

## **The Virtual Lab for Prior Studies**

### **An Example of a Closed Collaborative Community**

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#### **Background**

Arthur Norman Prior (1914-69) is the founder of modern temporal logic. It is not the aim of the present report to explain the life and work of A.N. Prior in detail. This 'background' is included to briefly sketch the research within the field of temporal logic, to serve as a good example of the demands a research community puts on an it-system developed to support its work – in this case "The Virtual Lab for Prior Studies".

The work and research of A.N. Prior secured the discipline temporal logic as a theoretical subject within philosophy, theology, and mathematical logic. In more recent years it has shown its power as an application oriented tool in verification of parallel processes in chip design as well as program verification of temporal aspects in software, a discipline within theoretical computer science.

Shortly after the all too early and sudden death of A.N. Prior in 1969 – he died from a heart attack in Trondheim, Norway, during a lecture tour – his widow Mary Prior (1922-2011) together with close friends and colleagues went through all his written material, sorted it into archival boxes, and entrusted this 'Prior Archive' to the Bodleian Libraries in Oxford. Upon request to and with written permission from the Prior family, the archive is made available for researchers to use it in the Special Collections Reading Room (SCRR).

From a Danish perspective, the research within temporal logic and with that into the works of A.N. Prior was initiated by professor Peter Øhrstrøm, Aalborg University. His first visit to Oxford and the Bodleian Libraries dates back to 1989. Through contacts with Mary Prior and Martin Prior, the son of Mary and Arthur Prior, he obtained permission to use the archive for research purposes. Later professor Per Hasle, University of Copenhagen, joined this

research. Through annual visits to Oxford, Hasle and Øhrstrøm worked in the SCRR to research the work of A.N. Prior. An important work was made by Per Hasle to produce so called box lists of the content of each archival box. This meant a much better overview of the Prior Archive and made it very easy for researchers to locate manuscripts, letters, and notes, without having to do this more or less at random or by memory. Another important tool for the research done in the Prior Archive is the bibliography of the works of A.N. Prior. This work was started by the Norwegian librarian and bibliographer Olav Flo (1922-89) during the 1970ies, completed by Øhrstrøm and Hasle in 1996, with later additions 2011 by now assistant professor David Jakobsen, Aalborg University.

These indispensable tools formed an integral part of “The World-Wide-Web Site for Arthur Norman Prior Studies”, launched in 1999, present day web address [www.priorstudies.org](http://www.priorstudies.org) and now a part of the project “The Virtual Lab for Prior Studies”.

### **The Virtual Lab for Prior Studies**

In 2007, Hasle and Øhrstrøm negotiated a new agreement with Mary Prior for the use of the Prior archive specifically giving permission “to edit and publish, separately or jointly, all scientifically relevant material by my late husband Arthur N. Prior, of which I am the copyright holder.” (Typed statement, signed Dr. Mary Prior, Oxford, 15 September 2007). This meant that access to the archive was to be more elaborate and frequent for the research taking place, since it would now be of greater interest to publish material from the archive. To complement this, Prior researchers from around the world were more and more aware of the Prior research centred in Denmark, and were keen to join this growing ‘Prior Community’.

One initiative was the idea to have the complete ‘Nachlass’ of Prior, i.e. hitherto unpublished manuscripts, letters, and notes be published. It was obvious that modern web technology could somehow be used to facilitate the access and it was further quickly realised that the publication of Prior’s Nachlass was to be a collaborative effort which could attract even more researchers to the Prior community, some of them new to the field.

2010 work was initiated to gain permission from the Bodleian Libraries to use digital cameras to photo the archival material. A new policy by the library had made it possible to take digital photos but only for personal use.

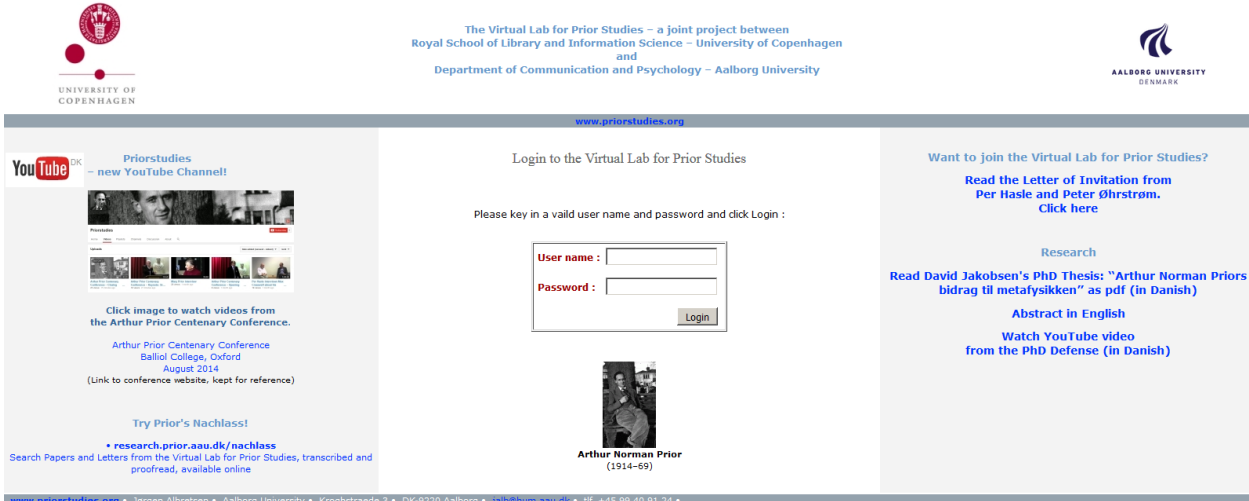
It must be stressed that the digital photos taken legally remain the property of Bodleian Libraries and they must not be copied to any third party without permission. Furthermore, Bodleian Libraries retain the right to ask for free copies of the digital photos. These demands in themselves meant that some sort of access control had to be imposed.

During spring 2011, computer scientist Jørgen Albretsen started the development of the prototype of “The Virtual Lab for Prior Studies” (VL), and he is currently main responsible for the VL. After two research visits to Oxford, a huge number of digital photos was available and a pilot system was put together. After successful tests, researchers from the Prior Community were allowed to use the VL, which has now been developed into a stable system in permanent use. PHP is used as main programming language with extensive use of its ease of integration with SQL databases, forming the basis of the VL. JavaScript is used to a minor extend. The VL is running on a Linux server, hosted by Aalborg University.

Such a system must also encompass the obvious need to annotate the digital photos, and not the least facilitate the transcription based on the digital photos, of the text and formulae in the original documents. The transcribed text must then be searchable and the entire system must be made like a laboratory in the sense of a researcher’s workplace when dealing with the Prior Archive.

## How the VL is structured – a Closed Collaborative Community

The VL is reached via login at the web address [research.prior.aau.dk](http://research.prior.aau.dk) (figure 1):



The screenshot shows the login page for the Virtual Lab for Prior Studies. At the top, there are logos for the University of Copenhagen and Aalborg University. The main heading is "Login to the Virtual Lab for Prior Studies". Below this, it says "Please key in a valid user name and password and click Login:". There is a form with two input fields: "User name:" and "Password:", followed by a "Login" button. To the left of the login form, there is a section for a YouTube channel "Priorstudies" and a link to the "Arthur Prior Centenary Conference". To the right, there is a section titled "Want to join the Virtual Lab for Prior Studies?" with links to "Read the Letter of Invitation from Per Hasle and Peter Øhrstrøm" and "Research". At the bottom, there is a small portrait of Arthur Norman Prior (1914-69).

Figure 1.

Status as of September 1, 2016: 48 researchers from around the world have been granted a login to the VL. The VL is logically divided into a papers section and a letters section. 6242 digital photos classified into 297 papers (200 papers by Prior and 97 papers by others – probably send to Prior) and 1102 letters (247 from Prior and 829 to Prior, remaining 26 are letters between other persons, that Prior received in copy as well as notes attached to letters). A total of 152 papers and 91 letters have been transcribed, and of these 37 papers and 5 letters are now in the Nachlass (explained later).

The whole idea behind such a setup for a VL may not seem new. Within the Digital Humanities, a collaborative process as the present can be classified as crowdsourcing. What makes it special is the closed character imposed by two restrictions:

1. the demand by Bodleian Libraries that the digital photos are not distributed freely but only to persons having a professional research-based interest.
2. the researchers commit themselves to contribute to the Nachlass by signing up to transcribe texts that fit into the overall goal to do research on the life and work of A.N. Prior, with the benefit that they are credited for their work and can use it for publishing within their own field of research.

This Prior Community of roughly 50 persons made the step to label it 'closed' rather easy. Almost everybody knows everybody, newcomers are often Ph.D.-students of senior researchers with a keen eye on what needs to be transcribed and made available for comment.

The term 'Virtual Lab for a Closed Collaborative Community' (VL-3C) was then coined by Jørgen Albretsen. Recent literature list evaluation terms like the following, which the VL-3C easily fulfils – the relation to VL-3C added in parentheses:

- High Concept, Good Title (A.N. Prior, the need to be virtual)
- Small Autonomous Tasks (transcribing texts and adding comments)
- Use Custom and Open Tools (PHP, SQL, JavaScript, open standards)
- Recognize Community (aiming at the Prior Community)
- Organizational Team (centred in Denmark)
- Small Crowds Work Too (50 people, growing to maybe 100)

(source: Deegan, Marylin & McCarty, Willard (eds.). 2012. "Making Crowdsourcing Work", from chapter 9 "Crowdsourcing the Humanities" in *Collaborative Research in the Digital Humanities*, 147-9. Abingdon: Ashgate – Taylor & Francis Group Ltd.)

## A typical use of the VL-3C

Upon registering as a member of the VL-3C, the user chooses any number of texts to transcribe. This is done by e-mail to the VL-3C administrator who then assigns the user to the texts in question by updating relevant databases. It is not compulsory that a user must sign up for transcription of texts. The digital photos that make up a digital document in the VL can be read by any user, and any user can add her or his own comments to a digital document. However, to get credit for transcribing, the user is required to sign up for this.

The user can use a search facility to have documents – papers or letters – listed, as shown in figure 2.

Below is a search form: Enter search criteria in one or more fields.  
The search form works like a logical AND.  
Ex: logic in Title and 1949 in Year means: Search for records from 1949 with the word logic in the title.  
An empty field evaluates to True in the logical AND.  
Fill in search criteria and click Search.  
Click Search with no search criteria entered to get all records.  
To clear search form of any unwanted search criteria click Clear.

| Search | Clear |

No.	Author	Title	Content	Date	Comment
	First name <input type="text"/> Last name <input type="text"/>	<input type="text"/> <input type="text"/>	Enter word or part of word to do case-insensitive free text search of content: <input type="text"/> Note: this search criteria is AND'ed with the other criteria	Day <input type="text"/> Month <input type="text"/> Year <input type="text"/>	<input type="text"/>

Figure 2.

A search without criteria gives all documents available. The search facilities is rather standard: VL identification number, author, title, date. More specific for this VL is the possibility to combine with the following criteria: box number, content, and comment. A word about "Content": this applies to digital documents where transcribed text is available, which means that any digital document without transcription will be excluded in searches where a search criteria is entered in the content field.

In figure 3, an extract from the list of papers in the VL-3C is shown. The numbers inset in the buttons in the leftmost column are the VL identification numbers. Each new entry in the VL is automatically assigned a VL identification number when the system administrator enters it into the VL. In the third column, the titles of the digital documents are marked using three colours: red, yellow, and green.

1. Red means that the digital photos are available, but transcribed text has NOT been entered.
2. Yellow means that transcribed text HAS been entered but the transcription is still being worked on. Typically this means that a VL user has signed up to transcribe the text. The user in question is then credited in the (general) comments field on the right, maintained by the VL administrator.
3. Green means that the text has been fully transcribed, proof read, and APPROVED by the editorial board of the VL, to be published in the Nachlass – explained further on page 9.

63	Arthur N. Prior	The Fable of the Four Preachers <span style="color: green;">Box 6</span>	Transcribed and proofread <a href="#">Display transcription</a>	1962	This text has been transcribed and edited by Julie Ravn, Peter Øhrstrom, and Ulrik Sandborg-Petersen, proofread by Jørgen Albretsen. TU. Synthese (2012) 188-455-457.
331	Charles L. Hamblin	The Logic of Tenses <span style="color: red;">Box 15</span>		1962	16) Hamblin, C.L. The Logic of Tenses. MS. 20 p. [Latest reference 1962].
343	Nuel D. & Richmond H. Bellinap, Jr. & Thomason	A Rule Completeness Theorem <span style="color: red;">Box 13</span>		July 1962	
344	Alonzo Church	Logic, Arithmetic, and Automata <span style="color: red;">Box 13</span>		August 20 1962	A lecture delivered to the International Congress of Mathematicians at Stockholm on August 20, 1962. Probably published, but not in a readily accessible place.
111	Arthur N. Prior	The History of Logic: II Terms and Sentences <span style="color: red;">Box 6</span>		October 25 1962	Typed version of paper from History of Logic on BBC Manchester, 3rd programme, tape id YMR (YMK?) 25278
59	Arthur N. Prior	The History of Logic I: The End of a Myth <span style="color: yellow;">Box 6</span>	<a href="#">Display</a>	October 25 1962	This text has been transcribed and proofread by Chrissy van Hulst and Max Cresswell, Victoria University of Wellington, New Zealand, e-mails Max.Cresswell@vuw.ac.nz and chrissyvanhulst@hotmail.com. The History of Logic Containing the following sections: 1. The End of a Myth, HWU, 16 p. 2. Terms and Sentences, TU(?), 8 p.+ HWU 20 p. 3. Words and Things, HWU, 19 p. A "header" to the typewritten version of II: 'Terms and sentences' contains the following information: recorded 04.10.62. in Manchester, broadcast 23th October [1962?], 9.20-9.40 p.m., producer T.S. Gregory, Third programme. --- Per Hasle
1267	Arthur N. Prior	Names <span style="color: red;">Box 7</span>		1963	DATE? YEAR guessed from text quotes compared to letters see note.TU (34 p.) First page handwritten note "unpublished".
84	Arthur N. Prior	Indirect Speech Again <span style="color: red;">Box 5</span>		February 1963	With Rejoinder by L. Jonathan Cohen. Philosophical Studies Volume XIV, January-February 1963, Numbers 1-2.
78	Arthur N. Prior	Existence in Lesniewski and in Russell <span style="color: yellow;">Box 5</span>	<a href="#">Display</a>	July 1963	Reprinted from Studies in Logic, Proceedings of the eighth logic colloquium Oxford, July 1963. This text has been transcribed by: Zuzana Rybářková, Palacký University, Olomouc, Czech Republic zuzka.rybankova@gmail.com

Figure 3.

To access a document in the VL, a user clicks on the button with the VL identification number. If the user has been signed up for transcription of a text, a typical view of the screen during transcription is shown in figure 4.

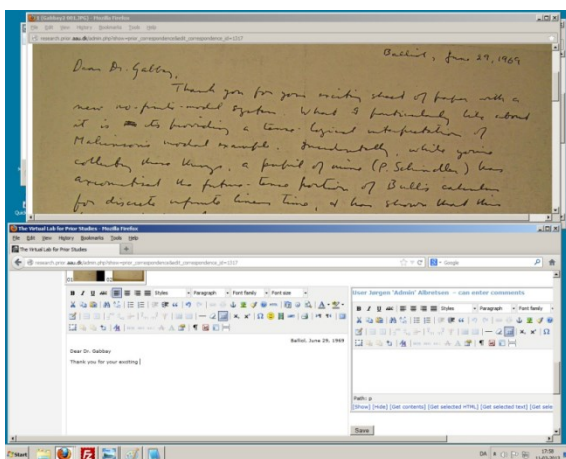
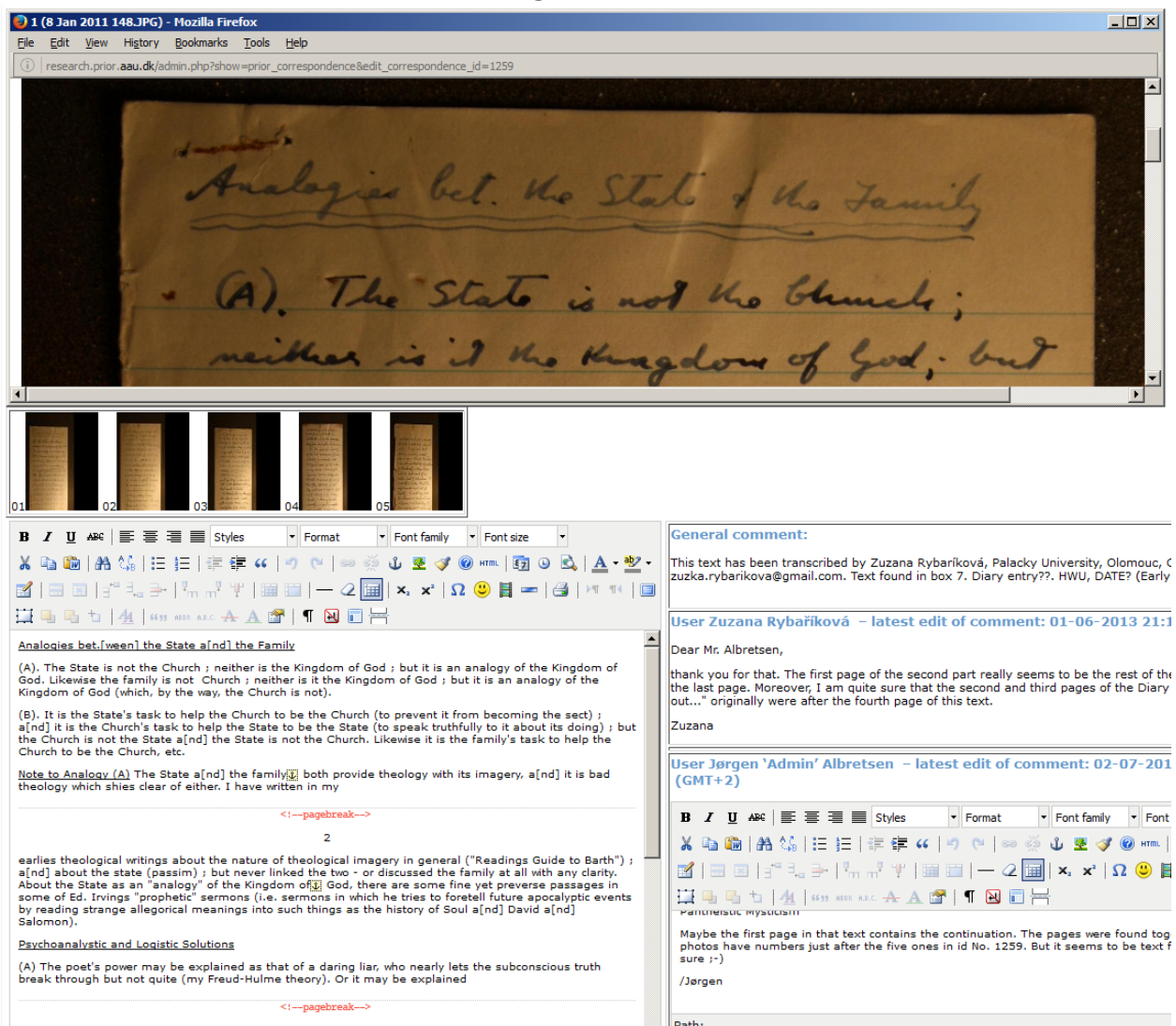


Figure 4.

The top window in figure 4 contains one of the digital photos making up the digital document in question. In another window, below the digital photo, the editor on the left is ready to accept the transcribers input – the text being read from the digital photo. On the right a comment editor assigned the user is opened for the user to enter e.g. remarks on the transcription. Earlier comments that the user may have entered in earlier sessions will appear in that editor for the user to evaluate, edit and maybe delete.

Other users can add comments under their own name. Of course, they cannot change the comments of other users, only enter comments in their own comment editor as shown in figure 5.



The screenshot shows a web browser window displaying a digital document. The document is a handwritten note on aged paper with the title "Analogies bet. the State of the Family" and the main text: "(A). The State is not the Church; neither is it the Kingdom of God; but". Below the photo is a thumbnail gallery with five images labeled 01 to 05. The interface is split into two main editing areas. The left area is a rich text editor for transcription, containing the text: "Analogies bet.[ween] the State a[nd] the Family", "(A). The State is not the Church ; neither is the Kingdom of God ; but it is an analogy of the Kingdom of God. Likewise the family is not Church ; neither is it the Kingdom of God ; but it is an analogy of the Kingdom of God (which, by the way, the Church is not).", "(B). It is the State's task to help the Church to be the Church (to prevent it from becoming the sect) ; a[nd] it is the Church's task to help the State to be the State (to speak truthfully to it about its doing) ; but the Church is not the State a[nd] the State is not the Church. Likewise it is the family's task to help the Church to be the Church, etc.", and "Note to Analogy (A) The State a[nd] the family, both provide theology with its imagery, a[nd] it is bad theology which shies clear of either. I have written in my". The right area is a comment editor with a "General comment:" section containing a transcription credit to Zuzana Rybariková and a "User Zuzana Rybařiková – latest edit of comment: 01-06-2013 21:" section with a message to Mr. Albretsen. Below that is a section for "User Jørgen 'Admin' Albretsen – latest edit of comment: 02-07-201 (GMT+2)" with a message about the document's page numbering and the name "Jørgen".

Figure 5.





The Virtual Lab for Prior Studies

No.	Author	Title	Date
41	George Hughes	A letter on 'The Prisoner's Paradox'	00 00

Dear Arthur,

Certainly this advances things very nicely. But I feel it is not the end of the road. You may know the poem

"I see you take his loss." "His true?"

"O, miserly!" "Twas strictly best!"

He thought me asleep: at least I knew

He thought I thought he thought I slept."

Suppose the prisoner takes the argument as far as you have done. He sees that the the [sic] judge's statements argued by your system,  $S_1$ , lead to  $H_4$  and  $H_{14}$ , so that no conclusion can be drawn from them with confidence. Let system  $S_2$  be the way in which the prisoner will then argue. He now sees that, if he confides himself to  $S_1$  arguments, the judge can hang him either on Sunday or Monday, and catch him by surprise. So he need not doubt 5, 6, 7, 8. But now the argument starts again; he sees the judge has a loophole, in dealing with an  $S_1$  mentality prisoner: if he retains the axiom that the judge does mean to hang him, he will know by Sunday that he is due for execution on Monday. So the question arises, did the judge consider the possibility that he might have an  $S_2$  mentality? (or an  $S_3$  mentality - i.e., that he might not be a philosopher at all - in which case he would not even reach the  $S_1$  argument, and could legitimately be killed on Sunday).

I have not thought this through thoroughly, but I am inclined to think that it may resemble the old question of the double bluff. If the judge attributes to him the power of performing the argument up to stage  $S_2$ , but not  $S_{2+1}$ , then he must be executed on Sunday; but if the judge thinks he can reach  $S_{2+1}$  but not  $S_{2+2}$  (as in your theory) then he can be executed on either day.

If the judge says "you will be surprised when we hang you", this clearly depends on the judge's estimate of the prisoner's reasoning powers and on the prisoner's estimate of the judge; I think the present form of words also involves the same.

My own position, in the place of the prisoner, is that I am an  $S_{2+2}$ ; if the judge executes me on Monday, I realise he thinks infinity is an odd number; if on Sunday, either even or odd.

As I can only guess what he thinks, I know nothing, and can be executed on either day without contradiction.

(2011030923411)(2011030923411)(2011030923411)(2011030923411)

(Record no. 41 title A letter on 'The Prisoner's Paradox' fetched by user Jørgen Albrechtsen)

General comment:

A letter on 'The Prisoner's Paradox' (undated; according to Mary Prior possibly from George Hughes); see 'The Paradox of the Prisoner' in Logical Form/Box 5. The text has been transcribed by Sara L. Uckelman, Durham University, e-mail s.l.uckelman@durham.ac.uk

User Sara L. Uckelman  
- latest edit of comment: 05-06-2012 13:07:23 (GMT+2)

Though there are three images associated with this object, they are all photographs of the same leaf; the letter is only one page, and apparently incomplete.

User Jørgen "Admin" Albrechtsen  
- latest edit of comment: 18-02-2015 13:53:45 (GMT+2)

This text has been transcribed by Sara L. Uckelman, Durham University, e-mail s.l.uckelman@durham.ac.uk

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There is only one leaf, the letter or note is only one page. Photos two and three were taken to include the notes in the box list and the handwritten note by Mary Prior.

Figure 7.

## Once transcribed – what then – the Nachlass

Text that has been transcribed does not appear in the Nachlass before it has been through an editorial process and quality control as follows. The Closed Collaborative Community assures that any discussion before the transcription takes place among very few people with knowledge on the subject. A part of the academic tradition is that review of one's work is a peer process, this is mirrored in the VL. Transcribed text along with the comments are evaluated by an editorial board. Comments deemed important and relevant are converted to footnotes. The text is proof read and again compared to the digital photos. A PDF is generated and saved separately. The database behind the VL stores the transcribed text so to speak in parallel to the PDF.

The Nachlass website [nachlass.prior.aau.dk](http://nachlass.prior.aau.dk), available without login, has a search facility in the following rather simple form, shown in figure 8:

> Papers proofread • Menu

**The Nachlass of A.N. Prior – Papers Section with 37 proofread papers**

|  |  |

**Number of database records found: 37**

Title	Content
<input style="width: 95%; height: 20px;" type="text"/> <input style="width: 95%; height: 20px;" type="text"/>	<p style="text-align: center;">Enter word or part of word to do case-insensitive free text search of content:</p> <input style="width: 95%; height: 20px;" type="text"/> <p style="text-align: center; font-size: small;">Note: this search criteria is AND'ed with the other criteria</p>

Figure 8.

Links to the PDFs of all available texts – in figure 8 the 37 papers – are listed (not shown here) below the search facility when the user of the Nachlass first

enters the webpage. The idea is to show what is available for the user to choose from without a search being necessary. Title and/or Content can be searched. In the Title part a drop down list is provided to choose a particular title if the user prefers that. In the box above the drop down list the user can instead type parts of the title – maybe a word or parts of a word from the title – to broaden the search.

The “Content” field makes it possible for a Nachlass user to search the contents of the transcribed texts stored in the database, and thus also the corresponding ‘parallel’ PDFs. The present Nachlass thus ensures an easy but simple access to a transcribed text and does make it easy to compare the hits in the text with the more ‘clean’ view of the corresponding PDF. After a search, any hits are shown in a KWIC (Key Word In Context) style concordance with the hits marked in red. In figure 9, a search for papers with the word “logic” in the title and the word “consequence” in the text (here added in the search facility and marked in green for clarity) yields three texts:

Title	Content
<input type="text" value="logic"/> <input type="text"/>	Enter word or part of word to do case-insensitive free text search of content: <input type="text" value="consequence"/> Note: this search criteria is AND'ed with the other criteria

- [The Logic of Calvinism](#)

- [The Logic of Obligation and the Obligations of the Logician](#)

- [The Paradox of the Prisoner in Logical Form](#)

>>consequence<<

than their stouter brethren to stomach the **consequence** that since Christ died to make God's

his brethren who accepted and rejoiced in this **consequence** he regarded as a kind of fifth column who were

between elect and reprobate. Might not the **consequences** with which they charged the Amyraldists really

was reversed and their nature changed in **consequence**. Perceiving the obstacle set to the exercise of

could not develop the presuppositions and **consequences** of truths which they only asserted by

>>consequence<<

to lay down something as a general law, but its **consequences** make it clear that this inclination is

>>consequence<<

that a man cannot be hanged twice over; 7 is a **consequence** of the fact that he is to be hanged at noon if

knows the conditions of his execution and the **consequences** of these conditions. From these premises, and

Figure 9.

By clicking on the “Display” button for a given text, a window opens with the hits marked in red and shown in capitals. In figure 10, a part of the text “The Paradox of the Prisoner in Logical Form” is shown with the two occurrences of “consequence”. The text remains of course unchanged in the database and the PDF, these typographical changes are done merely to make it easier for the user to locate the occurrences in the transcribed text.

5. CNHsHm (‘If the prisoner is not hanged on Sunday he will be on Monday’).
6. CHmNHs (‘If the prisoner is hanged on Monday he will not be hanged on Sunday’).
7. CNHsGsNHs (‘If the prisoner is not hanged on Sunday he will know on Sunday that he is not to be hanged on Sunday’).
8. CHt NG<sup>^</sup>tHt (‘If the prisoner is hanged on the day t he will know on the day before t that he is to be hanged on the day t’).

Here 5 expresses the judge’s sentence; 6 expresses the fact that a man cannot be hanged twice over; 7 is a **CONSEQUENCE** of the fact that he is to be hanged at noon if at all on a given day; and 8 expresses the judge’s stipulation. In deriving theorems we shall use the ordinary rules of substitution and detachment, together with these two special rules:

RGt:  $C\alpha\beta \rightarrow CGt\alpha Gt\beta$ , i.e. if it is a law of the system that if  $\alpha$  then  $\beta$ , then it is a law of the system that if the prisoner knows on the day t that  $\alpha$ , he knows on the day t that  $\beta$ .

RG<sup>^</sup>s:  $\alpha \rightarrow G^{\wedge}s\alpha$ , i.e. if it is a law of the system that  $\alpha$ , then it is a law of the system that the prisoner knows on Saturday (‘the day before Sunday’) that  $\alpha$ .

RG<sup>^</sup>s expresses the assumption that so long as the prisoner is alive he knows the conditions of his execution and the **CONSEQUENCES** of these conditions. From these premises, and with these rules, we may make the following deductions:

9. CHmGsNHs.  $1p/Hm, q/NHs, r/GsNHs = C6 - C7 - 9$
10. CGtNHsGtHm.  $5[5] \times RGt = 10$
11. CHmGsHm  $1 p/Hm, q/GsNHs, r/GsHm = C9 - C10 t/s - 11$
12. CHmG<sup>^</sup>mHm  $11 \times Df.s = 12$
13. CG<sup>^</sup>tHtNHt  $2[6] p/Ht, q/G^{\wedge}tHt = C8 - 13$
14. CHmNHm.  $1p/Hm, q/G^{\wedge}mHm, r/NHm = C12 - C13 t/m - 14.$
15. NHm.  $4p/Hm = C14 - 15.$
16. Hs.  $3p/Hs, q/Hm = C5 - C15 16.$
17. G<sup>^</sup>sHs.  $16 \times RG^{\wedge}s = 17.$
18. NHs.  $13 t/s = C17 - 18.$

Figure 10.

## Conclusion

The VL-3C and the Nachlass have formed and will form an interesting test bed for a much more elaborate it-system to be developed. This process will invariably address the general problem of how to present the professional works of a writer in digital form. In the present case, the substance – the Prior Archive – is of a scientific nature. But the ideas and experiences thus gained can most certainly be used in any setup where an archive, more or less structured and maybe containing many kinds of material, is photographed and/or scanned, structured into logical entities, written or printed text transcribed (if print quality permits, run through an Optical Character Recognition – OCR – to produce a text to work from) to produce machine readable text to markup and add comments or indeed add inline annotations to. Many perspectives present themselves. The case presented here forms the basis.