

# memorandum

DATE: MAR 22 1987

REPLY TO  
ATTN OF: RW-40

SUBJECT: Report on Foreign Travel to Sweden

TO: Distribution

On January 12, through 16, 1988, the traveler met with officials of the Swedish SKB, SKN and SKI. The traveler was accompanied by Mr. Paul Gnirk of RE/SPEC, Inc., and Dr. Lee Merkhoffer, of applied Decision Analysis Corporation.

The principal purpose of the trip was to respond to a Swedish government request to present to them a description of the U.S. multi-attribute decision analysis used to support the Department's decision on which sites to recommend for characterization as potential host sites for a high-level radioactive waste repository. A further description of this presentation is contained in the attached trip report of Mr. Gnirk. The presentations were attended by representatives of SKB, SKN, SKI and their contractors. They were well received.

In addition to these presentations, the traveler had the opportunity for some private meetings with Mr. Sten Burstrom, President of SKB (Swedish Nuclear Fuels Co.) with regard to changes in the U.S. program as a result of the Amendment Act of the previous month, and to discuss the potential impacts on our cooperative agreements. These discussions helped frame the U.S. approach to adjusting these agreements.



Thomas H. Isaacs, Acting Director  
Office of Policy and Outreach

Attachment

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412  
w/td  
3/22/88

**FOREIGN TRIP REPORT**  
**FOR TRAVEL TO**  
**SWITZERLAND, SWEDEN, AND THE UNITED KINGDOM**  
**ON**  
**JANUARY 10—JANUARY 20, 1988**

*by*

**Paul F. Gnirk**  
**RE/SPEC Inc.**  
**P. O. Box 725**  
**Rapid City, SD 57709**

**February 10, 1988**

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## SUMMARY

1. Name of Traveler: Paul F. Gnirk  
Affiliation of Traveler: RE/SPEC Inc.  
DOE Contractor Represented: Battelle-OWTD  
Dates of Travel: January 10-January 20, 1988  
Date of Trip Report: February 10, 1988
2. Travel Destinations: Zürich, Switzerland; Stockholm, Sweden; and London, England
3. Purpose of the Trip: To attend meetings in Zürich and London on matters related to the research investigations in progress in Phase 3 of the OECD/NEA Stripa Project, and to participate in a USA-Sweden bilateral technical-information-exchange meeting in Stockholm.
4. Abstract of Trip Report: On January 12, 1988, the traveler met in Zürich, Switzerland with the Manager for the Strip Project and the other Cochairman of the Technical Subgroup for the Stripa Project. The purpose of the meeting was to discuss the current status of the investigative activities within the Stripa Project and to finalize plans for the technical subgroup meeting to be held in the United Kingdom during the week of March 21-25, 1988. On January 14-15, 1988, the traveler, as a member of a delegation representing DOE/OCRWM met with representatives of SKB, SKi, and SKn in Stockholm, Sweden. The purpose of the meeting was to present an overview of the application of the multiattribute utility analysis to the comparative evaluation of sites nominated for characterization for the first radioactive-waste repository in the USA. On January 18, 1988, the traveler met, on behalf of the Stripa Project, with Dr. Michael Norgett and Dr. Alan Herbert, of AERE Harwell in London to review the status of the task on fracture flow modeling and to finalize development of a charter for a Task Force on Fracture Flow Modeling.
5. Summary of Commitments: None.
6. Summary of Recommendations: It is recommended that a representative with expertise in ground-water flow modeling be selected by DOE/CHI-RTP and assigned to the Task Force on Fracture Flow Modeling.

## **1.0 PURPOSE OF FOREIGN TRAVEL**

The U.S. Department of Energy has developed bilateral agreements in nuclear waste management with several European countries and organizations during the past several years for the purpose of fostering an exchange in technology directed towards the world-wide resolution of problems related to the geologic disposal of radioactive wastes. These agreements have led to exchanges of technical information and personnel between countries. In addition, extensive field-testing projects have been in progress since 1980 at the Stripa Mine in Sweden, under the auspices of OECD/NEA, of which the United States is a participant along with Canada, Finland, Japan, Sweden, Switzerland, and the United Kingdom. On May 20-22, 1986, the Joint Technical Committee of the OECD/NEA Stripa Project agreed to initiate a Phase 3, involving large-scale integrated in situ field tests at the Stripa Mine. The two principal tasks under Phase 3 involve "fracture flow and nuclide migration" and "ground-water flow path sealing."

On January 12, 1988, the traveler met in Zürich, Switzerland with the Manager for the Stripa Project and the other Cochairman of the Technical Subgroup for the Stripa Project. The purpose of the meeting was to discuss the current status of the investigative activities within the Stripa Project and to finalize plans for the technical subgroup meeting to be held in the United Kingdom during the week of March 21-25, 1988. On January 14-15, 1988, the traveler, as a member of a delegation representing DOE/OCRWM met with representatives of SKB, SKi, and SKn in Stockholm, Sweden. The purpose of the meeting was to present an overview of the application of the multiattribute utility analysis to the comparative evaluation of sites nominated for characterization for the first radioactive-waste repository in the USA. On January 18, 1988, the traveler met, on behalf of the Stripa Project, with Dr. Michael Norgett and Dr. Alan Herbert, of AERE Harwell in London for the purpose of reviewing the status of the task on fracture flow modeling and preparing in final form the charter for the Task Force the Task Force on Fracture Flow Modeling.

## **2.0 BENEFITS TO OCRWM PROGRAM**

The meeting in Zürich, Switzerland, provided an opportunity to evaluate the progress of Phase 3 of the Stripa Project and to assess the plans for continued work through 1988 in view of the areas of interest to the Office of Geologic Repositories of DOE/OCRWM and the Repository Technology Program of the DOE-Chicago office. The goals of Phase 3 of the Stripa Project, involving validation activities for geologic characterization and ground-water flow

modeling, are generally consistent with the interest of the DOE/OCRWM program. The meeting in Stockholm, Sweden, provided an opportunity to present the methodology used for the comparative evaluation of sites nominated for characterization for the first radioactive-waste repository in the USA. This meeting was scheduled by representatives of DOE/OCRWM and DOE/CHI at the annual bilateral meeting of Sweden and the USA in Stockholm in the summer of 1987. The meeting in London provided an opportunity to evaluate the progress to date on the development of a finite-element numerical model for ground-water flow in fractured rock masses, and to consider the basis for validation of the model under in situ conditions.

### **3.0 SUMMARY OF ACTIVITIES DURING TRAVEL**

#### **January 12**

The traveler met with Dr. Bengt Stillborg, (Stripa Project Manager) and Dr. Rudi Beck (Cochairman of the Technical Subgroup of the Stripa Project) for the purpose of discussing the status of the various investigations, the schedule and cost, and the forthcoming Technical Subgroup meeting for the OECD/NEA Stripa Project. The three principal activities of Phase 3 include (1) site characterization and validation, (2) improvement of site assessment methods and concepts, and (3) sealing of fractured rock. All of the tasks within these activities are generally being accomplished within the intended constraints of schedule and cost, and no significant problems to their continued progress are envisioned. The final details for the Technical Subgroup meeting in the United Kingdom during the week of March 21-25, 1988, were discussed prior to the development of a detailed agenda for distribution to the Technical Subgroup representatives by Dr. Stillborg.

The formation of a Task Force Group for Fracture Flow Modeling, according to the memorandum from Mr. Per-Eric Ahlstrom on December 14, 1987, was discussed. It was decided that the charter of the Task Force should be prepared jointly by Dr. Gnirk, Dr. Stillborg, and Dr. Michael Norgett of AERE Harwell, and, subsequently, the charter should be distributed to the members of the Joint Technical Committee for evaluation. The possibility of holding a Task Force meeting Berkeley, California, in late February 1988, and the general purpose of that meeting, was also discussed.

#### **January 13**

The traveler and Dr. Lee Merkhofer of Applied Decision Analysis met with Mr. Per-Eric Ahlstrom and Dr. Bengt Stillborg at the SKB offices in Stockholm. The purpose of the meeting was to discuss (1) the formation of a Task Force for Fracture Flow Modeling under the Stripa Project, and (2) the agenda for the USA-Sweden bilateral meeting on January 14-15 which was focused on the presentation of the methodology that was used in the comparative

evaluation of sites nominated for characterization for the first radioactive-waste repository in the USA. Regarding the Stripa Project, it was decided that Dr. Stillborg, Dr. Norgett of AERE Harwell, and the traveler would complete the preparation of the charter for the Task Force on Fracture Flow Modeling by the following week. After receipt of this charter, Mr. Ahlstrom would attach it to a memorandum explaining the formation of the Task Force and send copies to the members of the Joint Technical Committee for their evaluation. It was also decided that an ad hoc coordinating meeting on Fracture Flow Modeling would be held in Berkeley, California, in late February, and that the meeting would be chaired by the traveler. Each member country would be invited to send one delegate to the coordination meeting, with the expectation that such delegates be prepared to participate in future Task Force meetings.

With regard to the technical-information-exchange meeting on January 14-15, the composition of the attendees was discussed along with the nature of the presentations over the two days. It was concluded that the presentations by the USA representatives should proceed in a rather structured fashion on the first day according to the agenda. For the second day of the meeting, which would involve fewer attendees, Mr. Ahlstrom requested that the meeting proceed in a workshop fashion with interactive discussions. The composition of attendees for the first day of the meeting would include representatives from SKB, SKi, and SKn.

#### January 14

The USA-Sweden bilateral technical-information-exchange meeting began at 9:00 a.m. at the Ingenjoershuset in Stockholm. During the morning session, Mr. Tom Isaacs of DOE/OCRWM first discussed the changes in the course of the civilian radioactive-waste program in the USA as a consequence of the amendments in December 1987, to the National Waste Policy Act of 1982. Subsequently, he discussed the general background and strategy for implementation and use of multiattribute utility analysis for the comparative evaluation of sites nominated for characterization for the first radioactive-waste repository in the USA, as they occurred in 1985 and 1986. His presentation included the general process for repository siting that was employed in the USA prior to the National Waste Policy Act of 1982, the requirements of the act after its enactment as they related to repository siting, the development of the repository siting guidelines, and the development of the draft and final environmental assessments for the nominated repository sites for the first radioactive-waste repository in the USA. Finally, he discussed the pros and cons of the use of such a methodology in light of schedules, interpretations of policy from the provisions of the National Waste Policy Act, and interactions with the National Academy of Science.

During the afternoon session, Dr. Lee Merkhofer and the traveler discussed the characteristics of the five repository sites that were comparatively evaluated, the process that was required for application of multiattribute utility anal-



ysis, and the results that were obtained for the pre-closure and post-closure evaluations.

#### January 15

The second day of the USA-Sweden bilateral technical-information-exchange meeting convened at 9:00 a.m. at the SKB offices in Stockholm. During the morning session, Dr. Merkhofer and the traveler developed an upper-level objectives hierarchy for the Swedish repository siting program, based on a series of questions to the attendees. During the afternoon session, performance measures were developed for several of the objectives, followed by the development of the single-attribute utility functions for those performance measures. Subsequently, a simplified form of the multiattribute utility function was defined and the scaling factors were determined on the basis of value tradeoffs derived from structured questions to the attendees. The purpose of the activities during the day was to demonstrate a simplistic application of multiattribute utility analysis as applied to the selection of repository sites for characterization in Sweden.

#### January 18

Beginning at 9:00 a.m., the traveler met with Dr. Michael Norgett and Dr. Alan Herbert of AERE Harwell in the London office of AERE. During the morning, the bulk of the discussion was centered around the fracture flow model that is being developed by Dr. Norgett and Dr. Herbert for the site characterization and validation activity under the Stripa Project. The mathematical formulation of the model was reviewed and the types of data required for predictions of the ground-water flow at the underground site in the Stripa Mine were discussed. During the afternoon, the charter for the Task Force on Fracture Flow Modeling was completed and the agenda for the meeting in late February in San Francisco was developed.

## 4.0 PARTICIPATION BY TRAVELER IN ACTIVITIES

The traveler is Cochairman of the Technical Subgroup for the OECD/NEA Stripa Project and a member with observer status to the Joint Technical Committee. As discussed in Section 3 above, the traveler participated with the Stripa Project Manager and the other Technical Subgroup Cochairman in the discussions in Zürich, and with the Principal Investigator and his associate for the Fracture Flow Modeling Activity in the Stripa Project in London. As regards the USA-Sweden bilateral technical-information-exchange meeting in Stockholm, the traveler, along with Mr. Tom Issacs of DOE/OCRWM and Dr. Lee Merkhofer of Applied Decision Analysis, participated in the presentations.

## **5.0 RECOMMENDATIONS FOR FUTURE ACTIVITIES**

**The traveler recommends that a representative with expertise in ground-water flow modeling be selected by DOE/CHI-RTP and assigned to the Task Force on Fracture Flow Modeling.**

## APPENDIX A

### ITINERARY OF TRAVEL

- January 10-11: Travel from Rapid City, SD, to Zürich, Switzerland, via Minneapolis, Frankfurt, and London.
- January 12: Meetings with Dr. Bengt Stillborg (SKB-Sweden) and Dr. Rudi Beck (NAGRA-Switzerland). Travel from Zürich to Stockholm, Sweden.
- January 13: Meeting with Mr. Per-Eric Ahlstrom (SKB-Sweden) and Dr. Bengt Stillborg (SKB-Sweden). Preparations for USA-Sweden bilateral technical-information-exchange meeting on January 14-15.
- January 14-15: USA-Sweden bilateral technical-information-exchange meeting.
- January 16-17: Preparations for meeting with Dr. Michael Norgett (AERE Harwell-U.K.) in London on January 18. Travel from Stockholm to London.
- January 18: Meeting with Dr. Michael Norgett (AERE Harwell-U.K.).
- January 19-20: Travel from London to Rapid City, SD, via Boston, Omaha, and Denver.

**APPENDIX B**  
**LIST OF PEOPLE CONTACTED BY TRAVELER**

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**APPENDIX C**  
**BIBLIOGRAPHY OF LITERATURE**  
**ACQUIRED BY TRAVELER**

None

**APPENDIX D**  
**BIBLIOGRAPHY OF LITERATURE**  
**PROVIDED TO FOREIGN HOSTS**

None

**APPENDIX E**  
**AGENDA OF USA-SWEDEN BILATERAL TECHNICAL**  
**INFORMATION MEETING IN STOCKHOLM, SWEDEN**

DEAR PER-ERIC: :

THIS CONFIRMS OUR ARRANGEMENTS FOR A VISIT TO SKB BY TOM ISAACS, DEPUTY DIRECTOR, OFFICE OF GEOLOGIC REPOSITORIES, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT OF THE DEPARTMENT OF ENERGY; PAUL GNIRK, RESPEC; AND DR. LEE MERKHOFFER, APPLIED DECISION ANALYSIS, ON DECEMBER 8 AND 9, 1987. WE SUGGEST THE FOLLOWING AGENDA IN WHICH THE FIRST DAY WOULD COVER MUCH OF THE POLICY AND GENERALITIES OF THE PROCEDURE AND THE SECOND DAY WOULD COVER SPECIFIC DETAILS.

DECEMBER 8, 1987

USDOE PRESENTATION TO SKB ON THE DOE'S SELECTION OF SITES FOR CHARACTERIZATION AND ON THE MULTI-ATTRIBUTE UTILITY ANALYSIS [MUA] USED TO SUPPORT THE DECISION.

MORNING [0900 - 1200] (T. ISAACS)

GENERAL BACKGROUND, STRATEGY AND POLICY

GENERAL IMPLEMENTATION AND USE

GENERAL EXPERIENCE IN USE OF MUA

AFTERNOON [1400 -1630] (P. GNIRK - L. MERKHOFFER)

APPLICATION OF MUA

CHARACTERISTICS OF SITES FOR MUA

PRE AND POST CLOSURE ANALYSIS AND EVALUATION

DECEMBER 9, 1987

MORNING [0900 - 1200] (P. GNIRK - L. MERKHOFFER)

DETAILED IMPLEMENTATION OF MUA

HIERARCHY OF OBJECTIVES, PERFORMANCE MEASURES.



AFTERNOON [1400 - 1630] (P. GNIRK - L. MERKHOFFER)

ASSESSMENT OF TECHNICAL JUDGEMENTS

ASSESSMENT OF VALUE JUDGMENTS

ARRANGEMENTS FOR HOTELS ETC. ARE BEING MADE SEPARATELY.

BEST REGARDS,

CARL COOLEY

**APPENDIX F**  
**CHARTER FOR TASK FORCE ON FRACTURE FLOW**  
**MODELING FOR THE OECD/NEW STRIPA PROJECT**



DATUM DATE VAR REF - YOUR REFERENCE

1988-01-19 24.210  
ERT DATUM - YOUR DATE ER REF - YOUR REFERENCE

HANDLAGGARE - MATTER HANDLED BY

Per-Eric Ahlström

To the JTC-members of the Stripa Project.

Stripa Phase 3 - formation of a Task Force group for fracture flow modelling.

Dear Colleagues,

Based on discussions between the Stripa Project management, the principal investigator for the fracture flow modelling Michael Norgett, and some of the Stripa JTC-members, it is suggested that a Task Force group for Fracture Flow Modelling be formed, similar to the Task Force group on Sealing Materials and Techniques. It is thought that such a group would be most useful in guiding and coordinating the modelling work conducted using Stripa data. For your information I have enclosed a memorandum compiled by Paul Gnirk (one of the two TSG chairmen), Michael Norgett and the Stripa project manager Bengt Stillborg further explaining the purpose of the group.

Formally the formation of such a Fracture Flow Modelling Task Force should be established at our next JTC-meeting in June. It is however strongly felt that it would be of substantial benefit both to the project and to the Stripa project member countries to hold an ad hoc coordinating meeting chaired by Paul Gnirk before the TSG-meeting scheduled for March 22-24.

We have therefore scheduled such a coordinating meeting involving the Stripa modelling group and the two US modelling groups for February 24-26, 1988 in San Francisco, USA. Each member country is invited to send one delegate, who is knowledgeable in the field of fracture flow modelling, to the meeting. If the JTC decides in June to form the above mentioned Task Force, the delegate should preferably be prepared to participate in future Task Force meetings.

Please inform Bengt Stillborg no later than February 8 if you intend to send a delegate and of the name, complete address, phone and telex/telefax numbers of the delegate you might nominate. Details of the meeting will be distributed directly to the delegates two weeks before the meeting.

Yours sincerely

Per-Eric Ahlström  
Chairman Stripa-JTC

cc. TSG chairmen  
Michael Norgett

KÄRNBRÄNSLEHANTERING AB  
SWEDISH NUCLEAR FUEL AND WASTE MANAGEMENT CO

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## Purpose of a Task Force Numerical Modelling of Fracture Flow

The Task Force for Sealing Materials and Techniques has proved a great asset to the Stripa project and its participants. The Group has provided valuable support in guiding and reviewing the research programme, and has also contributed by gathering and evaluating relevant information.

A second Task Force would provide an opportunity to guide and review the development of numerical modelling of fracture flow within the Stripa project, as undertaken by Dr Michael Norgett of the Harwell Laboratory of the United Kingdom Atomic Energy Authority. This Task Force for Numerical Modelling of Fracture Flow would also: (i) co-ordinate with the work undertaken at Harwell the effort provided by two Groups in the United States of America, led by Dr Jane Long of Lawrence Berkeley Laboratory and Dr William Dershowitz of Golder Associates, since all three Groups utilise data collected at Stripa; (ii) recommend criteria for the verification and validation of the numerical models; and (iii) facilitate the wider dissemination amongst the countries participating in the Stripa project of progress in the development of numerical modelling and computer codes.

Paul  
Gnirk

Michael  
Norgett

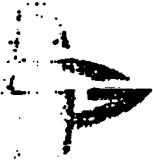
Bengt  
Stillborg

**APPENDIX G**  
**AGENDA FOR THE FEBRUARY 1988 MEETING OF THE**  
**AD HOC COORDINATION GROUP ON FRACTURE FLOW**  
**MODELING FOR THE OECD/NEA STRIPA PROJECT**

02/09/1988 10:33 59

1988-02-09 18:32 SGAB UPPSALA SWEDEN

01



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DATUM

ANTAL SID INKL. DENNA

88-02-09

10

TILL

Paul Gnirk

FRÅN

Bengt Stillborg

Bengt Stillborg

To the members of the Ad Hoc  
Task Force on Fracture Flow  
Modelling, Stripa Project  
Phase 3.

Dear Colleagues,

The first meeting of the Task Force on Fracture Flow Modelling will be held at the Rancho Caymus Inn, Rutherford, California, in the Napa County wine country. The technical program will occupy Wednesday and Thursday, February 24th and 25th, but an excursion has been arranged for Friday, February 26th; see enclosed details.

The objective of the meeting is to review the various contributions to modelling within the Stripa project. The agenda has been arranged to provide opportunities for wide-ranging discussion of the challenges posed by the attempt to base sophisticated numerical simulation upon data collected at a complex site. We hope that you will come to the meeting prepared to offer advice and constructive criticism. We appreciate your help and participation. Enclosed please find the agenda for the meeting and additional meeting details.

You should be prepared to pay for all costs involved in the Task Force meeting.

If you have any further questions do not hesitate to contact me or Michael Norgett at Harwell.

Best regards

*Bengt Stillborg*  
Bengt Stillborg

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**Agenda for a Meeting of the ad-hoc Task Force on Fracture Flow Modelling  
Wednesday, February 24th - Thursday, February 25th Rutherford, California**

**Wednesday, February 24th**

- |       |  |                             |
|-------|--|-----------------------------|
| 9.00  | Welcome, Purpose of the Task Force,<br>Round Table Introduction of Participants.           | P. Gnirk                    |
| 9.45  | Introduction to the Stripa Project.  | B. Stillborg                |
| 10.30 | Coffee.  |                             |
| 11.00 | Harwell Contribution to Modelling within<br>the Stripa Project.                            | A. Herbert                  |
| 12.00 | Lunch.   |                             |
| 13.00 | Golder Associates Contribution to<br>Modelling within the Stripa Project.                  | W. Dershowitz               |
| 14.00 | Lawrence Berkeley Contribution to<br>Modelling within the Stripa Project.                  | J. Long                     |
| 15.00 | Coffee.  |                             |
| 15.30 | Code Verification Exercise.  | A. Herbert<br>W. Dershowitz |
| 16.00 | Modelling Resources available to the<br>Stripa Project - Limitations and<br>Opportunities. | M. Norgett                  |
| 17.00 | General Discussion.  |                             |
| 17.30 | End of Day.  |                             |

**Thursday, February 25th**

- |       |   |         |
|-------|---|---------|
| 9.00  | What is known about the Stripa Test<br>Site.  | J. Gale |
| 10.00 | General Discussion - to identify and<br>order according to importance<br>Issues and Challenges, for example:<br>Boundary Conditions,<br>Impact of Disturbed Zone,<br>Validation Criteria. |         |
| 10.45 | Coffee.   |         |



## APPENDIX H TRAVEL COST ANALYSIS

### Zürich, Switzerland (1.32 SFr/1.00 US\$)

<u>Lodging:</u> Hotel Nova-Park (165 SFr)	\$125.00
<u>Taxi:</u> Zürich Airport to Hotel Nova-Park (37 SFr)	28.03
<u>Food:</u> • Continental breakfast at the Hotel Nova-Park (10 SFr)	7.58
• Glass of orange juice at the Zürich Hilton (45 SFr)	3.03
• Cup of tea at the Zürich Hilton (2.50 SFr)	1.89

### Stockholm, Sweden (5.88 SEK/1.00 US\$)

<u>Lodging:</u> Hotel Anglais (1070 SEK)	\$180.27
<u>Limo:</u> Hotel Anglais to Stockholm Arlande Airport (161 SEK)	27.38
<u>Food:</u> • Smorgasbord luncheon at the Hotel Angleis (100 SEK)	17.01
• Coffee at the Hotel Anglais (14.00 SEK)	2.38
• Dinner, dessert, and coffee at a nice restaurant (210 SEK)	35.71
• Dinner and coffee at an average restaurant (180 SEK)	30.61

### London, England (1.8798 US\$/1.00 £)

<u>Lodging:</u> Post House Hotel (75.90 £)	\$142.68
<u>Taxi:</u> Heathrow Airport to downtown London (22.50 £)	42.30
<u>Food:</u> • Light snack with meat at the Post House Hotel (6 £)	11.28