. Rafter, and N. W. G. Macintosh	The Formation of Carbonate Nodules in the Soils of the Dar ing Downs, Queensland, Australia.		15	
		Discussion			10
1215-1230	H. Oeschger, B. Stauffer, P. Bucher, C. C. Langway, B. L. Hansen, H. Clausen	C 14 and other Isotopes Studies on Natural Ice.		15	
		Discussion			10
1240		GENERAL DISCUSSION			20
1300		LUNCH			

MONDAY, 23 OCTOBER 1972

SESSION E

RADIOCARBON IN SOIL DEVELOPMENT

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
1400-1420	H. W. Scharpenseel	Natural Radiocarbon Measurement of Soil and Organic Matter Fractions on Profiles of Different Pedogenesis.	E1	20	
		Discussion			5
1425-1445	J. D. Stout	Factors Affecting Radiocarbon Enrichment in Soil and the Turnover of Soil Organic Matter.	E13	20	
		Discussion			5
1450-1510	K. R. Tate	Radiocarbon Dating in Studies of Soil Organic Matter-Vegetation Relationships.	E27	20	
		Discussion			5
1515-1535	J. H. Troughton	Carbon Isotope Fractionation by Plants.	E39	20	
		Discussion			5
1540		AFTERNOON TEA		30 minutes	
1610-1625	T. L. Grant-Taylor	The Extraction and Use of Plant Lipids as a Material for Radiocarbon Dating.	E58	15	
		Discussion			5
1630-1650	K. M. Goh	Radiocarbon Enrichment and the Turnover of Soil Organic Matter in a Chronosequence of Soils Developed on Windblown Sand in New Zealand.	E67	20	
		Discussion			5
1655		GENERAL DISCUSSION			10
1705		END OF SESSION			
1930		The Royal Society of New Zealand Reception — Overseas Terminal, Wellington.			

TUESDAY, 24 OCTOBER 1972

SESSION F

THE USE OF RADIOCARBON

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
0900-0910	H. S. Jansen	Extending the Use of Bomb Carbon in the Life Sciences.	F1	10	
		Discussion			10
0920-0940	W. G. Mook; A. V. Munaut, and H. T. Waterbolk	Determination of Age and Duration of Stratified Prehistoric Bog Settlements.	F27	20	
		Discussion			5
0945-1000	B. B. Hanshaw, and E. Spiker	Unusual Wood Preservation Used to Determine the Geochemical Kinetics of an Iron Spring Deposit.	F41	15	
		Discussion			5
1005-1020	P. J. F. Coutts	The Utility of Radiocarbon Determinations for Dating N.Z. Archaeological Sites.	F52	15	
		Discussion			10
1030		MORNING TEA		30 minutes	
1100-1115	E. D. Gill	Areas of Responsibility in Radiocarbon Assays.	F69	15	
		Discussion			10
1125		GENERAL DISCUSSION			10
1135		END OF SESSION			

TUESDAY, 24 OCTOBER 1972

AFTERNOON

VISITS TO SCIENTIFIC INSTITUTIONS

			Distance
GRACEFIELD ROAD	Institute of Nuclear Sciences, DSIR		
GRACEFIELD, LOWER HUTT	Physics and Engineering Laboratory	DSIR	5 km
	Chemistry Division	DSIR	
ANDREWS AVENUE, LOWER HUTT	N.Z. Geological Survey	DSIR	250 m
EASTERN HUTT ROAD TAITA, LOWER HUTT	Soil Bureau	DSIR	7 km
WELLINGTON	Victoria University of Wellington		16 km
	Geophysics Division	DSIR	16 km
	Oceanographic Institute	DSIR	16 km
	Fisheries Research		16 km
	Museum		16 km
	Meteorological Office		16 km

The mid-day meal in New Zealand is usually taken between 1200 and 1300 hours.

1700 hr Informal Cocktail Party buffet meal at Institute of Nuclear Sciences, Gracefield Road, Lower Hutt.

2000 hr Public Lecture by—Professor N. W. G. Macintosh, Professor of Anatomy, Sydney University:

RADIOCARBON DATING AS A POINTER IN TIME TO THE ARRIVAL AND HISTORY OF MAN IN AUSTRALIA AND ISLANDS TO THE NORTH WEST

WEDNESDAY, 25 OCTOBER 1972

SESSION G

SAMPLE CONTAMINATION

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
0900-0910	J. C. Freundlich	Natural Radon as a Source of Low Level Laboratory Contamination.	G1	10	
		Discussion			5
0915-0925	Ingrid U. Olsson	A Critical Analysis of 14C Datings of Deposits Containing Little Carbon.	G11	10	
		Discussion			5
0930-0950	K. M. Goh, and B. P. J. Molloy	Reliability of Radiocarbon Dates from Buried Charcoals.	G29	10	
		Discussion			5
0955-1005	J. M. Bailey, and R. Lee	The Effect of Alkaline Pretreatment on the Radiocarbon Dates of Several New Zealand Charcoals.	G46	10	
		Discussion			5
1010-1015	T. L. Grant-Taylor	Conditions for the Use of Calcium Carbonate as a Dating Materia'.	G56	5	
		Discussion			5
1020		GENERAL DISCUSSION			10
1030		MORNING TEA		30 minutes	

WEDNESDAY, 25 OCTOBER 1972

SESSION H

REFERENCE STANDARDS

Time			Page in Proceedings	Presentation Time Minutes	Discussion Time Minutes
1100-1115	L. A. Currie	The Evaluation of Radiocarbon Measurements and Inherent Statistical Limitations in Age Resolution.	H1	15	
		Discussion			10
1125-1140	J. C. Lerman	Carbon-14 Dating: Origin and Correction of Isotope Fractionation Errors in Terrestrial Living Matter.	H16	15	
		Discussion			10
1150-1205	T. A. Rafter; H. S. Jansen; L. Lockerbie, and M. M. Trotter	New Zealand Radiocarbon Reference Standards.	H29	15	
		Discussion			10
1215-1225	H. A. Polach	Cross Checking of NBS Oxalic Acid and Secondary Laboratory Radiocarbon Dating Standard.	H92	10	
		Discussion			10
1235-1245	B. Bannister, and P. E. Damon	A Dendrochronologically-derived Primary Standard for Radiocarbon Dating.	H80	10	
		Discussion			10
1255		GENERAL DISCUSSION			10
1305		LUNCH		one hour	
1405-1425	H. A. Polach; H. A. Krueger; B. Bannister; P. E. Damon, and T. A. Rafter	Correlation of C14 Activity of NBS Oxalic with Arizona—1850 Wood and ANU-Sucrose Radiocarbon Dating Standards: A Preliminary Report of Investigations and Results.	H90	20	
		Discussion			20
1445		Business meeting: Correction Curve 14C Half-Life Co-ordination of Standards			
1530		AFTERNOON TEA			
1645		CLOSING CEREMONY			

Lab.	Sucrose vs. .95 Oxalic ^ ‰ dev.	Sucrose vs. Wood ‰ dev.	δC^{13} ox	δC^{13} wood	δC^{13} sucrose
		↓ not age corr.	-21	-22.6	-11

↓ normalized to C^{13} -19

Sugar ~ 160 act.

cellulose lipids resins

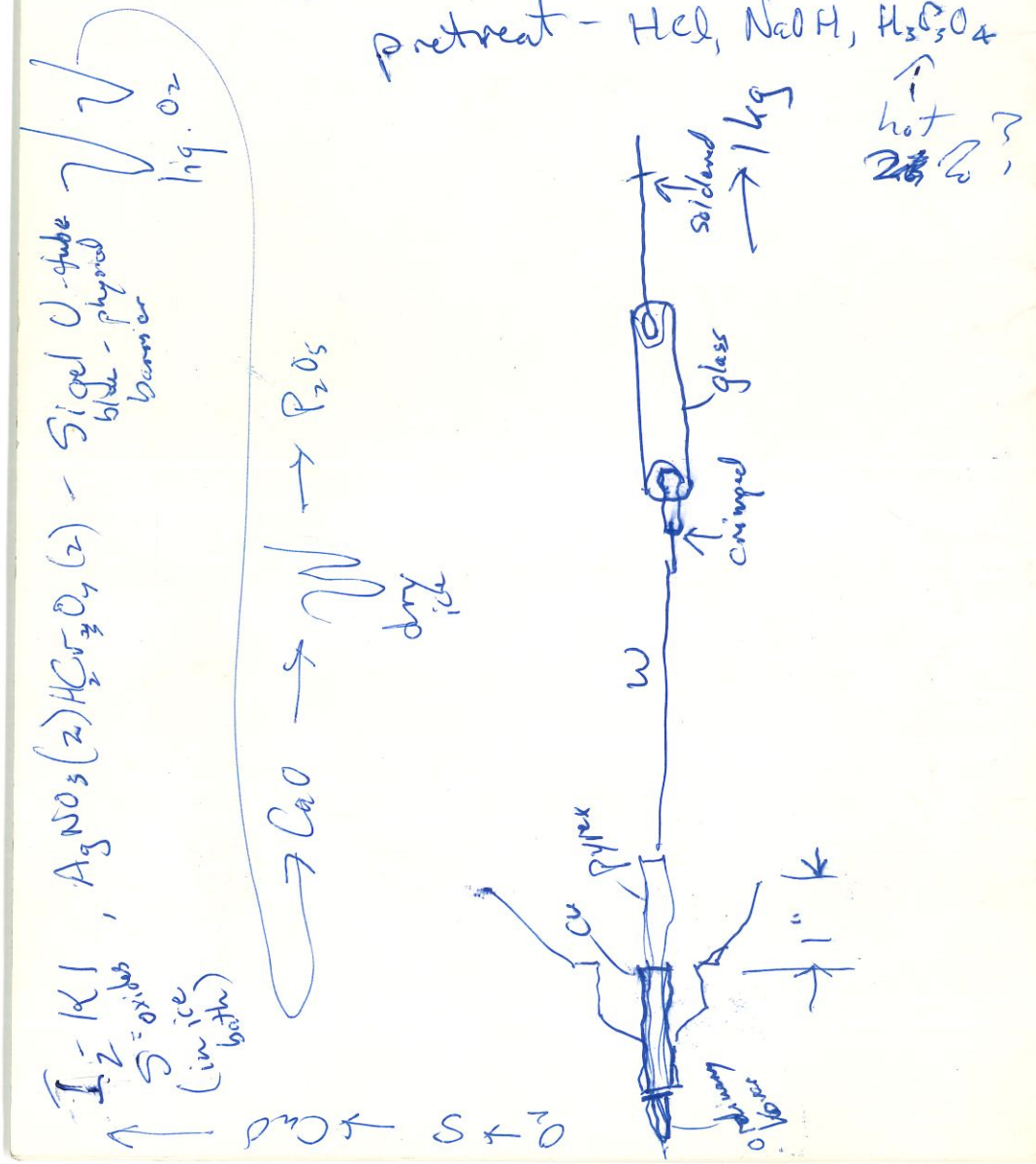
solvent C_6H_6 - solstak ext.

Deadline - modif

no. pp. same - Nov. 15

pretreat - HCl, NaOH, H_3PO_4

hot



REPRINTED FROM THE PROCEEDINGS OF THE
8TH INTERNATIONAL CONFERENCE ON RADIO CARBON DATING
WELLINGTON, NEW ZEALAND OCTOBER 1972

A CYCLIC SOLUTION FOR THE RELATIONSHIP BETWEEN MAGNETIC AND ATMOSPHERIC C-14 CHANGES

Elizabeth K. Ralph, University of Pennsylvania,
Philadelphia, Pennsylvania, U.S.A.

ABSTRACT

A cyclic, rather than exponential, solution to an equation proposed by Elsasser, Ney, and Winckler relating the effect of changes in the earth's magnetic field upon the rate of production of C-14 is presented. From the archaeometric data of Bucha and others the boundary conditions for the solution are found - in particular for the magnitude and duration of the measured magnetic cycle. The calculations show that for a period of 9000 years, the magnetic effect upon the atmospheric inventory of C-14 is of the order of 4% with a lag of about 250 years. As this is about half of the known changes in C-14 contents 7000 years ago, it is proposed that the changes in magnetic intensity are not the sole cause of changes in atmospheric C-14 contents, and that recent pole reversals might have contributed an effect upon the changes.

A Cyclic Solution for the Relationship Between Magnetic and Atmospheric C-14 Changes

by Elizabeth K. Ralph

University of Pennsylvania, Philadelphia, Pennsylvania, USA

From the C-14 dating of samples of tree-ring-dated sequoias and bristlecone pines, it is now known that there have been significant variations in the atmospheric inventory of C-14 (1, 3, 4). The measurements obtained at the University of Pennsylvania are shown in Fig. 1.

The rate of production of C-14, P(t) is proportional to the cosmic ray intensity which is influenced to some extent by the magnetic field of the earth. The relationship suggested by Elsasser, Ney, and Winckler (7) is:

$$P(t) = \frac{C_2}{\left[M(t)\right]^{0.52}} \qquad \text{where}$$

C_2 is a constant and M(t) is the magnetic dipole moment (dependent upon time, t). Since the experimental evidence now indicates that the changes were cyclic (at least for one cycle), let us try a cyclic solution rather than the exponential one proposed by Elsasser et al. If we take our boundary conditions from the magnetic data of Bucha (8) as shown in Fig. 2, and assume that these changes have been worldwide, a solution may be found as follows:

Let $P(t) = \frac{K}{\left[M(t)\right]^{\frac{1}{2}}}$ where

$$M(t) = 1 - A \sin\omega t$$

K is a constant and A is the amplitude of the cycle and is estimated to be $\frac{1}{2}$ from Bucha's archaeomagnetic data (9). When we take the square root of M(t) as shown in Fig. 3, we find that the average A becomes 0.26 or approximately $\frac{1}{4}$. We now have

$$P(t) = K\left(1 - \tfrac{1}{4}\sin\omega t\right)$$

If I is the amount of C-14, in the atmosphere, we then have the differential equation

$$\frac{dI}{dt} = -\lambda I + P(t) \qquad \text{where}$$

λ = decay constant of C-14

Neglecting the interchange of atmospheric C-14 with the biosphere and oceans, we assume that

$$I = \frac{C}{\lambda} + E\cos\omega t + F\sin\omega t + Ge^{-\lambda t}$$

We then have the derivative

$$\frac{dI}{dt} = - E\omega\sin\omega t + F\omega\cos\omega t - G\lambda e^{-\lambda t}$$

Then,

$$\frac{dI}{dt} + \lambda \; I = C + (E\lambda + F\omega)\cos\omega t + (F\lambda - E\omega)\sin\omega t$$

$$= K - \frac{K}{4}\sin\omega t$$

From this, we find that

$$C = K$$

$$F = - \frac{K\lambda}{4(\lambda^2 + \omega^2)}$$

$$E = \frac{K\omega}{4(\lambda^2 + \omega^2)}$$

and that the term $Ge^{-\lambda t}$, which represents the transient solution, has disappeared. Then,

$$I = K\left[\frac{1}{\lambda} + \frac{\omega}{4(\lambda^2 + \omega^2)}\cos\omega t - \frac{\lambda}{4(\lambda^2 + \omega^2)}\sin\omega t\right]$$

For this cycle with A = $\frac{1}{2}$ and a period of approximately 9000 years, we have

$$\omega = \frac{2\pi}{9000} = 0.70 \times 10^{-3}$$

and for the 5730 half-life,

$$\lambda = .693/5730 = 1.21 \times 10^{-4} \text{ per year.}$$

Then,

$$I = K\left[8300 + 343\cos\omega t - 59\sin\omega t\right]$$

At t = 9000 years, $\omega t = 6.3^{\circ}$ and

$$\cos\omega t = 0.994$$

$$\sin\omega t = 0.110$$

$$I = K\left[8300 + 334\right]$$

or I has changed by 4%.

To find the lag (t_L) in this effect, we have the ratio of the sine and cosine terms from the equation for I:

$$\frac{-59}{343} = -0.172 = \omega t_L$$

and $t_L = \frac{-0.172 \times 9000}{2\pi} = -246$ years.

Therefore, within a magnetic cycle of 9000 years' duration, the effect of changes in magnetic intensity upon C-14 contents will be periodic

(also, for that reason, within a period of 9000 years) with an amplitude of 334 years and a lag of 246 years. As yet we are not certain that C-14 contents are conforming to the cyclic pattern of the magnetic changes. This will not be known until the tree-ring chronology has been extended back in time another 3000 years and more archaeometric measurements are made covering the interval of 10,000 to 7,000 B. P.

The magnitude of the observed C-14 deviation at 7000 B. P. is now much greater - namely, 750 years or about 10%. If the assumptions made in these calculations are correct, one may state that changes in the magnetic intensity in past times are not the sole cause nor the dominant cause of changes in atmospheric C-14 contents. The magnetic effect may be diminished even more if it is found that the magnetic changes described by Bucha (10) are not worldwide. Even though similar results have been reported from France (11), the Soviet Union (12), Japan (13), Czechoslovakia (14), and the Americas (14), measurements made by Athavala (15) in India show only a 15 per cent negative change in magnetic intensity during the past 4000 years.

There are other uncertainties in regard to these calculations. As suggested by Lal and Venkatavaradan (16) one is that the ratios F_t/F_o given in Fig. 2 may not be truly equivalent to M_t/M_o (the dipole moments, past and present, respectively). The quantities measured, F_t and F_o (past and present) are based only on determinations of intensities. Since the field directions have not been measured, there may be possible corrections due to non-dipole components and dipole wobble.

There are suspicions (17, 18) also that pole reversals have occurred much more recently (within the past 30,000 years) than the known and accepted reversals that took place 700,000 years ago and earlier. If it is found that pole reversals have, in fact, occurred during the Holocene, I should like to suggest that these may have had an effect upon the atmospheric inventory of C-14.

Also, for the production of C-14, the effect of vertical cut-off rigidities as functions of geomagnetic latitudes has not been taken into consideration. These have been discussed by Lingenfelter and Ramaty (19) and others. However, since the mixing rate of the worldwide atmosphere is rapid - of the order of a few years (20), the neglect of the problem of rigidities may not be important.

REFERENCES

1) Suess, H. E., "Bristlecone Pine Calibration of the Radiocarbon Time Scale 5200 B. C. to the Present", pp. 303-311. (Reference 2)

2) Olsson, I. U. (Editor), Radiocarbon Variations and Absolute Chronology. Proceedings of the Twelfth Nobel Symposium, Uppsala, Sweden, August 11-15, 1969. (Almquist and Wiksell, Stockholm and Wiley Interscience Division, John Wiley and Sons, New York, 1970).

3) Damon, P. E., Long A., and Grey, D. C., "Arizona radiocarbon dates for dendrochronologically dated samples", pp. 616-618 (Reference 2).

4) Ralph, E. K. and Michael, H. N., "MASCA radiocarbon dates for sequoia and bristlecone-pine Samples", pp. 619-623 (Reference 2).

5) Ralph, E. K., Ch. 1, "Carbon-14 Dating", pp. 1-48. (Reference 6)

6) Michael, H. N. and Ralph, E. K. (Coeditors), Dating Techniques for the Archaeologist. (M. I. T. Press, Cambridge, Mass., 1971).

7) Elsasser, W., Ney, E. P., and Winckler, J. R., "Cosmic-Ray Intensity and Geomagnetism", Nature 178 (1956), pp. 1226-1227.

8) Bucha, V., ch. 3, "Archaeomagnetic Dating," p. 82 (Reference 6).

9) Bucha, p. 72 (Reference 8).

10) Bucha, (Reference 8), pp. 57-116.

11) Thellier, E. and Thellier, O., "Sur L'Intensité du Champ Magnétique Terrestre dans le Passé Historique at Geologique." Annales de Geophysique 15 (1959), pp. 285-376.

12) Burlatskaya, S. P., "The Ancient Magnetic Field of the Earth." Izvestiya AN SSSR, seriya geofyzikalnaya, No. 4 (1962), pp. 524-528.

13) Nagata, T. and Arai, Y., "Secular Variations of the Geomagnetic Total Force during the Last 5000 Years." Journal of Geophysical Research 68 (1963), pp. 5277-5281.

14) Bucha, V., "The Earth's Magnetic Field and C14", pp. 501-511 (Reference 2).

15) Athavale, R. N., "Intensity of the Geomagnetic Field in India over the Past 4,000 years." Nature 210 (1966), pp. 640-642.

16) Lal, D. and Venkatavaradan, "Analysis of the causes of C14 variations in the atmosphere," pp. 549-569 (Reference 2).

17) Bonhommet, N., "Paleomagnetism and Potassium Argon Age Determinations of Laschamp Geomagnetic Polarity Event." Earth and Planetary Science Letters 6, (1969), pp. 43-46.

18) McElhinny, M. W., "Notes on Progress in Geophysics, Palaeomagnetic Directions and Pole Positions - X." Geophysical Journal of the Royal Astronomical Society 19 (1969), pp. 305-327.

19) Lingenfelter, R. E. and Ramaty, R., "Astrophysical and geophysical variations in C14 productions," pp. 513-537 (Reference 2).

20) Libby, W. F., "Ruminations on radiocarbon dating," pp. 629-640 (Reference 2).

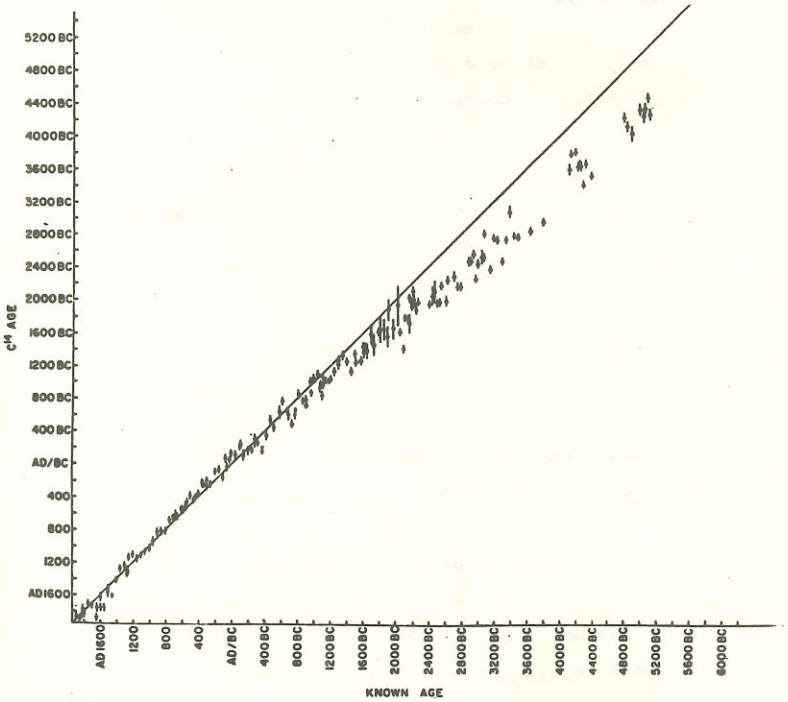


Fig. 1. Carbon-14 dates for all sequoia and bristlecone pine tree-ring samples processed by the Radiocarbon Laboratory at the University of Pennsylvania. Dates for sequoia samples are shown as solid dots. Bristlecone pine samples are represented by open symbols--triangles for those counted at the University of Pennsylvania, and circles for the ten samples counted by Isotopes, Inc. Carbon-14 dates have been calculated with the 5730 half-life and have been corrected for possible isotopic fractionation by means of C^{13}/C^{12} ratios. (See Reference 5 , p.26)

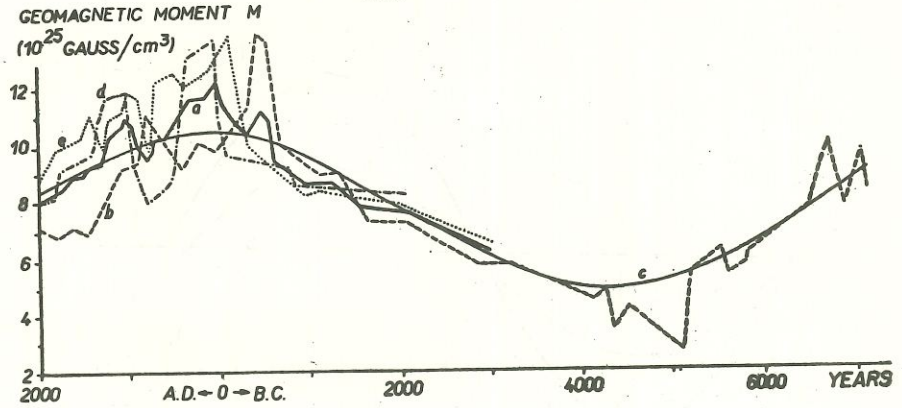


Fig. 2. Changes of the averaged reduced earth's magnetic moment (solid line a) determined from European (dashed line b), southwestern North American (dash-dotted line d), and Japanese (dotted line e) results. The smoothed curve c expresses the average. After Bucha (see Reference 6, p. 82).26).

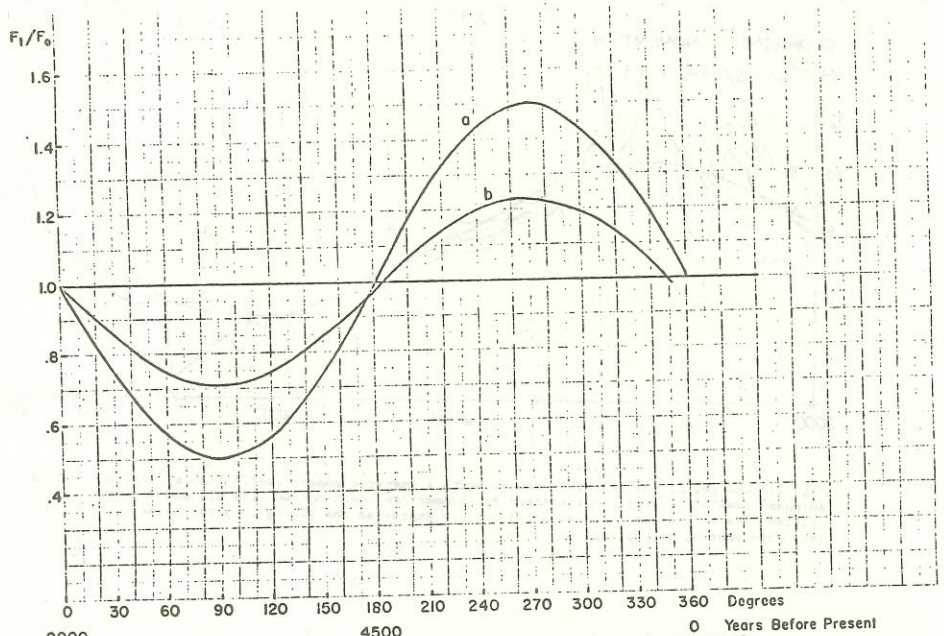


Fig. 3. F_t/F_o is the ratio of the change in magnetic intensities, past and present, respectively.
The values have been estimated from Bucha's Fig. 3.11, p. 72 (Reference 6).
Curve a = $1 - \frac{1}{2}\sin\omega t$ Curve b = $(1 - \frac{1}{2}\sin\omega t)^{\frac{1}{2}}$

November 14, 1972

Mr. G.K. Nevill, Executive Officer
The Royal Society of New Zealand
6 Halswell Street, P.O. Box 12249
Wellington, New Zealand

Dear Mr. Nevill,

Thank you for your recent notice in regard to the conference publications, and thank you even more for the excellent conference that you and your colleagues held. We have never attended one that was better organized, nor with so many enjoyable "after-hour" festivities, nor held in such a beautiful country.

In regard to reprints, we should like to order the following:

200 copies Michael and Ralph,
"Discussion of Radiocarbon Dates Obtained from Precisely Dated Sequoia and Bristle-cone Pine Samples"

50 copies Ralph,
"A Cyclic Solution for the Relationship Between Magnetic and Atmospheric Carbon-14 Changes".

With gratitude, we are sincerely yours,

Elizabeth K. Ralph Henry N. Michael

November 10, 1972

Mr. T.L. Grant-Taylor
N.Z. Geological Survey
P.O. Box 30368
Lower Hutt
New Zealand

Dear Mr. Grant-Taylor:

In regard to my conference paper, I forgot to correct the missing brackets (page 2 of the enclosure in red pencil). If I am too late to do so, it is not very important.

Two people commented that the effect that I had calculated should be doubled. I have consulted several physicists here and they do not agree that it should be doubled. The main reason is that the calculations are based upon the magnetic changes (not the C^{14} plots) with a period of approximately 9000 years. Therefore, I prefer to leave the paper as it is if that is all right with you.

I continue to think of the great conference that you, Dr. Nevill, and Dr. Rafter organized and how much we all appreciated it as well as being in your beautiful country. My thanks to all.

Sincerely yours,

Elizabeth K. Ralph

EKR/rdh

A Cyclic Solution for the Relationship Between Magnetic and Atmospheric C-14 Changes

by Elizabeth K. Ralph

University of Pennsylvania, Philadelphia, Pennsylvania, USA

~~5/31/72~~ 11/9/72

ABSTRACT

A cyclic, rather than exponential, solution to an equation proposed by Elsasser, Ney, and Winckler relating the effect of changes in the earth's magnetic field upon the rate of production of C-14 is presented. From the archaeometric data of Bucha and others the boundary conditions for the solution are found - in particular for the magnitude and duration of the measured magnetic cycle. The calculations show that for a period of 9000 years, the magnetic effect upon the atmospheric inventory of C-14 is of the order of 4% with a lag of about 250 years. As this is about half of the known changes in C-14 contents 7000 years ago, it is proposed that the changes in magnetic intensity are not the sole cause of changes in atmospheric C-14 contents, and that recent pole reversals ~~may~~ might have contributed an effect upon the changes.

$$\frac{dI}{dt} = - E\omega \sin\omega t + F\omega \cos\omega t - G\lambda e^{-\lambda t}$$

Then,

$$\frac{dI}{dt} + \lambda \ I = C + (E\lambda + F\omega) \cos\omega t + (F\lambda - E\omega) \sin\omega t$$

$$= K - \frac{K}{4} \sin\omega t$$

From this, we find that

$$C = K$$

$$F = - \frac{K\lambda}{4(\lambda^2 + \omega^2)}$$

$$E = \frac{K\omega}{4(\lambda^2 + \omega^2)}$$

and that the term $Ge^{-\lambda t}$, which represents the transient solution, has disappeared. Then,

$$I = K\left[\frac{1}{\lambda} + \frac{\omega}{4(\lambda^2 + \omega^2)} \cos\omega t - \frac{\lambda}{4(\lambda^2 + \omega^2)} \sin\omega t\right]$$

For this cycle with A = $\frac{1}{2}$ and a period of approximately 9000 years, we have

$$\omega = \frac{2\pi}{9000} = 0.70 \times 10^{-3}$$

and for the 5730 half-life,

$$\lambda = .693/5730 = 1.21 \times 10^{-4} \text{ per year.}$$

Then,

$$I = K\left[\ 8300 + 343 \cos\omega t - 59 \sin\omega t\right]$$

At t = 9000 years, $\omega t = 6.3^{o}$ and

$$\cos\omega t = 0.994$$

$$\sin\omega t = 0.110$$

$$I = K\left[\ 8300 + 334\ \right]$$

or I has changed by 4%.

To find the lag (t_L) in this effect, we have the ratio of the sine and cosine terms from the equation for I:

$$\frac{-59}{343} = -0.172 = \omega t_L$$

and $t_L = \frac{-0.172 \times 9000}{2\pi} = -246$ years.

Therefore, within a magnetic cycle of 9000 years' duration, the effect of changes in magnetic intensity upon C-14 contents will be periodic

SOCIETY OF EXPLORATION *Geophysicists*

March 1, 1973

Call for Papers

Geophysics and Archeology Section
43rd Annual Meeting of the
Society of Exploration Geophysicists
October 21-25, 1973, Mexico City

Dear Colleague:

You are well aware, I am sure, of the application of geophysics to archeological exploration and age dating. It may surprise you to know, however, that most geophysicists are probably not aware of the considerable work done in this field--the successes, variety of techniques, and world-wide applications. Therefore, this year at the forthcoming meeting of the Society of Exploration Geophysicists in Mexico City, there will be, for the first time ever, a special session on the application of geophysics to archeology. It promises to be of great interest to all geophysicists in attendance, whatever their activities or background.

As Chairman of this session, I am soliciting your participation in the program and ask that you submit an abstract of 200 words or less on a subject of general interest in this field. The subjects might include but are not limited to: geophysical techniques for archeological prospecting such as magnetics, electromagnetics, seismic, gravity, remote sensing, or geochemical methods; various methods for age dating including radioactive decay, thermoluminescence, archeomagnetism; or computer techniques for reduction, simulating or plotting or such geophysical-archaeological data; or marine exploration of archeological sites using sonar, seismic, or magnetics. Papers are to be 20 minutes long with 10 minutes for questions (total of 30 minutes - this schedule to be strictly adhered to). There will be time for only 6 papers in this session. Facilities include dual screens, 35 mm and lantern slide projectors, and overhead projectors.

Inasmuch as this is the first session of its kind, we would like to make it an outstanding one--one which will attract interest, enthusiam perhaps even technical advice and support of some of the geophysicists in attendance. The papers will be selected by the technical program committee on the basis of their merit, general interest to practicing geophysicists and according to the mix of disciplines represented.

I thank you in advance for your interest in participating in the program. Being a member of the SEG or even a practicing geophysicist is not a requirement for attendance at the session or for presentation of papers. I look forward to hearing from you.

Sincerely,

Sheldon Breiner
Chairman, Session on Geophysics and
Archeology

SB:jg

TAKESI NAGATA CONFERENCE 1974

MAGNETIC FIELDS PAST AND PRESENT

Sunday, June 2

19:00-22:00
Reception and Registration, University Club.

Monday, June 3

8:15-9:00
Registration at Auditorium Entrance, Graduate School of Public Health.

9:00
Introduction

9:15
LEVY, E., GENERATION OF MAGNETIC FIELDS IN THE COSMOS

10:00
Discussion

10:15
Coffee

10:30
DUNLOP, D., ROCK MAGNETISM - BASIS OF THE PALEOMAGNETIC RECORD

11:15
Discussion and Contributed Papers. Kent, D. Rock Magnetism of Ocean Sediments. Wu, Y., Micro-analysis of NRM of an Intrusive Rock. Griscom, D., Magnetites with Positive Anisotropy. Schmidt, V., TRM.

12:00
LUNCH

13:30
CAIN, J., PRESENT FIELD OF THE EARTH AND ITS SECULAR VARIATION.

14:00
Discussion and Contributed Papers. Alldredge, L. R., Secular Change from External Sources. Roederer, J., Secular Invariant Internal Field Phase Relationships in the Tilted Central Dipole Reference Frame. Peddie, N., Secular Variation. DuBois, R., Archeomagnetism.

14:30
COX, A., PALEOMAGNETIC RECORD OF THE EARTH'S MAGNETIC FIELD.

15:00
Discussion and Contributed Papers. Harrison, C., Reversals and Palaeontological Extinctions. Ralph, E., Reversals and C^{14}. Anderson, J., Photochemistry of Ozone and Reversals.

15:30
Coffee

15:45
Opdyke, N., Magnetism of Ocean Sediments. Watkins, N., Excursion in Deep Sea Sediment Core. Kukla, G., Stratigraphy of Magnetic Horizons. Darby, D., Arctic Ocean Paleomagnetic Stratigraphy. Tatsch, J. H., Reversals in Accordance with a Teconosphere Earth Model.

16:15
RIKITAKE, T., MODELS OF THE EARTH'S MAGNETIC FIELD GENERATION.

16:45
Discussion and Contributed Papers. Malkus, W., Magnetohydrodynamic Theory.

18:00
COCKTAILS AND BANQUET

Tuesday, June 4

8:30
ZIETZ, I., MAGNETISM OF CONTINENTAL CRUST.

9:00
JOHNSTON, M., SEARCH FOR SEISMOMAGNETIC EFFECTS.

9:30
Discussion and Contributed Papers. Williams, R. H., In Situ Rock Susceptibility. Kean, W., Stress Dependence of Weak Field Susceptibility.

10:00
Coffee

10:15
ATWATER, T., MAGNETICS OF THE SEA FLOOR AND PLATE TECTONICS.

10:45
MUDIE, J., DEEP TOW RESULTS AND THE REVERSAL TIME SCALE.

11:05
Disscussion and Contributed Papers. Taylor, P., Deep Tow Magnetics Across a Quiet Zone.

11:15
IRVING, E., LONG TERM VARIATIONS IN THE FIELD AND TECTONICS.

11:45
Discussion and Contributed Papers. Peterson, D. N., Paleomagnetic Results from Early Paleozoic Rocks. Rudman, A. J., Some Applications of Paleomagnetic Measurements.

12:00
LUNCH

13:15
SONNETT, C., MAGNETIC FIELDS IN THE SOLAR SYSTEM.

13:45
Discussion and Contributed Papers. Campbell, W., Spectral Behavior of Magnetic Fields During Substorm. Zmuda, A., Field Aligned Currents in the Ionosphere-Magnetosphere Coupled System. Polk, C., Schumann Earth - Ionosphere Cavity Resonances.

14:15
RUNCORN, S. K., MAGNETISM OF THE MOON.

14:45
Discussion and Contributed Papers. Martin, F., The Proposed 1979 Lunar Polar Orbiter.

14:50
WASILEWSKI, P., MAGNETISM OF METEORITES.

15:05
Discussion and Contributed Papers. Rowe, M., Magnetism of Meteorites. Remo, J., Magnetism of Meteorites. deGasparis, A., Magnetism of Tektites.

15:30
Coffee

15:45
TAKESI NAGATA, GEOMAGNETISM — 1838 - 1974

16:15
CLOSING REMARKS

16:30
APRÈS SCIENCE, FACULTY CLUB.

RATIONALE FOR CONFERENCE

The primary reason for this conference is to honor Professor Nagata on the occasion of his retirement from the faculty of the University of Tokyo. For more than ten years, he has come to the University of Pittsburgh and carried out research in rock magnetism. Since Apollo 11 this work has been predominantly in lunar magnetism. His presence in our laboratory has been an enormous asset to our own research effort. This conference is an expression of our gratitude for his help.

In view of the remarkable developments in the field of solid earth geomagnetism and planetary magnetism in the past few years, it seems an appropriate time to review some of these advances. The conference will focus on areas in which Professor Nagata has worked.

PROCEEDINGS

If you wish to receive a copy of the complete proceedings of the conference, please place your order at the registration desk.

SPONSORS

The sponsorship of the following organizations is gratefully acknowledged:

National Science Foundation
National Aeronautics and Space Administration
United States Steel Corporation
Gulf Research and Development Co.
Superconducting Technology, Inc.

TAKESI NAGATA CONFERENCE

MAGNETIC FIELDS PAST AND PRESENT

JUNE 3 & 4, 1974

Department of
Earth and Planetary Sciences
University of Pittsburgh

Cosponsored by the
Lunar Science Institute
Houston, Texas

Takesi Nagata Conf. June 3-4, 1974

Radiocarbon Variations and their Causes

by

Elizabeth K. Ralph
Department of Physics
University of Pennsylvania
Philadelphia, Pa. 19174

More than 600 C^{14} dates of tree-ring-dated sequoias and bristlecone pines have been obtained by the laboratories of the Universities of Arizona [Damon et al., 1970], California, San Diego at La Jolla [Suess, 1970] and Pennsylvania [Ralph and Michael, 1970 and Michael and Ralph, 1974]. Almost all of the samples have been dendro-dated at the Laboratory of Tree-Ring Research, University of Arizona by Ferguson [1970].

The results of the C^{14} dates versus dendro-dates are presented in Figs. 1-8. In Fig. 1, we have plotted the individual dates for each sample. As one can see, there is a general trend of deviations from true ages for C^{14} dates in the B.C. millennia. However, there is also a large scatter which appears to be outside of statistical expectations. In order to reduce this scatter and to see the true trends of oscillations, we tried a number of averaging techniques. In Figs. 2 to 8, the dashed curve represents a third-order polynomial which is the best fit of all of the C^{14} dates on the average. However, in this curve the shorter-term oscillations are eliminated. Therefore, we turned to 9-cell regression averaging to produce the curve represented by the dots in Figs. 2 to 8. Each dot represents the average of 9 samples centered at the median dendro-date of the 9 samples.

As one can see in the figures presented here, there is no doubt that the long-term trend of deviations with a period of approximately 9000 years and a maximum amplitude (centered about 4500 B.C.) of 10 percent is real.

It is most likely that part of the cause of this deviation is due to changes in the intensity of the Earth's magnetic field - probably in the Earth's dipole moment. Archaeomagnetic measurements of fired clays by Bucha and others (1971) as shown in Fig. 9 reveal that the trend is similar to that of the C^{14} contents and in the right direction to have caused this effect. However, if my calculations are correct, a sinusoidal solution for the equations proposed by Elsasser, Ney and Winckler (1956) indicates that the magnetic changes account for only half of the magnitude of the long-term C^{14} deviation.

My thoughts are that these long-term magnetic and the resultant changes in the atmospheric inventory of C^{14} may have been caused by a previous "recent" pole reversal such as that reported by Barbetti and McElhinny (1972) at 30,000 B.P. and another described by them at about 13,000 B.P. It is estimated that in the course of a reversal, with a duration of possibly 3 to 4 x 10^3 years (Cox, 1972), that the magnetic intensity would be at a minimum and consequently, the C^{14} inventory might be increased two-fold. Therefore, a pole reversal may be the basic cause of these changes. On the other hand, climatic changes, possibly as secondary effects may have contributed to the C^{14} deviations.

As for the shorter-term oscillations which seem to be real and significant in Figs. 3 to 8, many theories for their causes have been proposed. Efforts have been made to correlate them with sunspots, with "little ice ages", with changes in the Earth's non-dipole moment, with interplanetary magnetic fields, with explosions of supernovae, and so forth.

Hopefully, as the tree-ring chronology is extended another 3 to 4 millennia, some of these questions will be answered.

ACKNOWLEDGEMENTS

With gratitude I acknowledge the financial support of the National Science Foundation since the inception of the "known age" program in 1957. It has been supported through the Division of Earth Sciences by grants G-3281, G-5608, G-14094, GP-405, GP-3778, GA-993 and GA-12,572.

I wish also to express my appreciation to Dean William E. Stephens for his help in deriving the relationship between magnetic and C^{14} changes and for his generous advice and guidance for many years.

FIGURE CAPTIONS

Fig. 1. Individual C^{14} dates for dendro-dated sequoias and bristlecone pines obtained by three laboratories. C^{14} dates are calculated with the 5730 half-life.

Fig. 2 Composite plot of 9-sample regression averages of C^{14} versus dendro-dates. C^{14} dates are calculated with the 5730 half-life. The solid 45^{o} line represents 1:1 correspondence. The dashed line is the best fit for a third polynomial for the average of all C^{14} dates.

Figs. 3-8 One of the six detailed sections of Fig. 2.

Fig. 9 Changes of the averaged reduced earth's magnetic moment (solid line a) determined from European (dashed line b), southwestern North American (dash-dotted line d), and Japanese (dotted line e) results. The smoothed curve c expresses the average.

References

Barbetti, M. and M. McElhinny, Evidence of a Geomagnetic Excursion 30,000 yr. BP, Nature, 239, 327, 1972.

Bucha, V., Archaeomagnetic Dating. In Michael, H. N. and Ralph, E. K. (Coeditors), Dating Techniques for the Archaeologist, The M.I.T. Press, Cambridge, Massachusetts, and London, England, p. 82, 1971.

Cox, Allan, Geomagnetic Reversals: Characteristic Time Constants and Stochastic Processes. EOS, 53, no. 5, 613, 1972.

Damon, P. E., A. Long, and D. C. Grey, Arizona Radiocarbon Dates for dendrochronologically dated samples. In Olsson, I. U. (Editor), Radiocarbon Variation and Absolute Chronology. Proceedings of the Twelfth Nobel Symposium, Uppsala, Sweden, August 11-15, 1969. Almquist and Wiksell, Stockholm and Wiley Interscience Division, John Wiley and Sons, New York, 615, 1970.

Elsasser, W., E. P. Ney, and J. R. Winckler, Cosmic-Ray Intensity and Geomagnetism, Nature, 178, 1226, 1956.

Ferguson, C. W., Dendrochronology of bristlecone pine, Pinus aristata. In Olsson, I. U. (Editor), Radiocarbon Variations and Absolute Chronology. Proceedings of the Twelfth Nobel Symposium, Uppsala, Sweden, August 11-15, 1969. Almquist and Wiksell, Stockholm and Wiley Interscience Division, John Wiley and Sons, New York, 237, 1970.

Michael, H. N. and E. K. Ralph, University of Pennsylvania Radiocarbon Dates XVI, Radiocarbon, 16, 198, 1974.

Ralph, E. K. and H. N. Michael, MASCA radiocarbon dates for sequoias and bristlecone-pine samples. In Olsson, I. U. (Editor), Radiocarbon Variations and Absolute Chronology. Proceedings of the Twelfth Nobel Symposium,

Uppsala, Sweden, August 11-15, 1969. Almquist and Wiksell, Stockholm and Wiley Interscience Division, John Wiley and Sons, New York, 619, 1970.

Suess, H. E., Bristlecone pine calibration of the radiocarbon time-scale 5200 B.C. to the present. In Olsson, I. U. (Editor), Radiocarbon Variations and Absolute Chronology. Proceedings of the Twelfth Nobel Symposium, Uppsala, Sweden, August 11-15, 1969. Almquist and Wiksell, Stockholm and Wiley Interscience Division, John Wiley and Sons, New York, 303 and Plate I, 1970.

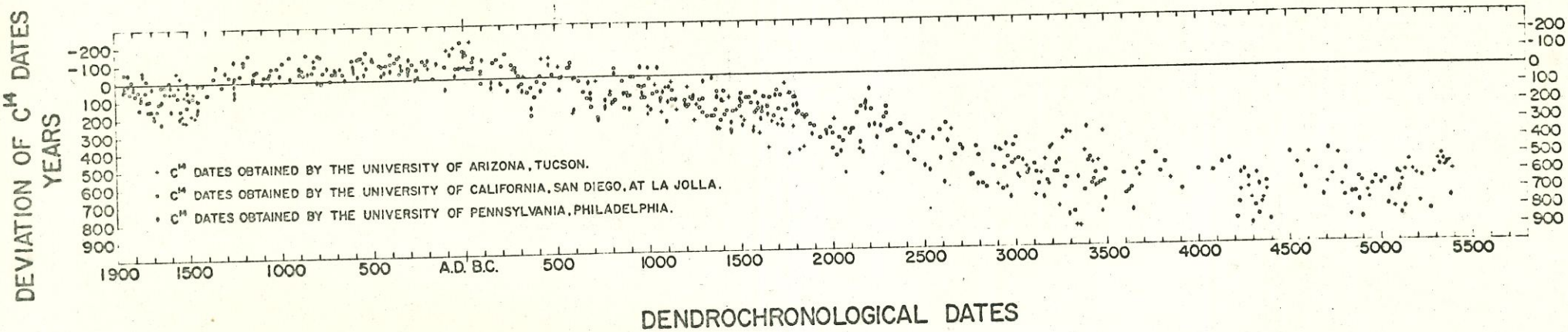


FIGURE 1

Individual C^{14} dates for dendro-dated sequoias and bristlecone pines obtained by three laboratories. C^{14} dates are calculated with the 5730 half-life.

Composite plot of 9-sample regression averages of C^{14} versus dendro-dates. C^{14} dates are calculated with the 5730 half-life. The solid 45° line represents 1:1 correspondence. The dashed line is the best fit for a third polynomial for the average of all C^{14} dates.

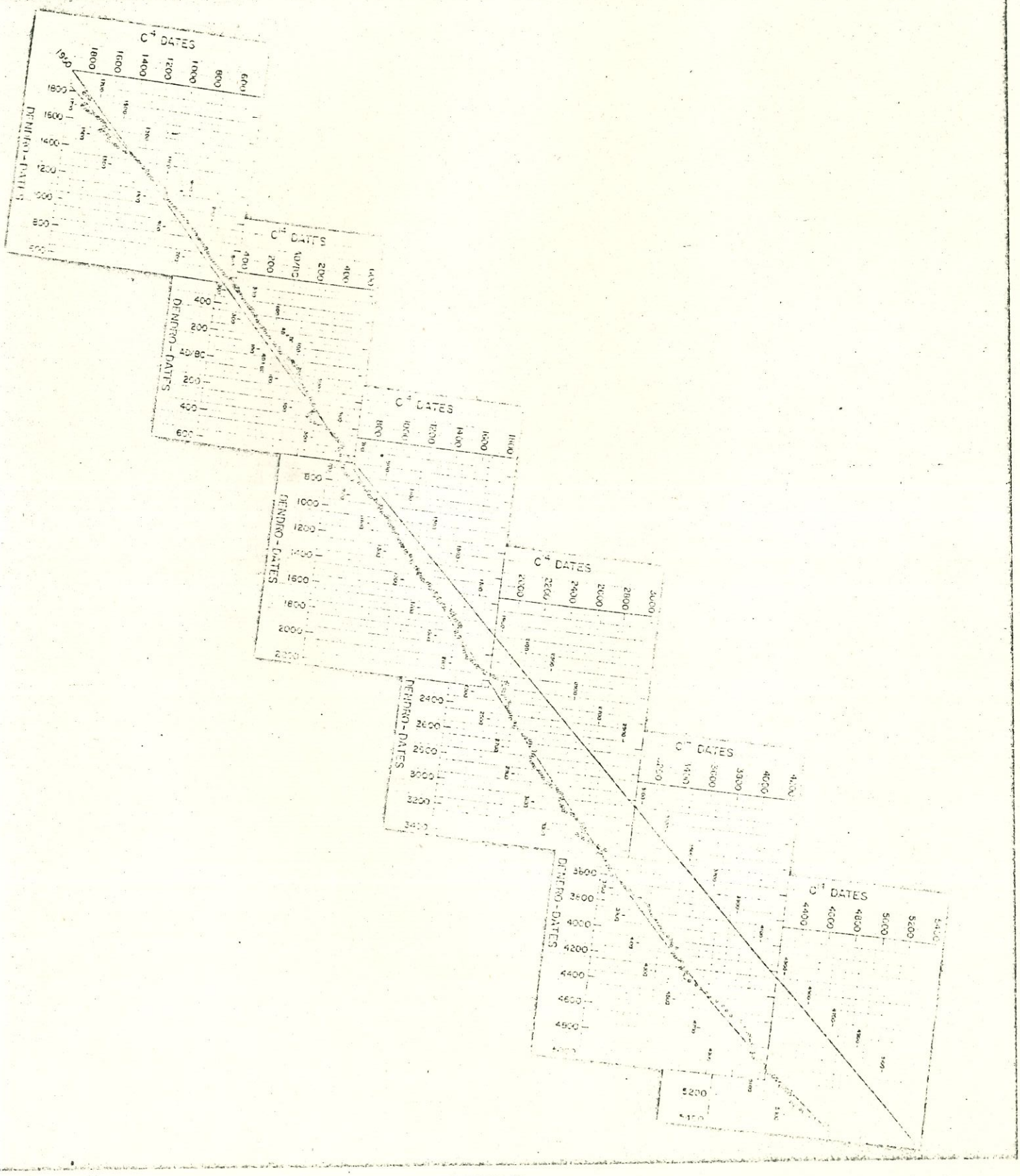


FIGURE 2

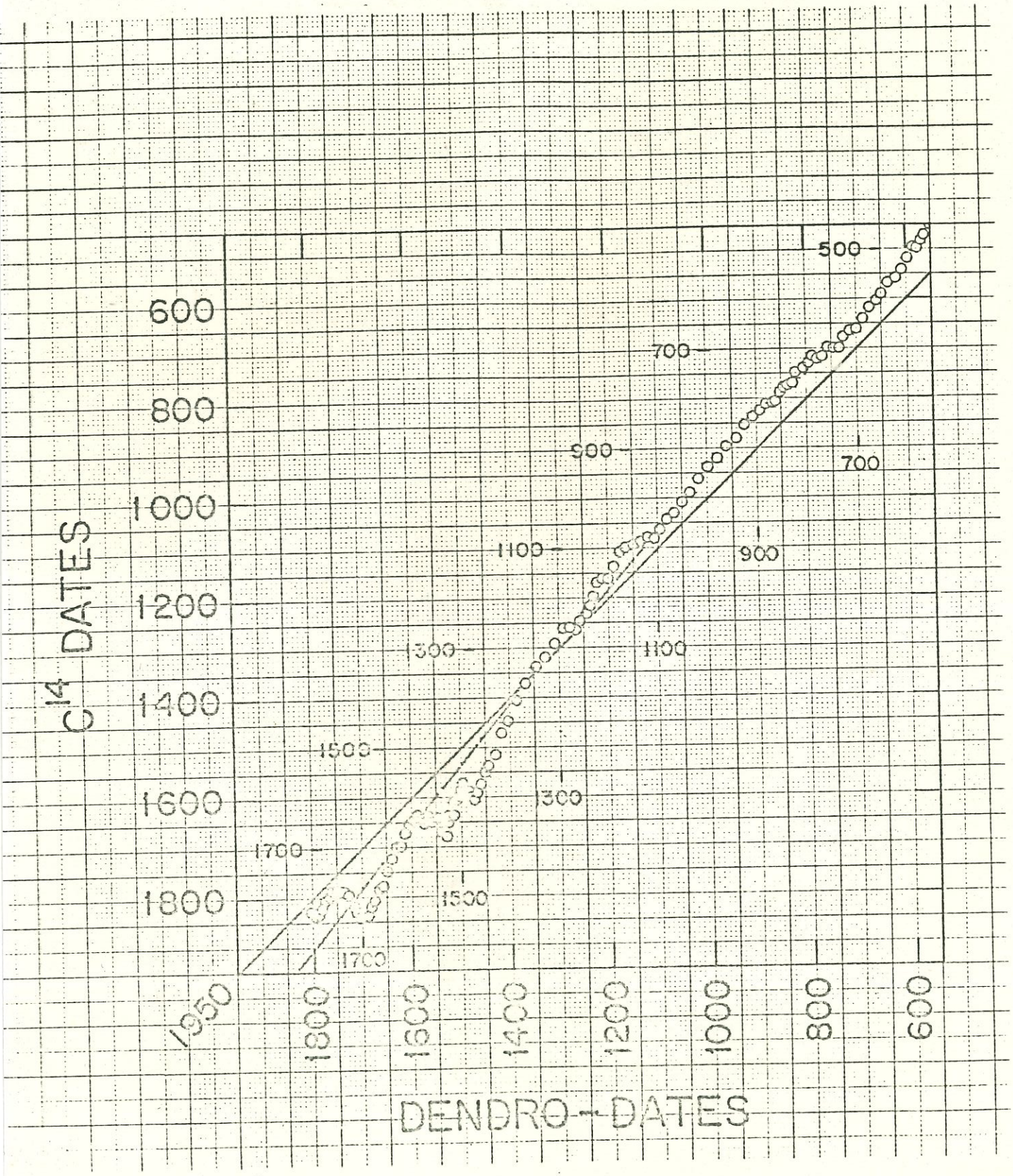


FIGURE 3

One of the six detailed sections of Fig. 2

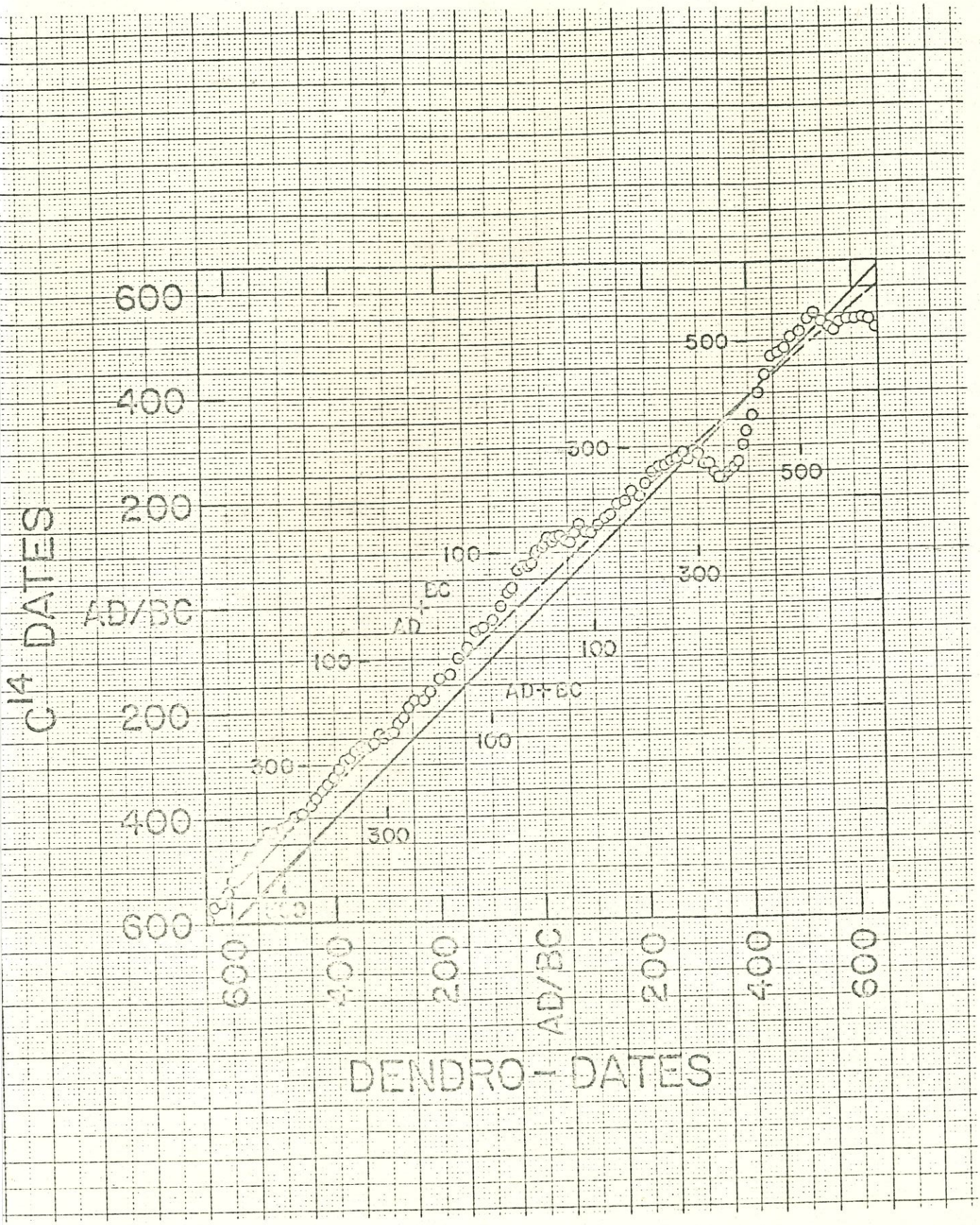


FIGURE 4

One of the six detailed sections of Fig. 2

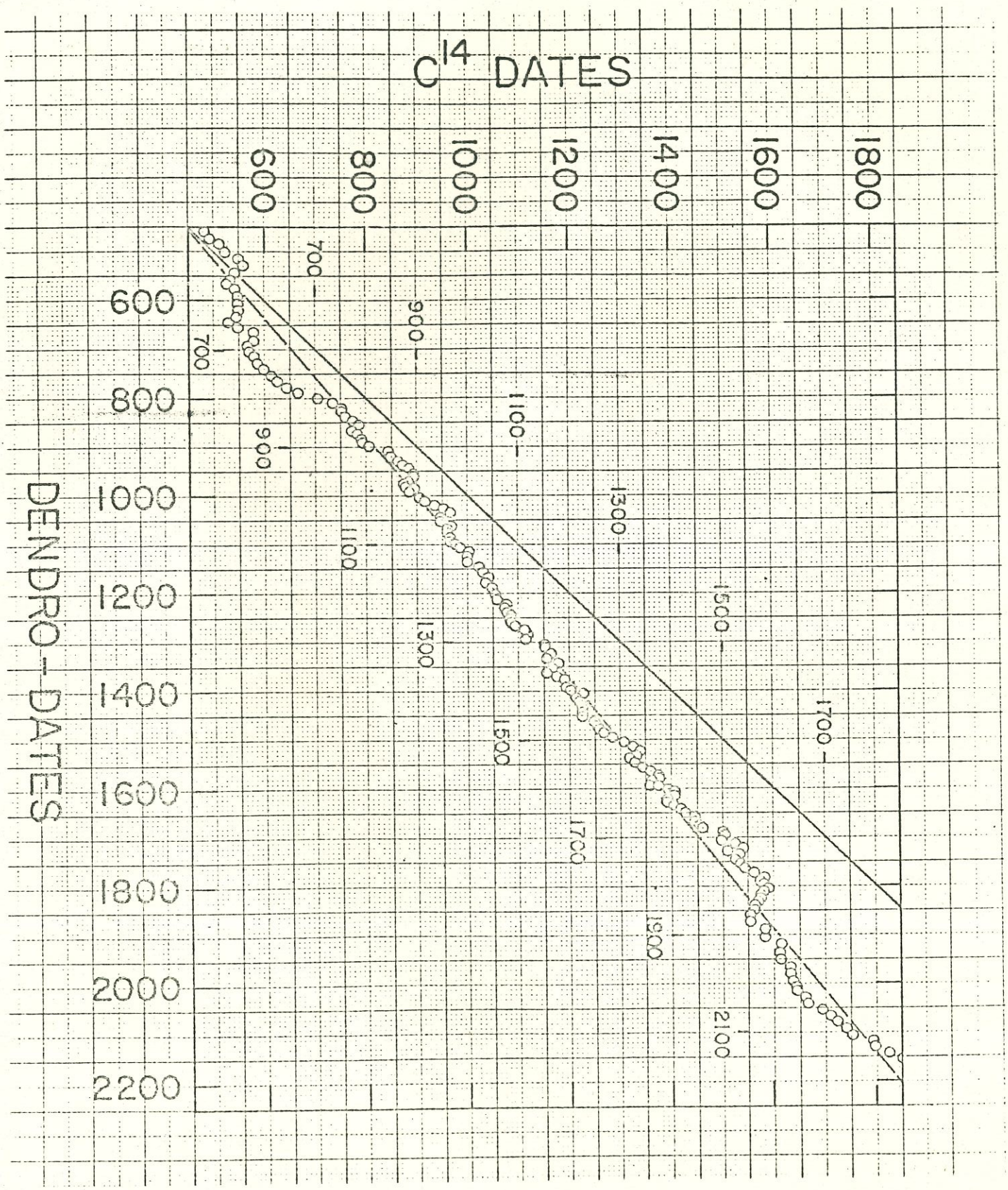


FIGURE 5
One of the six detailed section of Fig. 2.

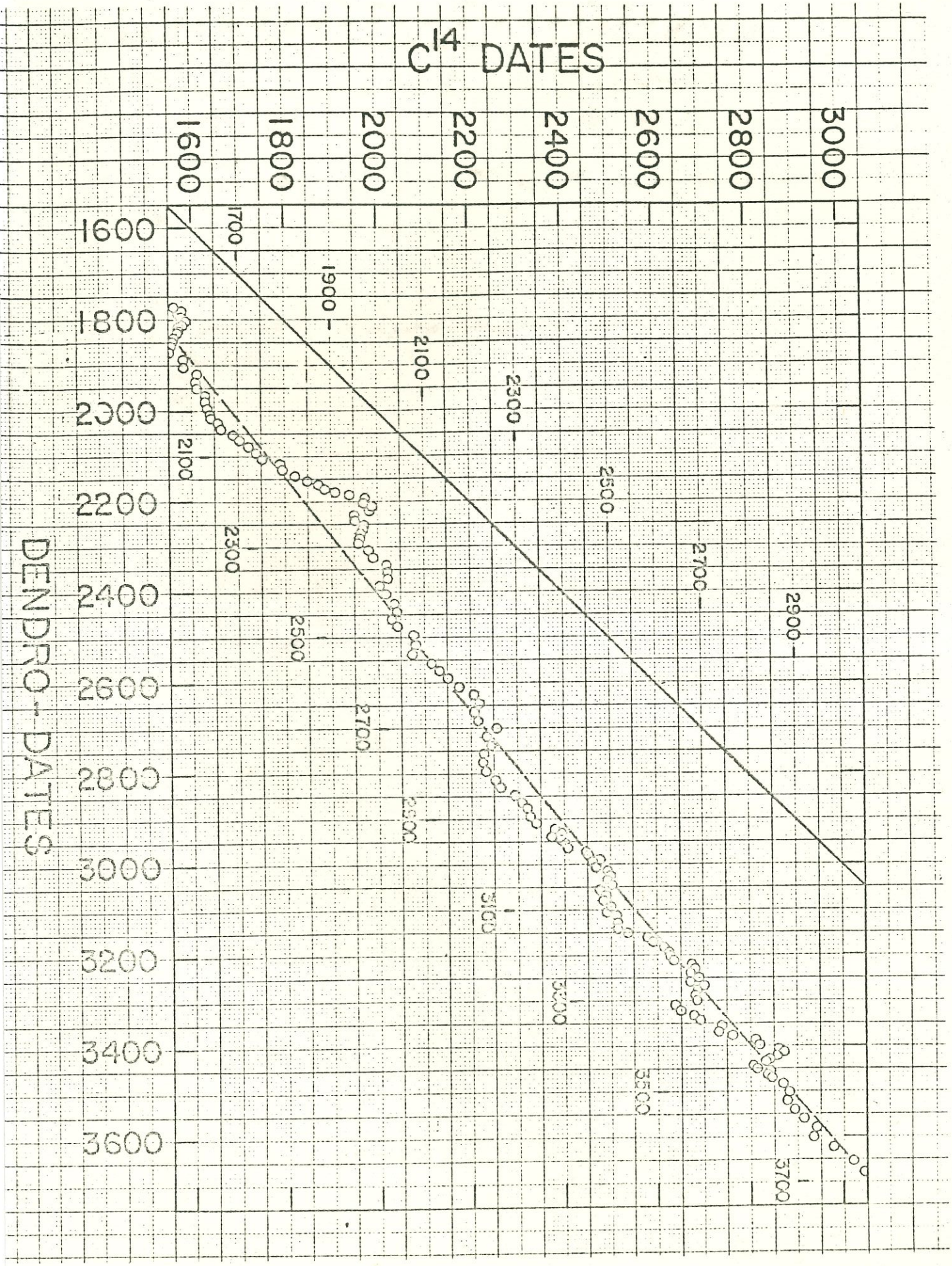


FIGURE 6
One of the six detailed sections of Fig. 2.

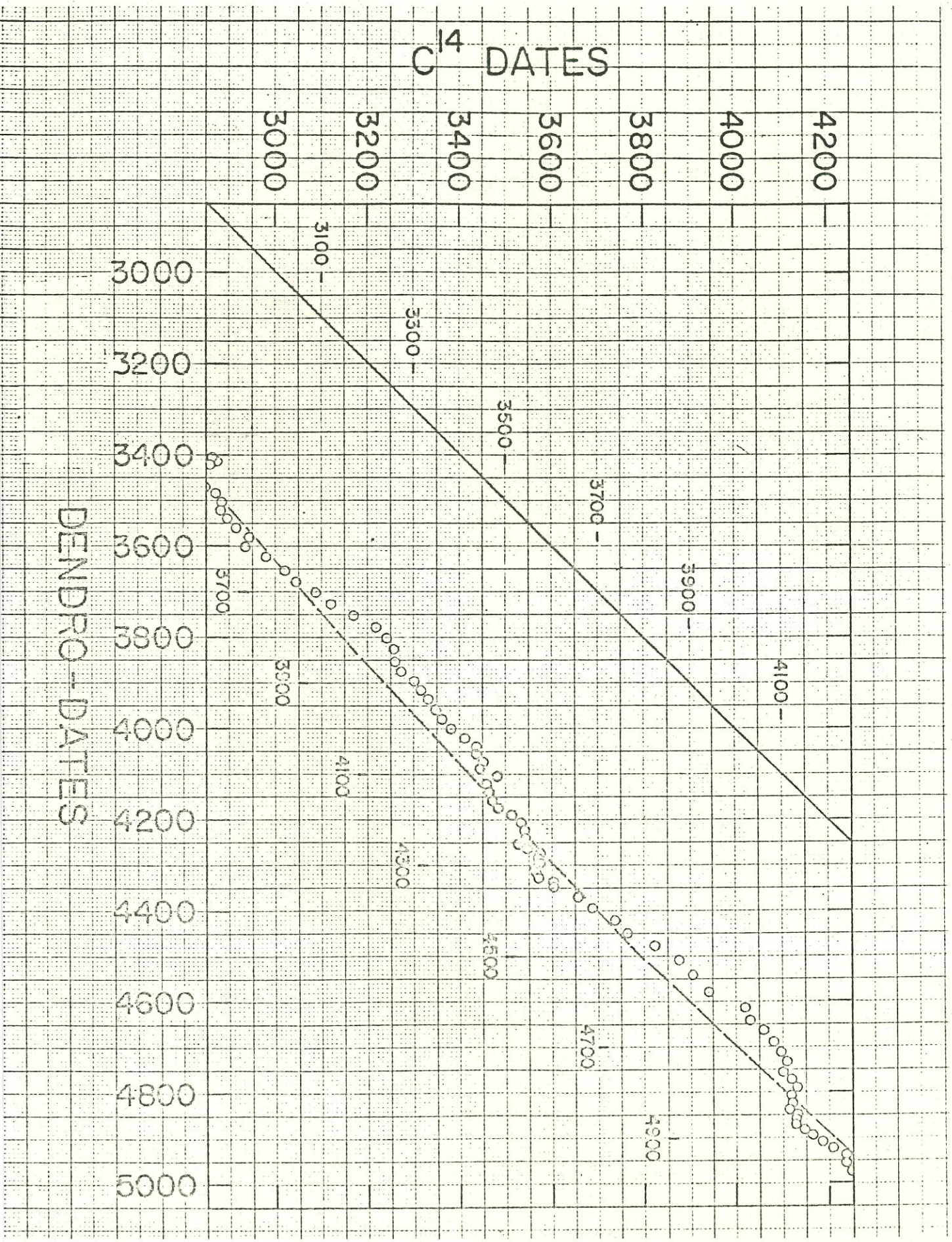


FIGURE 7
One of the six detailed section of Fig. 2

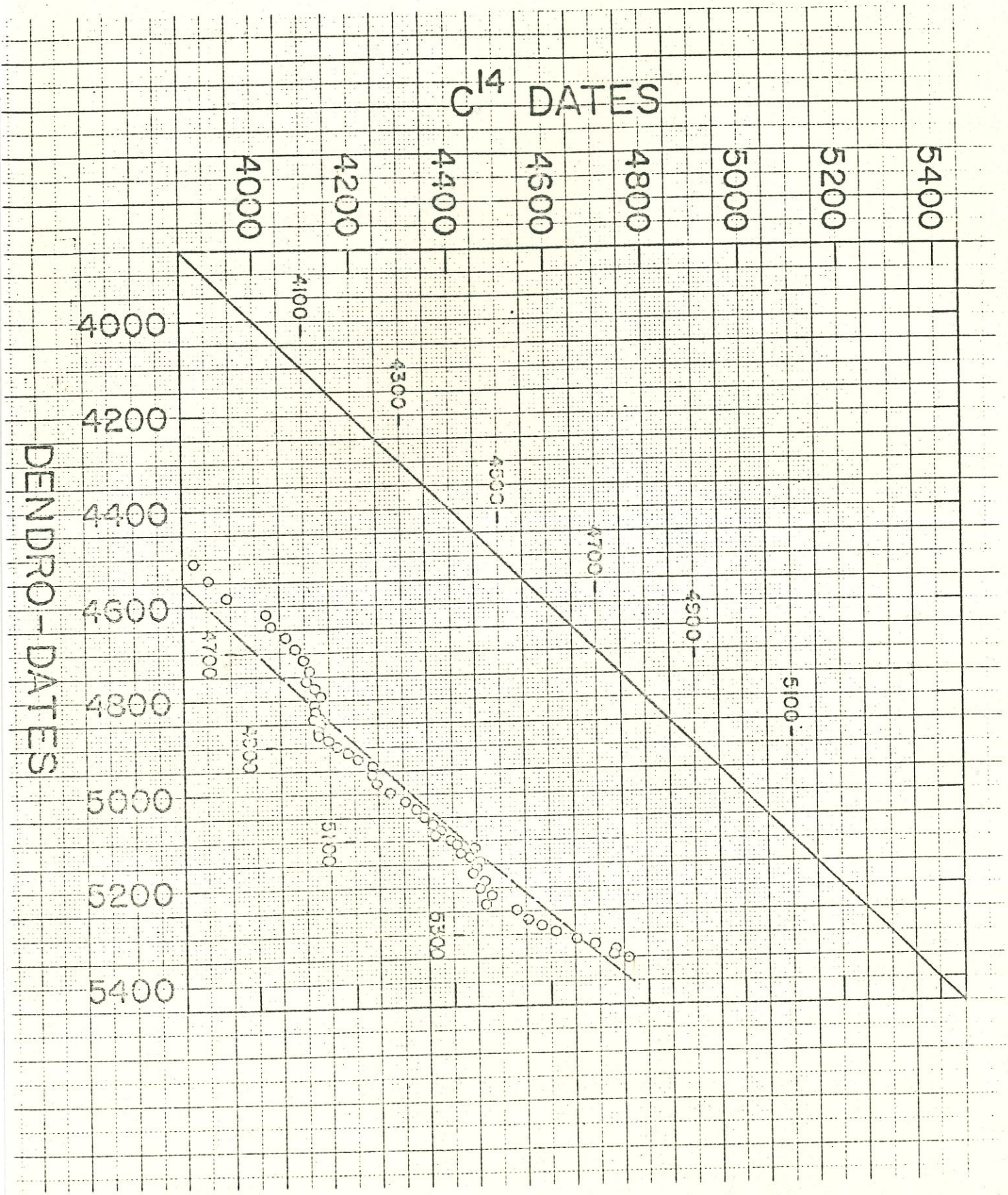


FIGURE 8
One of the six detailed sections of Fig. 2

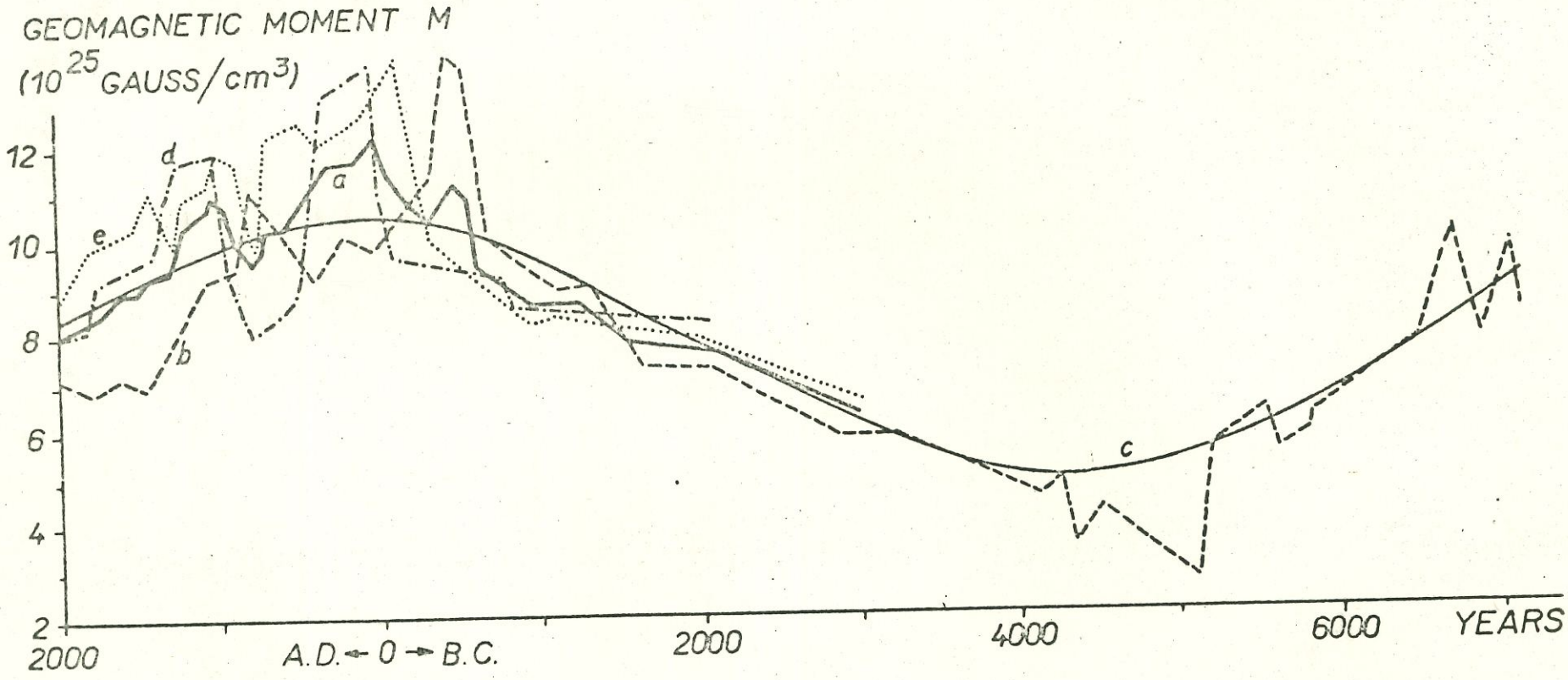


FIGURE 9

Changes of the averaged reduced earth's magnetic moment (solid line a) determined from European (dashed line b), southwestern North American (dash-dotted line d), and Japanese (dotted line e) results. The smoothed curve c expresses the average.