

# D IAGNOSIS AND DIGITIZATION OF DANTESQUE CODE “PHILLIPPS 9589”

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## 1. Introduction

The object of this case of study is the research carried out by the Dipartimento di Storie e Metodi per la Conservazione dei Beni Culturali Alma Mater Studiorum Università di Bologna (sede di Ravenna), according to the terms of collaboration with the Dantesque Centre of the “Fratelli Minori Conventuali” in Ravenna<sup>1</sup>, on the Dantesque Code catalogued at the Centre Library as *Manoscritto n. 2*.

The manuscript is known to the international scientific community with the acronym Phillipps 9589 and its importance lies in being the unique Dantesque palimpsest code and in conserving, in the *scriptio superior*, one of the oldest witnesses in Dante's *Commedia* manuscript tradition, named a tradition, the so-called “old vulgata” (fig. 1).

The research, developed in several stages, with the contributions of experts with different skills in the historical-philological and technical fields, intended to take into consideration some peculiar aspects as:

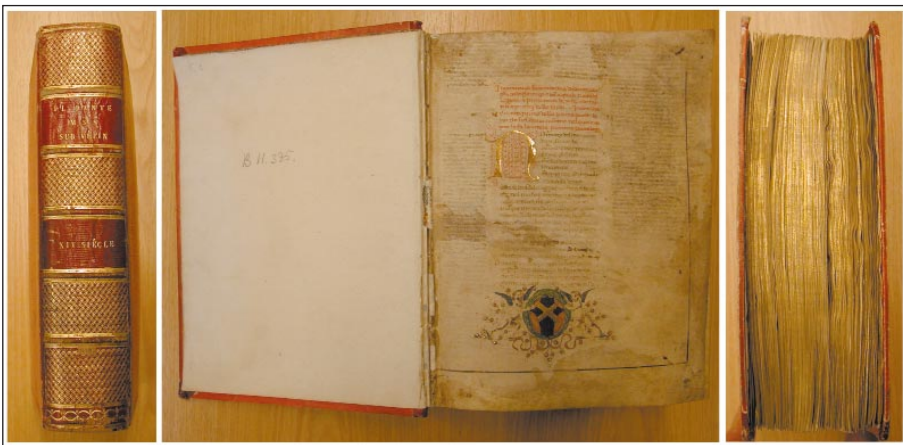


Figure 1. Code Dante Phillipps 9589.

- valuation of the state of conservation;
- characterization of materials;
- valuation of the conservation environment;
- improvement of the Dantesque text legibility;
- the palimpsest reading and dating;
- code digitization in order to make it available on the intranet and the Internet.

In particular this writing means to refer to the employment of non-destructive testing techniques to find out when the code was compiled.

As it is well known, no Dante's autograph survived and so it does not exist an original manuscript of the *Commedia*. In return Dante's masterpiece was widely distributed: a few years after his death, copies of the *Commedia* spread through Italy. Nearly 800 manuscripts have come to us. Such a circulation was made possible by a production of codes drafted by many copyists, some of them were famous, such as Giovanni Boccaccio, others were simple labourers in workshops producing manuscripts in the XIV and the XV century. This, while expediting the knowledge of Dante's work, yet it led inevitably to a rapid corruption of the text, preventing to go back to the original version. Doing a palaeographic investigation to get to a text as close as possible, in chronological terms, to the Dantesque original, involves an increase in the historic-philological, as well as economic, as far as it concerns here, value of the manuscript.

In this case, the difficulties in carrying out a palaeographic inspection were determined by the bad state of conservation, in some parts, of the Dantesque text and by the non-legibility, under normal conditions, of the palimpsest.

Before describing the testing relating to the use of diagnostic techniques to improve the



Figure 2. *Ex-library with the heraldic emblem of the family Guilford.*

text legibility and allow the reading and the dating of the palimpsest, we report first, briefly, the results of the investigations carried out on the code, referring to other texts for what it concerns the following diagnostic instruments features and use [1-4].

## 2. Historic anamnesis

The only reliable historical data about the manuscript are available from the XVIII century, when the *Comedy's* copy was purchased by Fredrick North, fifth Earl of Guilford (London 1766-Corfu 1827).

At the Earl's death, in 1827, his collection was auctioned and the code was sold by the lot (currently still visible on ex-library 7/19/G (seventh batch, composed of nineteen manuscripts) in 1830, and it became part of Sir Thomas Phillipps's library (fig. 3).

After T. Phillipps's death, occurred in 1938, the code was sold more than once until it was bought in 1950 by a collector from Milan and it eventually came to the Dantesque Centre in 1983.

In the research done by Father G. Zanotti (father G. ZANOTTI, *La biblioteca del «Centro Dantesco» in Ravenna. Dai manoscritti alle edizioni del Settecento*, Ravenna,

Longo Editore, p. 44), it is assumed, in lack of reliable sources, that the code was made in Tuscany in the second half of the XIV century, and that the client was the Aldobrandini-Bellincioni family, whose emblem is shown in the miniature on the verso of the first carta (fig. 4). The study points out that the obvious influences of the Renaissance graphics, found mainly in the putti, cast doubts on dating this emblem before the XV century.



Figure 3. Particular of the binding's spine where is present the number 9589



Figure 4. Hell, c.1 r., emblem ascribed to the family-Bellincioni Aldobrandini.

### 3. Evaluation of the state of conservation

The visual investigation on the manuscript underlined the dissimilarities among the Inferno (fig. 5) and the Paradise (fig. 6) Canticæ and the Purgatory (fig. 7) Canticæ, both in a palaeographic point of view (different handwriting) and in terms of writing support, since the parchment used for the Purgatory does not show *scriptio inferior* and is much whiter and more intact than the other two Canticæ.

There are, on the other hand, analogies among filigreed initial letters in the three Canticæ (fig. 8) which are very similar; as well as the simple letters, in alternate red and blue inks, seem to be by the same workmanship in the whole work [5-19].

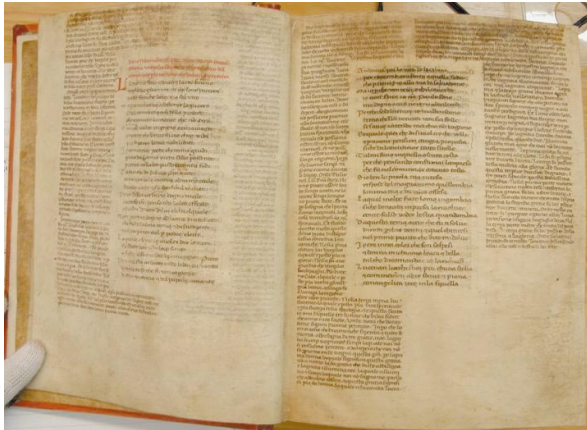


Figure 5. Code Dante Phillipps 9589, pages of Hell.



Figure 6. Code Dante Phillipps 9589, pages of Paradise.

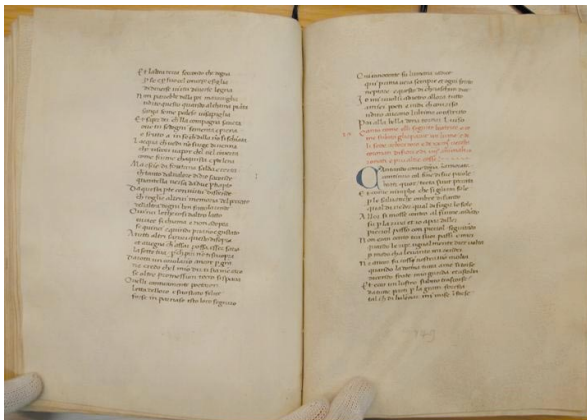


Figure 7. Code Dante Phillipps 9589, pages of Purgatory.



Figure 8. Filigreed initial letters in the Hell Cantica (a) and in the (b) Purgatory Cantica.

#### 4. Analytic-diagnostic investigations

The use of image-analysis video microscope allowed, thanks to the possibility to greatly enlarge the details, to acquire information about the artefact, not only concerning its state of conservation, but also its historical and technical aspects.

The employment, then, of the image-analysis software has been remarkably helpful to detect some important details related to degradation phenomena and, by making appropriate measures, it is a non-destructive, non-intrusive, applicable *in situ* method to keep under a steady surveillance the manuscript's state of conservation.

The multispectral investigation technique was – as we will discuss in detail later on – strongly supportive to the reading and the interpretation of the *scriptio inferior*.

The fluorescence spectroscopy of X-ray allowed the identification of chemical elements whose presence, interpreted through the information gathered from historical and artistic sources, led to the individuation of pigments, inks, gilt types, as well as the chemical characterization of parchment.

Colorimetric investigations allowed to distinguish chromatic changes due to degradation phenomena, as well as to quantify the differences in colour on the various Canticae's supports, creating documentation to be considered as reference for the evaluation of changes over time.

As to the microbiological analysis results, they showed that the biological development, very low and in some cases absent, is not cause of the parchment's damage at the moment. Nevertheless tests on microorganisms will have to be repeated in the future in order to monitor any possible biological development over time [20-27].



## 5. Environmental monitoring

As part of the study system/artefact-environment, in order to evaluate whether the thermo-hygrometric conditions conform to the regulations regarding the conservation of graphic documents, hygrometric campaigns with reference to trends over time (yearly campaign) and daily ranges.

The results in the temperature and relative humidity monitoring have shown:

stable values and dependent on the season in deposit (in the safe), notable thermo-hygrometric ranges in case of use by scholars (fig. 9).

It's been highlighted, therefore, the need to find a place for the artefact that could enhance and make accessible the precious code and, at the same time, provide an optimal microenvironment for its conservation [4, 7, 19-21, 24-25].

On the other hand, among the causes of graphic documents degradation, must be mentioned the everyday reading.

Among the protective and conservative actions the code digitization was planned.

As everybody knows this operation permits the consultation, even remotely, of a copy without any interaction with the original text.

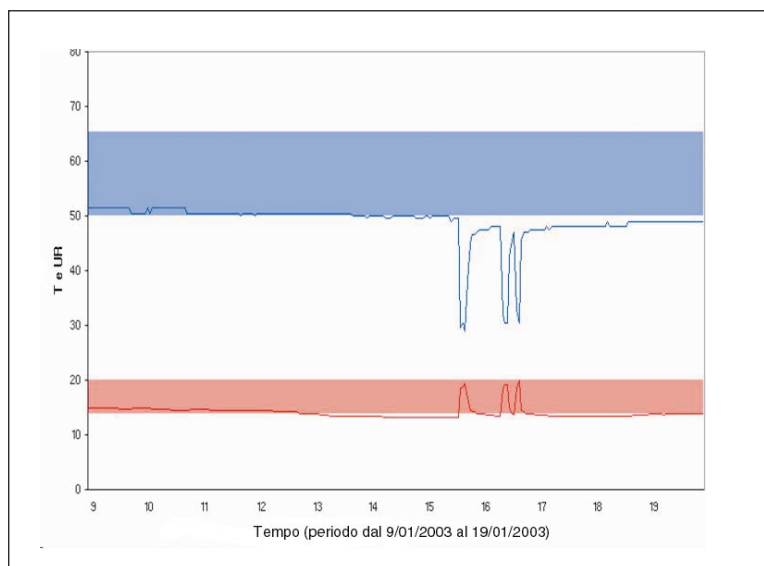


Figure 9. Temperature and relative humidity trends, compared with the respective well being bands for graphics documents.

The code digitization was carried out at the Photographic Laboratory in the Department of History and Methods for Preservation of Cultural Heritage.

## 6. The digitization of the code

The digitization of the codes was carried out at the Photographic Laboratory of the Dipartimento di Storie e Metodi per la Conservazione dei Beni Culturali Alma Mater Studiorum Università di Bologna in respect of legislation for the acquisition of digital photographs (Istituto Centrale per il Catalogo and Documentation ICCD-1998).

For the digitization, it was used the scanner planetary KODAC master File with Cradle. The images captured were made with a depth of 48 bit colour.

The scanner has the planetary core functions to produce quickly an image file faithful to the original, perfectly centred and aligned, and has the following characteristics:

- shot from above, prerequisite to manipulate the code to a minimum;
- presence of a cradle that allows, once supported by book, to compensate for the difference between the two parts of volume so as to always put them in line with the recovery plan;
- optical image-correction need to eliminate shadows, misalignment and curvature of the page.

The processing was done with specific tools and filters: MATTLAB graphics processing Fotoshop CS3.

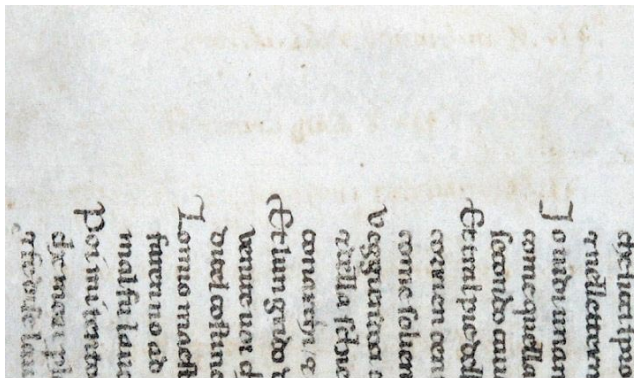


Figure 10. Hell, c. 27 v., see traces of scriptio inferior in the visible image.

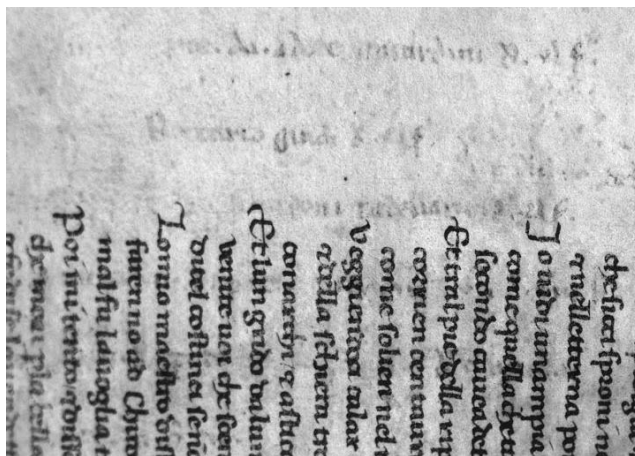


Figure 11. Hell, c.27 v., see scriptio inferior (370 nmUV).

At the Centro Interbibliotecario dell'Università di Bologna has developed a search using various parameters for the test, allowing the recovery of the information and view of digital images of pages in corresponding Jpeg format (fig. 10) and DjVu. This last format, in particular, allows for further image processing. In fig. 11 shows an example of measurement of an Initial letter.

The parameters of the question are as follows:

- ✓ Cantica (Inferno, Purgatory, Paradise);
- ✓ Card number;
- ✓ Canto;
- ✓ Verse;
- ✓ Current page;
- ✓ Previous page;
- ✓ Following page.

#### **7. Use of diagnostic techniques to improve the legibility of the Dantesque text and allow the palimpsest reading and dating**

Some shots with the multispectral system were taken during the digitization process in the Diagnostic Lab, in the Department, to acquire images (MuSIS). This system allows the acquisition of images, in the electromagnetic radiation band, ranging from the 320 nm for the ultraviolet (UV) wavelength to the 1000 nm for infrared. The



MuSIS allows moreover the visible radiation decomposition in components from violet to red.

The instruments adopted are:

- detection system consisting in a visible and infrared video camera with UV filters;
- connection to a computer;
- software for the image acquisition management.

This system allows to select the wavelength range which is used to study the artefact.

As already pointed out, the investigation aimed to allow the palimpsest's (*scriptio inferior*) legibility – impossible under normal conditions (fig. 10) –, to carry out the palaeographic survey and so to make a *post quem* dating possible for the Dantesque text written upon (*scriptio superior*). The *range* that provides the best results in this context is the ultraviolet one (fig. 11).

### **7.1. Palaeographic inspection**

After taking such shootings, it was possible to submit the palimpsest's to a palaeographic inspection. Such an investigation revealed that:

The *scriptio superior* (the Dantesque text) was written in a Semi Gothic or Pre-humanistic handwriting approximately datable around the last two decades of the XIV century, since it shows the same characteristics of some codes by Coluccio Salutati (*r* and *d* still have, in several examples, the “gothic” or *modern letter* form).

The *scriptio inferior*, largely covered by the Dantesque text upon and rotated by 180 degrees, is a notarial cursive writing datable to the end of the XIII or the beginning of the XIV century (approximately between 1280 and 1330). Isolated words (personal names, sums of money or bushels of wheat) lead the text to a list of people required to provide specific payments in kind (bushels of wheat or librae or flasks of wine) or in cash.

## **8. Considerations**

This lecture meant to demonstrate the importance of non-destructive diagnostic techniques to find out the code writing period.

The use of multispectral system for acquiring images (MuSIS) allowed to read the palimpsest, making possible to carry out the palaeographic investigation which identified in the *scriptio inferior* a notarial cursive writing datable between 1280 and 1330. The dating is compatible with the *scriptio superior* one. The subjects discussed in the palimpsest

text, relating to exchanges of goods and trade certified by a notary and therefore without any value after few years, testify the parchment paper reuse after a short period following the drawn up of the deed.

In conclusion, the possibility of conducting a palaeographic survey to get back to a text as close as possible to the Dantesque original in terms of time caused an increase in the manuscript historic and philologic value, and thus also in its economic one.

### Notes

- <sup>1</sup> The research has been carried out with the collaboration of Friar Maurizio Bazzoni Director of the Dantesque Centre of the "Fratelli Minori Conventuali". From a scientific point of view his contribution played a decisive role and his availability is particularly valuable since deriving from a Christian and human vision.

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## Summary

This work concerns the study of Dante's Code, illuminated on parchment, which is preserved at the Library of "Centro Dantesco dei Frati Minori Conventuali" in Ravenna.

This Code is well-known by the international scientific Community as Phillipps 9589 and its notoriety is not only due to the fact that it's the only Dante's Palimpsest, but also because it preserves, at the scripto superior, one of the older witness of that branch of handwritten tradition of Dante's Commedia named "Tradition  $\alpha$ ", the so-called "old Vulgate".

The research, worked out for several stages, had aimed to examine the technical-diagnostic aspects, in particular the general purposes had been:

- evaluation about the state of preservation;
- materials characterization;
- improvement of the legibility of Dante's text and Palimpsest reading;
- evaluation about the preservative environment;
- code digitization suitable for an intranet and internet use.

In this connection, the following non-destructive diagnostic techniques had been employed, also related to a documentary aim:

- image analysis videomicroscope;
- spectrophotometric colorimetry;
- X-ray fluorescence (XRF);
- Multispectral Imaging System (MuSIS);
- environmental monitoring Instruments (thermohygrometer, illuminometer, aerosol spectrometer PTS e PM10).

## Riassunto

Il presente lavoro riguarda lo studio del Codice dantesco miniato su pergamena conservato presso la Biblioteca del Centro Dantesco dei Frati Minori Conventuali di Ravenna.

Tale codice è noto alla comunità scientifica internazionale con la sigla di Phillipps 9589 e deve la sua notorietà al fatto non solo di essere l'unico palinsesto dantesco, ma anche di conservare, nella scriptio superior, uno tra i testimoni più antichi di quel ramo della tradizione manoscritta della Commedia di Dante chiamata "Tradizione  $\alpha$ ", la cosiddetta "antica Vulgata".

La ricerca, svolta in più fasi, si è proposta di approfondire gli aspetti tecnico-diagnostici, in particolare le finalità generali sono state:

- valutazione dello stato di conservazione;
- caratterizzazione dei materiali;
- miglioramento della leggibilità del testo dantesco e lettura del palinsesto;
- valutazione dell'ambiente di conservazione;
- digitalizzazione del codice per una fruizione intranet ed internet.

A tal riguardo ci si è avvalsi dell'impiego delle seguenti tecniche diagnostiche non-distruttive anche a scopo documentario:

- fotografia digitale;
- videomicroscopio ad analisi di immagine;
- colorimetria spettrofotometrica;
- fluorescenza a raggi X (XRF);
- sistema multispettrale per l'acquisizione di immagini (MuSIS Multispectral Imaging System);
- strumentazioni per il monitoraggio ambientale (termoigrometro, luxmetro, prelevatore polveri PTS e PM10).

## Résumé

Le présent ouvrage concerne l'étude du Code dantesque miniaturé sur parchemin, conservé auprès de la Bibliothèque du Centre Dantesque des Frères Mineurs Conventuels de Ravenne.

Ce code est connu par la communauté scientifique internationale avec le sigle de Philipps 9589 et doit sa notoriété au fait non seulement d'être l'unique palimpseste dantesque, mais aussi de conserver, dans la scriptio superior, un des témoignages les plus antiques de cette branche de la tradition manuscrite de la Comédie de Dante appelée "Tradition  $\alpha$ ", la soi-disant "antica Vulgata".

La recherche, développée en plusieurs phases, s'est proposée d'approfondir les aspects technico-diagnostiques, en particulier les finalités générales ont été:

- évaluation de l'état de conservation;
- caractérisation des matériaux;
- amélioration de la lisibilité du texte dantesque et lecture du palimpseste;
- évaluation du milieu de conservation;
- numérisation du code pour une jouissance intranet et internet.

À ce propos, on s'est servi de l'emploi des techniques diagnostiques non-destructives suivantes aussi dans un but documentaire:

- photographie numérique;
- vidéomicroscope à analyse d'image;
- colorimétrie spectrophotométrique;
- fluorescence à rayons X (XRF);
- système multispectral pour l'acquisition d'images (MuSIS Multispectral Imaging System);
- instrumentations pour le monitoring environnemental (thermoigromètre, luxmètre, préleveur poussières PTS et PM10).

## Zusammenfassung

In dieser Arbeit wird der mit Miniaturen verzierte dantische Kodex auf Pergament studiert, der in der Bibliothek des Zentrums der Dante-Forschung der Minoriten des Konvents in Ravenna verwahrt wird. Dieser Kodex ist der internationalen wissenschaftlichen Welt unter dem Namen Philipps 9589 bekannt, er ist berühmt nicht nur weil er der einzige dantische Palimpsest ist, sondern auch weil er in der Scriptio Superior eines der antiksten Zeichen der Tradition der Manuskripte von Dantes Commedia trägt, die sogenannte "Tradition  $\alpha$ " oder "antike Vulgata".

Die Forschung ist in verschiedenen Phasen aufgeteilt und zielt darauf, die technischen und diagno-



stischen Aspekte eingehend zu studieren, insbesondere waren die allgemeinen Ziele der Forschungsarbeit folgende:

- den Erhaltungszustand zu bewerten;
  - die Materialien zu charakterisieren;
  - die Lesbarkeit des dantischen Textes zu verbessern und den Palimpsest zu lesen;
  - die Konservierungsumgebung zu bewerten;
  - den Kodex zu digitalisieren, um ihn im Intranet und im Internet lesen zu können.
- In diesem Zusammenhang wurden die folgenden Diagnosetechniken angewendet, die nicht zerstörerisch sind, auch mit einem dokumentarischen Ziel:
- digitale Fotografie;
  - Videomikroskop mit Bildanalyse;
  - spektrale photometrische Kolorimetrie;
  - Röntgenfluoreszenz (XRF);
  - multispektrales System für das Aufnehmen von Bildern (MuSIS Multispectral Imaging System);
  - instrumentelle Ausrüstung für die Umweltüberwachung (Thermohygrometer, Luxmeter, Vorrichtung zur Staubentnahme PTS und PM10).

## Resumen

Este trabajo se refiere al estudio del códice de Dante miniado en pergamino que se conserva en la Biblioteca del Centro Dantesco del Convento de los Frailes Menores de Rávena.

El códice, conocido por la comunidad científica internacional con la sigla Phillipps 9589, debe su notoriedad no sólo al hecho de ser el único palimpsesto de Dante, sino también a que conserva, en la scriptio superior, uno de los testimonios más antiguos de aquella rama de la tradición manuscrita de la Comedia de Dante llamada "Tradición  $\alpha$ ", la conocida como "antigua Vulgata".

El estudio, que pasó por dos fases, se ha propuesto profundizar en los aspectos técnico-diagnósticos. En particular, las finalidades generales han sido:

- evaluación del estado de conservación;
- caracterización de los materiales;
- mejora de la legibilidad del texto de Dante y lectura del palimpsesto;
- evaluación del ambiente de conservación;
- digitalización del código para su acceso intranet e internet.

En relación con ello se ha recurrido a las siguientes técnicas de diagnóstico no destructivas, también con fines de documentación:

- fotografía digital;
- videomicroscopio con análisis de imagen;
- colorimetría espectrofotométrica;
- fluorescencia por rayos X (XRF);
- sistema multispectral para adquisición de imágenes (MuSIS Multispectral Imaging System);
- instrumentación para la monitorización del ambiente de conservación (termohigrómetro, luxómetro, captador de polvos PTS y PM10).

## Резюме

Данная статья рассматривает изучение Кодекса, древней рукописи Данте, написанной на пергаменте и украшенной миниатюрами. Эта рукопись находится на сохранении в Равенне, в Центре Данте, принадлежащем монахам францисканцам. Эта рукопись известна международному сообществу под кодом Phillips 9589 и знаменита не только потому, что представляет собой

единственный палимпсест Данте, но и потому что в части *scriptio superior* содержит одну из самых древних традиций написания Комедии Данте, названной «*tradizione a*», или «древняя вульгата». Исследование, проведенное в несколько этапов, было направлено на углубленное изучение технико-диагностических аспектов.

В частности:

- оценка степени сохранности;
  - оценка материалов;
  - улучшение удобочитаемости рукописи Данте и чтения палимпсеста;
  - оценка места сохранения рукописи;
  - введение текста рукописи в компьютер с целью его использования в Интернете.
- Для проведения этих исследований были применены следующие диагностические методы обработки документов:
- цифровая фотография;
  - видеомикроскоп, анализирующий изображение;
  - спектрофотометрическая колориметрия;
  - флуоресценция лучей X (XRF);
  - мультиспектральная система получения изображений (MuSIS Multispectral Imaging System);
  - приборы для исследования окружающей среды (термогигрометр, люксметр, измеритель пыли PTS и PM 10).