Chapter 1

OVERVIEW AND CONTEXT OF THE SCLADINA PALAEOANTHROPOLOGICAL PROJECT

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The Scladina I-4A Juvenile Neandertal (Andenne, Belgium)
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1. Introduction

Many of the most famous Neandertal fossil discoveries occurred numerous decades ago: Gibraltar (1848), the Neandertal type site (1856), Krapina (from 1899), La Quina (from 1908), La Chapelle-aux-Saints (1908), La Ferrassie (from 1909), etc. As a result, their context is not precisely known by comparison to current standards of research, particularly in the absence of rigorous stratigraphic and chronological position as well as planimetric distribution or strict association with lithic material. Within the Meuse River Basin of southern Belgium (i.e. in the vicinity of Scladina) this same situation is encountered in a series of illustrious karstic discoveries (Toussaint, 1992, 2001): in 1829-30 at Engis by Ph.-Ch. Schmerling (Schmerling, 1833-34; Tillier, 1983), in 1866 at La Naulette in the Lesse Valley by E. Dupont (Dupont, 1866; Leguebe & Toussaint, 1988), and in 1886 at Spy (Fraipont & Lohest, 1887). The same may be said about the lesser known discovery of some teeth and bones at Goyet around 1870 (Rougier et al., 2009, 2014) and of a partial femur in 1895 at Fonds de Forêt (Twiesselmann, 1961).

To finally have at our disposal Neandertal remains from Meuse River Basin caves which possess a precise enough context compatible with modern scientific requirements, we had to wait until the last three decades for the discovery of new Middle Palaeolithic human fossils in the sedimentary fillings of three other caves, successively in 1984 at Trou de l'Abîme (Couvin; Toussaint et al., 2010), from the early 1990s onwards at Scladina (Sclayn-Andenne; Toussaint et al., 1998) as well as in 1997 at Walou (Trooz; Toussaint, 2011). At Couvin and Walou, however, the discoveries are limited to an isolated tooth, a decidous mandibular right second molar and a mandibular left first premolar, respectively.

This explains the tremendous interest in the discovery of both halves of a mandible, a fragment of a maxilla, and a series of teeth, all from the same juvenile Neandertal (Figure 1), during the excavations of Scladina Cave, on the left bank of a small tributary of the Meuse Valley (Figure 2). Excavations at Scladina have been conducted almost without interruption since 1978 by the University of Liège and, at present, by Archéologie Andennaise. The importance accorded to the context of all the fossils and artefacts at Scladina was enhanced by the discovery of the right hemi-mandible (Scla 4A-1) of a child in 1993, the first Neandertal osseous element encountered in Belgium in 98 years. A very high degree of resolution has been achieved over the past 10 years based on the stratigraphic revision (Pirson, 2007; Chapter 3, this volume) and an excavation method adapted to this stratigraphic complexity (Chapter 2, this volume; Bonjean, 2009). In this regard, a unique field technique based on combined horizontal and vertical excavations on a reduced surface has recently been developed in order to obtain a very precise stratigraphical position for all lithic and faunal artefacts without the

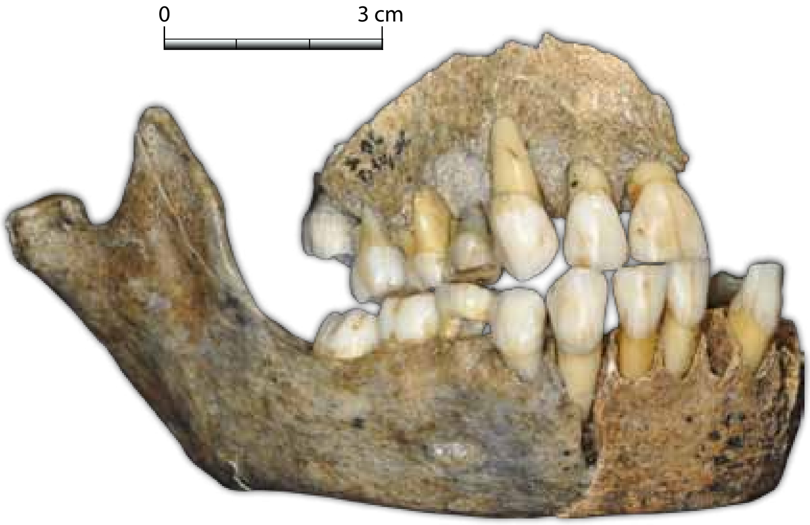

Figure 1: Refitting of most Scladina Neandertal fossils found in former Layer 4A (photograph Joël Éloy, AWEM).

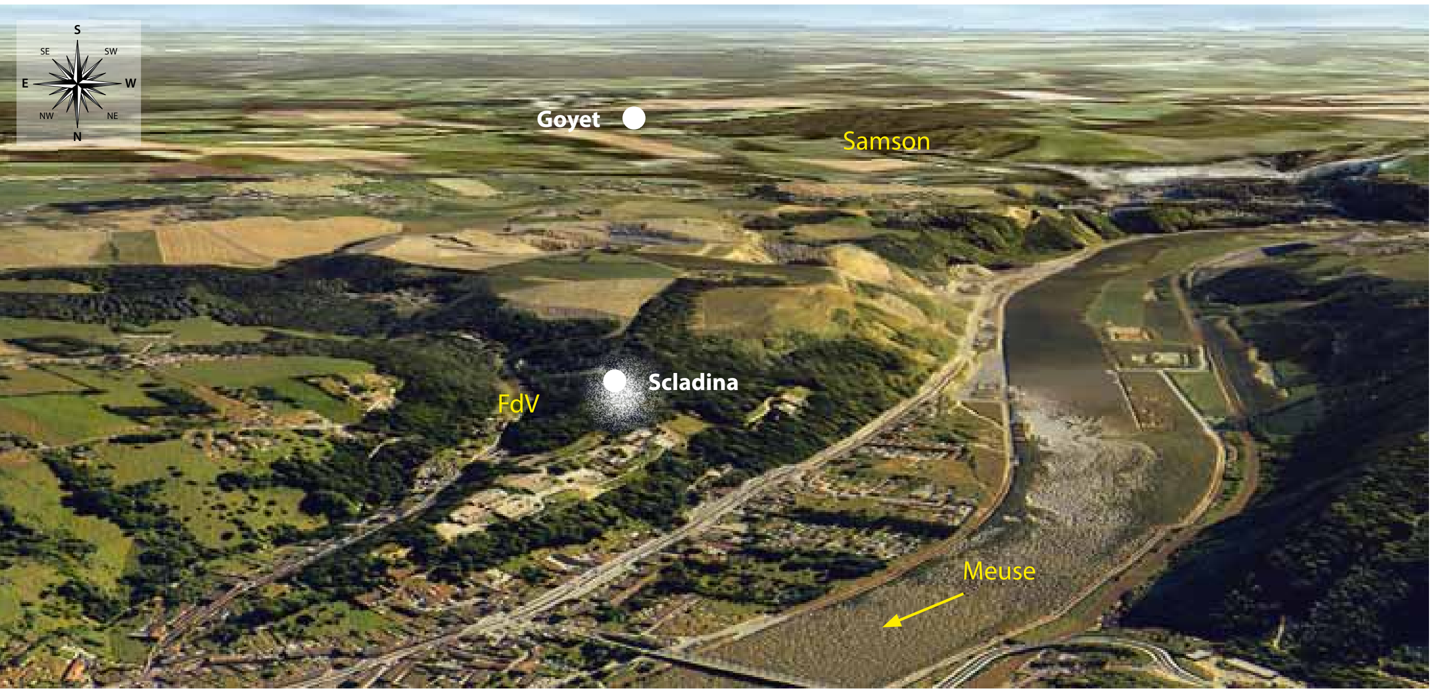

Figure 2: 3D representation of the Meuse Valley and two of its tributaries, Fond des Vaux (FdV) and Samson, with the location of Scladina and Goyet caves (Joël Éloy, AWEM).

loss of their planimetric distribution, as all the Cartesian coordinates are precisely recorded.

2. Scientific context of the Neandertal child, Scladina I-4A

The anthropological finds from Scladina derive from a prehistoric and palaeontological site of major importance to the Belgian Meuse Basin as well as northwest Europe. The application of the latest standards of modern multidisciplinary Quaternary research to the excavation of the site provides remarkable precision in the contextual allocation of these finds, amplifying their interest.

The human fossils found in former Layer 4A have each received a number, from 1 to 20 (for example Scla 4A-11 which refers to the isolated permanent maxillary right central incisor). In addition, as all these fossiles of former Layer 4A belong to the same 8-year-old specimen, it has been decided to use the code 'Scladina I-4A' to referred to the juvenile as an individual.

The stratigraphical sequence of the cave had been partially described in the pioneering works of archaeologists (Otte et al., 1983; Bonjean, 1998[a]) and geologists (Deblaere & Gullentops, 1986; Gullentops & Deblaere, 1992; Haesaerts, 1992; Benabdelhadi, 1998) who had revealed the tremendous potential of the site. The recent meticulous reappraisal of the sequence during the course of Stéphane Pirson's (2007) PhD thesis in geology at the University of Liège revealed the sequence of deposits was much more complex and rich in information than previously thought, with significant variability in the sedimentary and diagenetic processes as well as in the scale of the lateral variations of facies.

The cave is also rich in palaeontological and palynological information. In this regard, it has led to multiple research projects, published in numerous papers and PhD theses.

Initial projects focused on palynology (e.g. Bastin & Schneider, 1984; Bastin et al., 1986; Schneider, 1986), microfauna (Cordy in Bastin et al., 1986), and macrofauna. Many of these contributions were developed in the first monograph dedicated to the site (Otte (ed.), 1992; Bastin, 1992; Cordy, 1992; Simonet, 1992). Some more recent works deal with archaeozoology (e.g. Patou-Mathis, 1998[a, b]; Patou-Mathis & López-Bayón, 1998; Crépin, 2002) and taphonomy (Pionnier, 2006; Delaunois et al., 2012).

All this previous research referenced initial lower resolution stratigraphic records that have been improved in recent years (Pirson, 2007). For example, the authors combined all data from what they called 'Layer 4' (Simonet, 1992; Patou-Mathis, 1998[a]), whereas this vast layer was actually very stratigraphically complex.

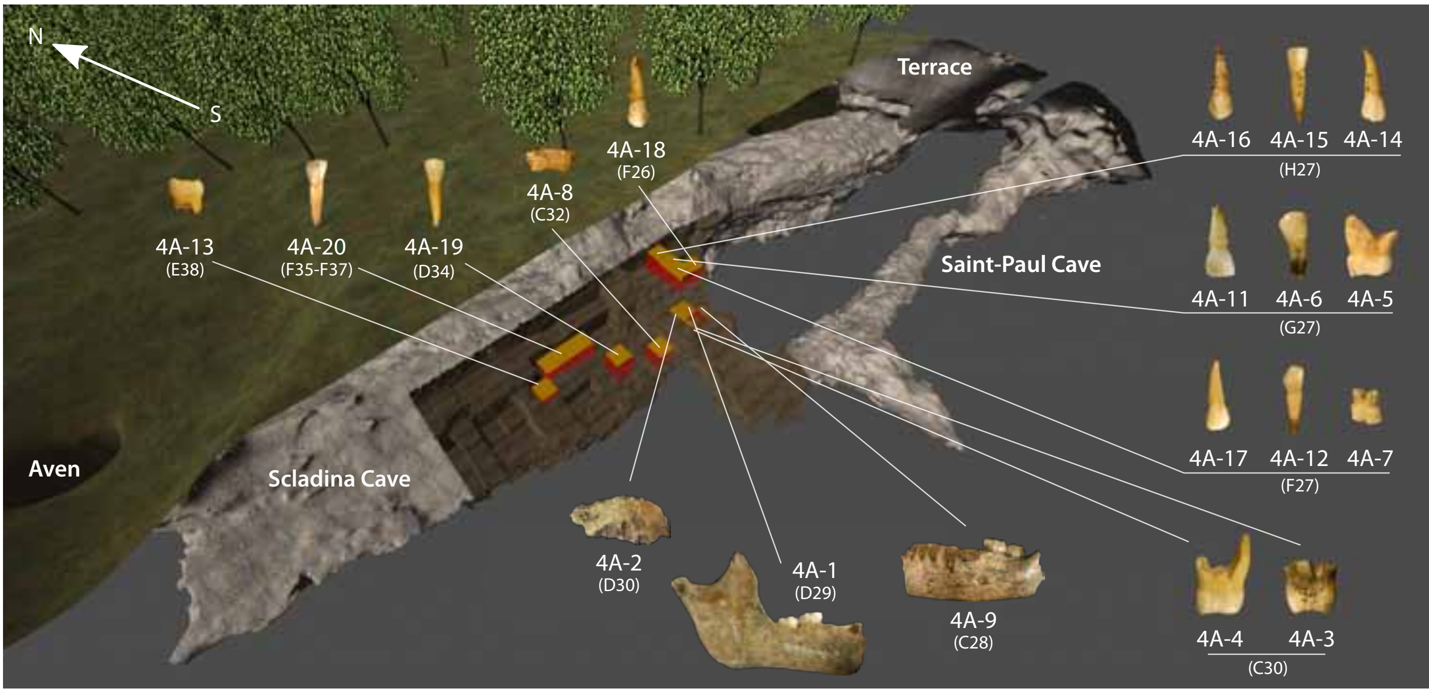

Figure 3: 3D reconstruction of Scladina Cave positioning the Neandertal fossils found in former Layer 4A (Joël Éloy, AWEM).

Despite this problem, the correlation of information gathered from old palaeontological data with recent palynological and anthracological data (Damblon & Court-Picon, in Pirson, 2007) based primarily on the last stratigraphic revisions is possible. This association forms an innovative palaeoenvironnemental synthesis, confirming the remarkable quality of preservation of the Scladina deposits (Pirson, 2007).

A variety of dating methods provided numerous dates for Scladina: conventional radiocarbon dating of bones and stalagmites; AMS dating of animal bones and teeth; U/Th dating of concretions, stalagmitic floors, and teeth; TL dating of calcite, burned flint, and silt; gamma spectrometry of the Neandertal mandible, and ESR dating of bones (e.g. Gilot, Szabo & Aitken in Otte et al., 1983; Gewelt in Bastin et al., 1986; Gewelt et al., 1992; Gilot, 1992; Huxtable & Aitken, 1992; Debenham, 1998; Bonjean, 1998[b]; Falguères & Yokoyama in Toussaint et al., 1998; Pirouelle, 2006; Pirson, 2007; Pirson et al., 2008). These dates are discussed in Chapter 4 and placed in the context of the general stratigraphic sequence of Scladina. With few exceptions, all these dates become gradually younger from sedimentary Unit 5, which yielded the richest prehistoric occupation of the Middle Palaeolithic — some 130,000 ± 20,000 years BP — up to sedimentary Unit T, near the top of the Pleistocene sequence, from which a ^{14}C date of 37,300 +370/−320 BP (GrA-32633; Pirson, 2007) was recently obtained. Based on this set of dates, a palaeoenvironmental synthesis can tentatively be related to a hypothetical stratigraphic position, in which some benchmarks appear fairly clearly (see Chapter 4).

Another cave of the Meuse River Basin, Walou, located about sixty km east of Scladina, has also yielded a magnificent Pleistocene sequence whose chronostratigraphy is better known (Draily et al. (dir.), 2011; Pirson et al. (dir.), 2011). The comparison of the stratigraphy of these two caves contributes to the establishment of a palaeoenvironmental and chronostratigraphic reference for Meuse River Basin caves to which other regional archaeological and palaeoanthropological discoveries can be correlated. For example, fossils found in an acceptable, albeit less complete, stratigraphy than those of Walou and Scladina, may be reinterpreted as is notably the case for the decidous mandibular right second molar found at Trou de l'Abîme, in Couvin (Toussaint et al., 2010, 2011).

In addition to its stratigraphic, palaeontological and palaeoenvironnemental interest, Scladina yielded some essentially Middle Palaeolithic occupation layers (mainly units 5 and 1A). Numerous archaeological studies focusing on lithic typology, technology, spatial distribution and raw materials have been published (for example Otte et al.

(dir.), 1998, Di Modica & Bonjean, 2004 and more recently Di Modica, 2010, 2011).

The event which confers a major international appeal for Scladina was the in situ discovery (from 1993) of dental and osseous remains of a Neandertal child (Figure 3) although the first fragments (found in 1990) were not identified at that time. The studies offered in this monograph correspond only to the first stage of our understanding of the human palaeontological heritage of the cave as the potential for the discovery of Neandertal remains seems far from exhausted. A distributional comparison of the location of recovered hominin fossils with the large unexcavated areas of the cave provides an indication in this respect, notably by highlighting a concentration of teeth at the limit of the excavated area. The fact that the Neandertal face is only represented by a fragment of right maxilla adds another argument in this regard.

The outstanding state of preservation of the bone material, like that of numerous other limestone caves of the Meuse River Basin, allowed the extraction of fossil DNA, animal (Orlando et al., 2002) as well as human (Orlando et al., 2006). At that time one tooth of the child delivered the oldest fragment of the Neandertal sequence and this sample exhibited a larger genetic variability than more recent samples, for example those of the eponymous Feldhofer site. The $\delta^{13}C$ and $\delta^{15}N$ from Scladina bones, either belonging to mammals (Bocherens et al., 1997) or Neandertals (Bocherens & Biliou, 1998; Bocherens et al., 1999, 2001), have also deepened our knowledge of the diets of extinct taxa. Some fragments of the TRAP protein were also recovered (Nielsen-Marsh et al., 2009).

3. About human palaeontology

Human palaeontology is a science whose complexity has been steadily increasing over the years. A scientist a quarter of a century ago could potentially publish alone and satisfy research demands by describing fossils anatomically and by comparing them statistically with the corpus of more or less similar hominins.

Today, numerous new disciplines yield information about fossils in diverse fields such as the details of the internal morphology; diet studied by means of isotopic biogeochemistry; DNA, both mitochondrial and nuclear, and the timing of dental development, microwear analysis, and enamel thickness. A number of sophisticated techniques are also available: micro-CT scanning, synchrotrons, tooth histology, mass spectrometry, 3D statistical analysis, etc. Obviously, a palaeoanthropologist is unable to master them all. Wisdom suggests, and this summarizes the philosophy governing the present work, the acceptance of limitations and the adaptation to them. More than ever, multidisciplinary collaborations are imperative. For example, a single tooth has many messages to deliver. Accordingly, numerous chapters in this monograph take into account the wealth of signals recorded within the Scladina Child's teeth. They cover in particular the morphological description of the teeth; statistical comparisons; age determination by histological techniques; analysis of the roots; the diet analyzed through microwear of the occlusal surface; EDJ, and enamel thickness, etc.

Interest in the contextual study of human remains continues to increase. In the past, palaeoanthropologists were frequently relegated to laboratories where they studied human remains brought to them by archaeologists. They wrote reports annexed to archaeological publications or anatomical analyses of human remains with very little knowledge of the contexts or conditions of discovery.

Current palaeoanthropologists are now inclined to put the fossils they are studying in an ever more precise chronostratigraphical context which allows them to better understand the evolution of the taxa. They turn to microstratigraphy and dating techniques, classify fossils according to the isotopic stages, and closely analyze the conditions of introduction and modification of the fossils in the sediments (taphonomy).

Palaeoanthropologists are now more involved from the early stages of the field work: drawing or commenting on the distribution maps of bones and dental remains, trying to decipher burial practices, etc. A good example of the evolution of anthropological practices is provided by the comparison of a series of monographs on Neandertals. La Chapelle-aux-Saints (Boule, 1911–1913), Mount Carmel (McCown & Keith, 1939), or Shanidar (Trinkaus, 1983), are all pure — but very interesting — laboratory projects as opposed to Kebara (Bar-Yosef & Vandermeersch (eds.), 1991) and Dederiyeh (Akazawa & Muhesen, 2002), which reflect a real involvement of palaeoanthropologists from the beginning of the excavation.

Through numerous collaborations such as those currently underway at Scladina, which involve Neandertal remains and multidisciplinary focus from the early stages of field work, the scientific adventure is coupled with an equally exciting human adventure, especially from all the personal meetings, discussions and passionate debates, etc.

Could we not say that the very purpose of our disciplines is to decipher the millions of years of the long adventure which slowly transformed our early ancestors into current humans, therefore, building bridges through the millennia? Somehow, palaeoanthropology finds parallels in the time machines that have haunted the dreams of so many authors like Henri Vernes in "The Dinosaur Hunters" (1957 for the original French edition), adapted into a comic book by Coria in 1984, and E.P. Jacobs in his comic book "The Time Trap" (1962 for the original French edition).

4. Scladina, palaeoanthropology in the field

The exploration of Scladina Cave was initiated in 1971 with speleological work which quickly turned into a haphazard collecting of out-of-context archaeological artefacts. This went on until 1977. From 1978, with Marcel Otte's involvement, the excavations immediately took on a scientific approach. Very early, the archaeologist looked for information relative to the palaeoenvironnement and the age of the Palaeolithic layers which retained his interest. He initiated collaborations with specialists of the earth sciences, mainly geologists (Paul Haesaerts, Franz Gullentops), palaeontologists (Jean-Marie Cordy, Pierre Simonet, Marylène Patou-Mathis) and palynologists (Bruno Bastin), as well as with dating specialists (Etienne Gilot, Michel Gewelt, Yves Quinif, etc.).

However, the specialized in situ interventions remained rare. One of them involved Paul Haesaerts drawing a few sections on the terrace while another saw two sections in the cave itself analyzed by Christophe Deblaere and Franz Gullentops. Bruno Bastin was involved in palynological sampling and Yves Quinif in U/Th analysis. The palaeontologists were restricted to laboratory studies so their work had little impact on excavation. The excavation remained under the exclusive control of the archaeological team. No continuous geological recording of stratigraphy was possible in the course of the excavation.

Anthropological No.	Archaeological No.	Description	Unearthed	Identified	Square Metre
Scla 4A-1	Sc 1993-148-185	right half of the mandible	16/07/1993	20/07/1993	D29
Scla 4A-2	Sc 1992-1283-96-1	small part of right maxilla	18/02/1992	October 1993	D30
Scla 4A-3	Sc 1992-411-107-1	permanent maxillary right second molar	15/10/1992	October 1993	C30
Scla 4A-4	Sc 1993-330-127	permanent maxillary right first molar	14/12/1993	14/12/1993	C30
Scla 4A-5	Sc 1990-81-46	deciduous maxillary right second molar	13/03/1990	October 1993	G27
Scla 4A-6	Sc 1990-132-41	mandibular right first premolar (P3)	4/07/1990	October 1993	G27
Scla 4A-7	Sc 1991-574-11	deciduous maxillary right first molar	12/11/1991	October 1993	F27
Scla 4A-8	Sc 1995-286-7-1	permanent maxillary right third molar	14/07/1995	14/07/1995	C32
Scla 4A-9	Sc 1996-203-1	left half of the mandible	12/07/1996	12/07/1996	C28
Scla 4A-11	Sc 1990-81-47	permanent maxillary right central incisor	13/03/1990	May 2000	G27
Scla 4A-12	Sc 1990-90-1	permanent mandibular right canine	28/03/1990	July 2001	F27
Scla 4A-13	Sc 2001-262-44	deciduous mandibular right second molar	13/11/2001	13/11/2001	E38
Scla 4A-14	Sc 1990-37-1	permanent maxillary right lateral incisor	22/02/1990	14/12/2004	H27
Scla 4A-15	Sc 1990-37-25	permanent mandibular right central incisor	22/02/1990	14/12/2004	H27
Scla 4A-16	Sc 1990-49-1	permanent maxillary right canine	23/02/1990	16/12/2004	H27
Scla 4A-17 (= Scla 3-2)	Sc 1991-526-1	permanent maxillary left lateral incisor	17/10/1991	October 1993	F27
Scla 4A-18 (= Scla 3-3)	Sc 1991-590-1	permanent maxillary left canine	19/11/1991	October 1993	F26
Scla 4A-19 (= Scla 3-4)	Sc 1995-108-197-1	permanent mandibular left lateral incisor	8/03/1995	10/04/1995	D34
Scla 4A-20	Sc 2006-81-1	permanent mandibular right lateral incisor	12/07/2006	12/07/2006	F35 to F37

Table 1: List of all Scladina Neandertal remains unearthed in former Layer 4A.

Fortunately, the situation gradually improved: first at the instigation of Dominique Bonjean, archaeologist in charge of the excavation since 1991, followed by the involvement of Stéphane Pirson as part of his PhD in geology from the end of the summer 2003.

The first discoveries of Neandertal teeth took place in 1990 but were not identified as human at the time.

The first fossil discovered in situ in Scladina's former Layer 4A was the hemimandible Scla 4A-1 (Table 1). Found on Friday, July 16th 1993, the morphology of the specimen alerted the student (Claire Curvers) assigned to the square, who informed Dominique Bonjean. Interest increased when work resumed the following Monday. The nature of the mandible, however, remained uncertain. The decision was made to contact Marcel Otte, professor of prehistory at the University of Liège. The next day, during a visit to the site, Marcel suggested seeking the advice of the present author who rushed to the cave and identified the fossil as Neandertal (Bonjean et al., 2009). Fortunately, the coordinates of the mandible had been recorded in three dimensions (Figure 4), like most of the faunal remains, but no in situ pictures had been taken.

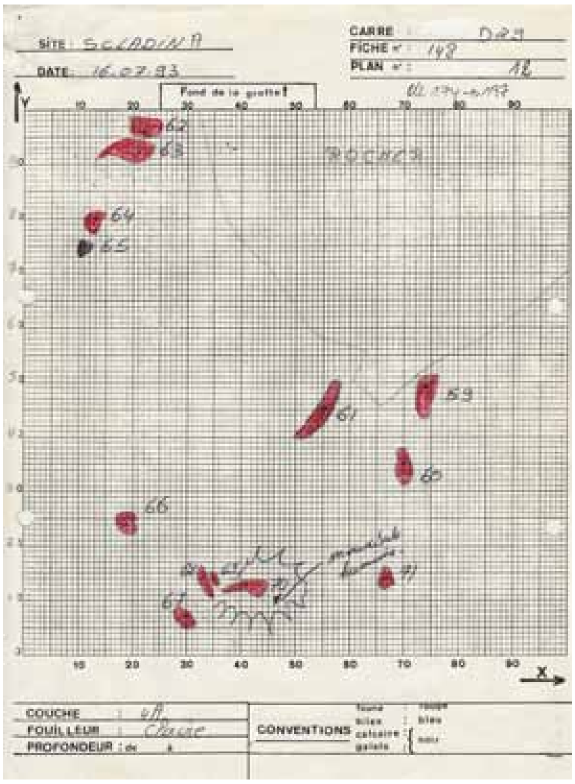

Figure 4: Technical sheet and field plan drawn up by a student during the in situ discovery of the right hemimandible Scla 4A-1.

From that moment on, the excavation of the cave took another direction. The field team learned to recognize human teeth and bones.

In the cave, continuous attention was given to identifying the human remains in situ, and, indeed, numerous fossils were recognized at the moment of their discovery, such as the left half of the mandible, Scla 4A-9 (Figure 5), and the permanent maxillary right first molar Scla 4A-4 (Figure 6). The palaeoanthropologist advised the excavation team to contact him if they encountered more remains with suspicious morphology.

At the same time, a new review was conducted, this time with an anthropological focus, of all the skeletal and dental remains discovered earlier in the stratigraphic layers directly above and below the one in which the two hemimandibles were found. This allowed the identification of the series of Neandertal teeth unearthed in Scladina during the years 1990-1992 that had not been recognized during the excavation nor when the collections were classified.

The recent revision of the stratigraphy (Pirson, 2007 and Chapter 3) represents a further step in the precise positioning of the Neandertal fossils within the sediments of the site. The identification of an important, previously unnoticed, longitudinal gully, 4A-CHE, which had reworked a portion of the cave sediments, was crucial to understanding how the fossils were deposited. As a result, the sediments from which the fossils came have been divided into three large stratigraphic units: the sediments before Stalagmitic Floor CC4, the 4A-CHE gully which is subdivided into at least 8 discontinuous lithofacies, as well as the four 4A-POC layers. The attempt to reposition all the Neandertal remains found earlier within these layers and lithofacies of the new Pirson stratigraphy was necessary. For that purpose, all fossils have been reviewed from a combination of plans, sections, and photographs corresponding to the time of their discoveries, and by virtually projecting them on the closest sections (Chapter 5). Through this procedure, most fossils could be repositioned within the gully (4A-CHE) or the group of layers immediately over it (4A-POC). With the help of a new excavation method that relies on vertical microstratigraphy, future finds will be positioned precisely in the context of the new, extremely precise stratigraphic sequence.

Figure 5: Left half of the mandible, Scla 4A-9, in situ, on Section D/C 28 (photograph Dominique Bonjean, AA).

Figure 6: Permanent maxillary first right molar Scla 4A-4, in situ (Square C 30; photographs Dominique Bonjean, AA).

Prior to 1990, human remains had already been found in the upper part of the stratigraphic sequence; however, these discoveries have no bearing on the present palaeoanthropological project. For example, several fossils that might correspond to a Neolithic multiple burial comprising several individuals seem to have been found in the Holocene layers during the early work by speleologists (Otte et al., 1988; Otte, 1990). These are currently inaccessible and were never studied in detail. Later, a first metatarsal was found in 1982, in Layer 3, apparently in an area close to disturbed sediments. Its study was not conducive to a definitive taxonomic identification although it was probably associated with the Neolithic (Leguebe et al., 1989). This fossil was also lost. A few other human remains (teeth, vertebrae), whose study goes beyond the scope of the present monograph, have also been found in the sedimentary units 3 and 1B (Toussaint et al., 1998).

The facial elements of Scladina I-4A have been the subject of a few preliminary reports describing the remains and presenting their context (e.g. Otte et al., 1993; Toussaint et al., 1994, 1998; Bonjean et al., 1996; Toussaint, 1996; Pirson et al., 2005). Some detailed analyses were also published, such as the age at death (Smith et al., 2007).

The current study of these fossils (Figure 1) is the subject of a large international collaboration. The following people took part in this monograph:

In Belgium:
- **Grégory Abrams**, MA, Archéologie Andennaise
- **Dominique Bonjean**, MA, Archéologie Andennaise
- **Mona Court-Picon** (France), PhD, Belgian Royal Institute of Natural Sciences
- **Freddy Damblon**, PhD, Belgian Royal Institute of Natural Sciences
- **Élise Delaunois**, MA, Musée de la préhistoire en Wallonie/Prehistomuseum
- **Kévin Di Modica**, PhD, Archéologie Andennaise
- **Paul Haesaerts**, PhD, Belgian Royal Institute of Natural Sciences
- **Marcel Otte**, PhD, Université de Liège
- **Stéphane Pirson**, PhD, Direction de l'Archéologie, Service public de Wallonie
- **Michel Toussaint**, PhD, Direction de l'Archéologie, Service public de Wallonie

At the Max Planck Institute for Evolutionary Anthropology, in Leipzig, Germany:
- **Stefano Benazzi** (Italy), PhD, now also at the Department of Cultural Heritage, University of Bologna
- **Sireen El Zaatari** (Lebanon), PhD, now at Tübingen University
- **Katerina Harvati** (Greece), PhD, now at Tübingen University
- **Jean-Jacques Hublin** (France), PhD
- **Kornelius Kupczik** (Germany), PhD, now at the Friedrich-Schiller-Universität Jena.
- **Adeline Le Cabec** (France), PhD, now at the ESRF, European synchrotron Radiation Facility, Grenoble
- **Anthony J. Olejniczak** (USA), PhD
- **Matthew Skinner** (Canada), PhD, now at University College London
- **Tanya Smith** (USA), PhD, now at Harvard University
- **Christine Verna** (France), PhD, now at the CNRS, Paris

In France:
- **Sanda Balescu** (Belgium), PhD, Lille1 University
- **Hervé Bocherens**, PhD, now at Tübingen University
- **Christophe Falguères**, PhD, Museum National d'Histoire Naturelle, Institut de Paléontologie humaine, Paris
- **Catherine Hänni**, PhD, École Normale Supérieure of Lyon
- **Ludovic Orlando**, PhD, formerly at the École Normale Supérieure of Lyon, now at the University of Copenhagen, Centre for Geogenetics
- **Paul T. Tafforeau**, PhD, ESRF, European Synchrotron Radiation Facility, Grenoble
- **Yuji Yokoyama** (Japan), PhD, Museum National d'Histoire Naturelle, Institut de Paléontologie humaine, Paris

In Canada:
- **Cheryl A. Roy** (USA), MA, Vancouver Island University
- **Rhylan McMillan**, BA (Distinction), Vancouver Island University

In the USA:
- **Dorien De Vries** (Netherlands), MA, Stony Brook University, New York,
- **Kristin L. Krueger**, PhD, Department of Anthropology, Loyola University Chicago, Chicago **Donald J. Reid** (UK), PhD, now at George Washington University

5. Overview of the Scladina monograph

This monograph is the third about Scladina Cave: a first volume covered the stratigraphic context—before the recent revision of S. Pirson—and the palaeoenvironnement (Otte (ed.), 1992), and a second one dedicated to the archaeology (Otte et al. (dir.), 1998). Both were written in French, with the exception in each case, of one chapter in English concerning TL dating.

After the present overview, this third monograph proposes, in its second chapter, an overall presentation of the Scladina site with its geographic location, its topography and geology, the history of the excavations that have been conducted there for over a third of a century, as well as the archaeological context and history of the anthropological discoveries. The third chapter is an overview of the stratigraphic context of the Neandertal remains discovered at Scladina. The layers presented in that chapter are just those related with palaeoanthropological remains, namely former layers 4A/4B, as well as those directly below (former Layer 5) and above them (former Layer 3). The chapter then proceeds with an analysis of the sedimentary dynamics of the site and its implications for fossil deposition.

Figure 7: Evocation of the Scladina Child (Benoît Clarys, 2013, © Archéologie Andennaise).

The fourth chapter presents both a palaeoenvironmental overview of the site and a critical analysis of all dates obtained and integrates this data within the newly revised stratigraphy. The fifth chapter discusses in detail the stratigraphic position of each element of the partial face of the Scladina Neandertal child.

In 1994, non-destructive gamma-ray spectrometry applied to the right hemimandible Scla 4A-1 provided an age of 127 +46/−32 ka BP, which allowed to think that the Scladina I-4A Child lived around 100,000 years ago (Chapter 6).

The taphonomy of the Neandertal fossils from Scladina is analysed in Chapter 7, using four approaches: first, the fossils are examined for evidence of different surface modifications; second, their spatial and stratigraphic distribution is analysed; third, these observations are compared to the analysis of the faunal material found over the last ten years in the new stratigraphy as revised by S. Pirson; and finally, in the discussion, these different approaches are integrated in order to build a model of successive chronological phases in relation to death, burial and postdepositional processes, as well as archaeological and/or palaeontological excavations.

The eighth chapter presents an estimation of the age of the child (Figure 7) as calculated from histological studies, with an age estimation of 8 years. This histological result, clearly the most reliable age determination technique, makes the Scladina Child younger than previously thought. Indeed, in previous papers we concluded that "If the criteria of age linked to dental eruption and to the formation of molar roots observed in modern humans are applied to Neandertals, the child of Sclayn […] would have been at least 12-13 years old. The persistence of deciduous molars could however indicate a younger age, probably hardly more than about ten years" (Toussaint et al., 1998: 738). This position was complemented in more recent syntheses: "Dental age determination compared with cutting teeth and molar root formation in modern humans suggests the child died at the age of 12. Yet the persistence of deciduous molars is consistent with a younger age, but probably not less than 10. In addition, Granat and Heim's new method of Neandertal dental age determination seems to indicate the child could not have been older than 8.5" (Toussaint & Pirson, 2006: 382-383; see also Toussaint et al., 2001, 2011).

Can sex be determined on the basis of a mandible or teeth not associated with coxal bones? This question is discussed in Chapter 9. The temptation is to suggest that the Scladina Child might be female; however, the accuracy of sex determination is questionable.

Chapter 10 systematically describes the mandible anatomically, while seeking to distinguish the plesiomorphic features from the derived ones. This chapter also aims to stastistically compare the Scladina mandible to samples of subadult and adult Neandertals, and also modern humans. Chapter 11 develops these morphometric camparisons using 3D geometric analysis. The maxillary fragment of the child is presented in Chapter 12.

In Chapter 13, the teeth are described morphologically, with a focus on their taxonomic implications, before being statistically compared to a large collection of similar data. Particular aspects of the teeth, enamel thickness, enamel-dentine junction morphology, and micro-computed tomographic quantification of tooth root size and tissue proportions, are the subject of Chapters 14 to 16.

Two chapters concern the diet of the child, using isotopic biogeochemistry (C/N; Chapter 17) and dental microwear texture (Chapter 18). Both techniques indicate that the child was omnivorous but mainly ate meat: biogeochemistry indicates the consumption of open environment herbivores, while the microwear data also reveals a diet that most likely included small amounts of abrasive plant foods.

Chapter 19 deals with mtDNA extraction and demonstrates that the Scladina Neandertal Child was more distantly related to modern humans than more recent Neandertals, suggesting that the Neandertal population experienced a significant demographic bottleneck in the last 50-30 ka preceding their extinction.

Chapter 20 places Scladina I-4A within the chronological context of the other Neandertal remains from the Belgian Meuse River Valley and northwest Europe. It discusses the association of the La Naulette and Scladina remains to MIS 5 or earlier, then addresses the absence of occupation during the second part of MIS 4 due to a major climatic deterioration, and finally evaluates the allocation of Late/Classic Neandertals to MIS 3.

The concluding chapter (21) integrates the key findings of this monograph from an multidisciplinary perspective, and discusses various ideas concerning regional Neandertal research.

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Annexes

Lists of papers concerning directly or indirectly the Neandertal fossils of Scladina:

1. Papers written by researchers associated with the Scladina scientific team, in chronological order

(A) = announcement of the Scladina anthropological discoveries and evolution of research
(B) = studies of various scientific aspects
(C) = Scladina through syntheses on Neandertals
(D) = presentation to the public

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