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CONTRASTING BOOKS ON CLAY MINERAL SCIENCE – HOW SHOULD THEY BE JUDGED?
(Shortened title Two books on clay mineral science**)**

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ABSTRACT
Clays (2005) and the *Handbook of Clay Science* (2006) are new textbooks. *Clays*, written by Alain Meunier, is for those studying earth sciences.
The *Handbook of Clay Science*, edited by Faïza Bergaya, Benny Theng and Gerhard Lagaly, is concerned particularly with the industrial application of clay mineral science. Both books are timely and could fill important gaps in the library of mineral science. Their quality as textbooks is discussed. Critical analysis of editorial accuracy, indexes and user-friendliness indicate that both books fall short of the high standards that should be the hallmark of academic publication. Their shortcomings seem to be related to widespread problems that may beset commercial publication of scientific books.

KEYWORDS: *Clays* (Meunier 2005), *Handbook of Clay Science* (Bergaya et al., 2006), critical analysis, indexes, accuracy, editorial quality, Barbara Neumann, laponite test

1. INTRODUCTION

The appearance of two new books in the last three years on clay mineral science is an important event, particularly as one is a textbook and the other is a handbook suggesting that the answer to almost any clay mineral question can be found within them. Such are *Clays* and the *Handbook of Clay Science* published respectively by Springer (2005) and Elsevier (2006). At the time when these books were conceived the library world was a rather different place than it is now. Gone are the days when it did not matter for whom a book was published. Was it really for the benefit of the reader and not the publisher and author? At least the library would always purchase a copy however expensive it might be. Today with massive cutbacks in library funds, at least in the UK (for example the Geoscience Library at Cambridge University has suffered a 40 % reduction in its annual allocation) the subscriptions to many old favourite but little-used journals had to be stopped, fewer books are now purchased, and these are largely concerned with the teaching courses. The reason for this approach – and I do think it is the correct one in the circumstances – is the recognition that the primary source of reliable data are the well refereed journals and monographs; whereas books today are, with exceptions, much less rigorously reviewed and refereed and are only a secondary source of information. This may be hard on books that are well conceived, researched, written and produced, but they are usually recognised for their worth: they benefit from their use as standard texts and from the likelihood of additional reprintings and editions where errors can be corrected and new developments included. There is a pertinent question for clay scientists – why are so few books on clay mineral science represented by additional reprintings or second editions?

2. GAPS IN CLAY SCIENCE LITERATURE

Clays and the *Handbook of Clay Science* are books that could fill important gaps in the clay mineral literature. For many years there has not been a satisfactory and up-to-date textbook covering the chemical and physical behaviour of clay minerals and their role in the geological world. Alain Meunier's textbook *Clays* could be just what is needed for undergraduates and researchers, providing a broad view of the subject with a firm mathematical, physical and chemical foundation. There has never been a handbook or manual that draws together all the different aspects of clays and clay minerals both in industry, engineering, agriculture, geology, etc. which could act as a dictionary or encyclopaedia for easy use. A book that every person involved with the science or technology of clays should have on their bookshelves. The *Handbook of Clay Science* is possibly such a book. Sixty-six authors have contributed under the guidance of three editors – Faïza Bergaya, Benny Theng and Gerhard Lagaly. Both books are expensive. *Clays* is priced at €89.95. It was published by Springer, the book first appeared in French (2003) and then in an English edition (2005). The *Handbook of Clay Science* is priced at €150 and was published by Elsevier in 2006. Both books are the result of major projects by their authors: Alain Meunier has attempted a very complete view of clay minerals and of the environments in which they occur; Faïza Bergaya, Benny Theng and Gerhard Lagaly have managed to bring together a considerable proportion of the world's clay scientists to contribute to their handbook. The contents of each are summarised in Tables 1 and 2. However great the effort, grand the intentions and famous the authors, it does not necessarily guarantee the success of the projects. Both books have supporting prefaces as to their excellence by well established persons of clay science. Both books have been reviewed (*Clays*; Cuadros, 2005; *Handbook of Clay Science*; Ferrell, 2007; Wilson, 2007; Jeans, 2008). They should be examined and judged by the traditional and not always popular standards of quality, accuracy, balance, inspiration and user- friendliness.

The questions I am trying to help you to answer are simple. Should you buy either or both books for your own bookshelves? Or should you encourage your University's or firm's library to purchase them so you can borrow them? Or should they be left on the publisher's shelf hoping to acquire copies at a reduced price when they are remaindered in a couple of years' time? In my own experience, however unsatisfactory a book may be it is always better to have it in your library – there are usually some nuggets of gold lurking unseen, in spite of all the problems which may be present.

Am I qualified to judge these two major publications by well-known authors and scientists? A good question. I am neither a clay mineralogist nor clay chemist, but just a mineralogically and chemically inclined geologist with a long love affair with clay minerals and what they can tell us about the geological present and past. Nor am I an author of

Table 1 *Clays*: details and contents.

CLAYS

written by Alain Meunier, preface by Bruce Velde

Translated by Nathalie Fradin, Published 2005 by Springer, Berlin

Number of pages: 472. Price €89.95.

Cost per page €0.191. Weight 1 kg.

Contents

1 Crystal Structure – Species – Crystallisation

The Crystal Structure of Clay Minerals

The Elementary Structure Level: the Layer. Crystal – Particle – Aggregate. Identification Keys for Simple and Mixed-Layer Species of Clay Minerals

Nucleation and Crystal Growth: Principles

Basics. Nucleation and the First Growth Stages of Clay Minerals. Growth of Clay Minerals. Ripening Process. Growth of Mixed Crystals and Particles

2 Crystal Chemistry of Clay Minerals

Solid Solutions

Introduction. The concept of Solid Solution Applied to Phyllosilicates. Experimental Study of Solid Solutions. Solid Solutions in Nature

Mixed Layered Minerals

Introduction. Crystallochemistry of Mixed-Layer Minerals. Composition of the Most Common Mixed-Layer Minerals

3 Energy Balances: Thermodynamics – Kinetics

Thermodynamics of Equilibrium

Introduction. Free Energy of Formation of Clay Minerals. Equilibria Between Simple Minerals Without Solid Solutions. Equilibria Between Solid Solutions. Qualitative Construction of Phase Diagrams

Kinetics of Mineral Reactions

Introduction. Fundamental Laws of Kinetics. Kinetics of the Montmorillonite → Illite Reaction

Isotopic Composition of Clay Minerals

Stable Isotopes

Isotopic Fractionation. Water – Clay Mineral Interactions. The Isotopic Composition of Clays of the Weathering-Sedimentation Cycles. Isotopic Composition of Clays Under Diagenetic Conditions. Isotopic Composition of Clays in Active Geothermal Systems

Table 1 continued

Table 2 Handbook of Clay Science: details and contents.

HANDBOOK OF CLAY SCIENCE

Edited by F. Bergaya, B. Theng and G. Lagaly
Forward by Radko Kühnel
Published 2006 by Elsevier, Amsterdam
Number of pages 1224. Price €150.
Cost per page €0.123. Weight 2.5 kg.

Chapter 1, *General Introduction* (18 pp, F. Bergaya and G. Lagaly)

Chapter 2, *Structure and Mineralogy of Clay Minerals* (67 pp, M.F. Brigatti et al.)

Chapter 3, *Surface and Interface Chemistry of Clay Minerals* (27 pp, R.A. Schoonheydt and C.T. Johnston)

Chapter 4, *Synthetic clay minerals and purification of natural clays* (25 pp, K.A. Carrado et al.)

Chapter 5, *Colloid Clay Science* (105 pp, G. Lagaly)

Chapter 6, *Mechanical properties of clays and clay minerals* (13 pp, R. Pusch)

Chapter 7, *Modified Clays and Clay Minerals*:
Acid activation of clay minerals (25 pp, P. Komadel and J. Madejova)
Thermally modified clay minerals (19 pp, Heller-Kallai)
Clay mineral organic interactions (69 pp, G. Lagaly et al.)
Clay minerals and the origin of life (13 pp, A. Brack)
Pillared clays and clay minerals (29 pp, F. Bergaya et al.)

Chapter 8, *Properties and behaviour of iron in clay minerals* (53 pp, J.W. Stucki)

Chapter 9, *Clays, microorganisms and biomineralization* (21 pp, K. Tazaki)

Chapter 10, *Clays in Industry: Conventional applications* (39 pp, C.C. Harvey and G. Lagaly), *Clay minerals as catalysts* (41 pp, J.M. Adams and R.W. McCabe), and *Clay Mineral – and organoclay-polymer nanocomposite* (39 pp, E. Ruiz-Hitzky and A. van Meerbeek)

Chapter 11, *Clays, environment and health*:
Clays and clay minerals for pollution control (51 pp, G.J. Churchman et al.)
Clays and pesticides (15 pp, S. Nir et al.)
Clay liners and waste disposal (9 pp, K. Czurda)
Clays and nuclear waste management (13 pp, R. Pusch)
Clays and human health (25 pp, M.I. Carretero et al.)
Clay and clay minerals as drugs (9 pp, M.T. Droy-Lefaix and F. Tateo)

Chapter 12, *Critical assessment of some analytical techniques*:
Mössbauer spectroscopy of clays and clay minerals (9 pp, E. Murad)
Identification and quantitative analysis of clay minerals (23 pp, J. Srodon)
X-ray absorption spectroscopy (75 pp, W.P. Gates)
X-ray photoelectron spectroscopy (13 pp, H. Seyama et al.)
Small-angle scattering techniques (29 pp, D. Tchoubar and N. Cohaut)
Fourier transform infrared spectroscopy (9 pp, S. Petit)
Nuclear magnetic resonance spectroscopy (19 pp, J. Sanz)
Transmission electron microscopy (25 pp, F. Elsass)
Surface area and porosity (13 pp, L.J. Michot and F. Villiéras)
Cation and Anión exchange (23 pp, F. Bergaya et al.)
Thermal analysis (15 pp, F. Rouquerol et al.)

Chapter 13 contains three articles on *Some other materials related to clays*:
Layered double hydroxides (75 pp, C. Forano et al.)
Parallels and distinctions between clay minerals and zeolites (15 pp, D.L. Bish)
Cement hydrates (15 pp, H. van Damme and A. Gmira)

Chapter 14, *Genesis of Clay Minerals* (33 pp, E. Galán)

Chapter 15, *History of Science: a young disclipline* (19 pp, F. Bergaya et al.)

Chapter 16, *Teaching clay science: a great perspective* (13 pp, R. Berry et al.)

books. A wise teacher, Professor J.H. Taylor (1909-1968; see Dunham, 1968 for biographical details), an early advocate of the importance of clay minerals in sediments (Taylor, 1952) reminded us, when students at Kings College, London, that many good geologists lose their reputation by writing books. I have heeded his advice to this day.

My analysis of *Clays* and the *Handbook of Clay Science* is restricted to two aspects, user-friendliness and accuracy, both are vital for the reader and any confidence he may have in the book as a reference source. Have the authors, editors and publishers given proper consideration to those who hope to access the wise words within these books? Is the information clear, consistent and a fair account of the topic under discussion? I shall limit my opinions only to those parts that I am fully qualified to.

There are different aspects of user friendliness – paper quality, clarity of figures, typography, layout, binding etc. I am going to concentrate on the list of contents and indexes and their relationship to the actual contents of the books. Both *Clays* and *Handbook of Clay Science* rely on these two sources of information as neither have a glossary of the many technical terms used.

3. INDEXES: AN IMPORTANT TOOL FOR THE READER

The core of a textbook or handbook is its specific contents and an information and retrieval system which allow the user to access the data. Without a satisfactory system the reader has to go through the whole or at the very least a large part of the book to answer their enquiry. Both *Clays* and the *Handbook* are served by a single general subject index.

Table 3 shows three styles of subject index and page-referencing that could be used for the kaolinite entry in a particular book. Type A is characterised by thirteen entries each with one page reference, type B has a single entry with thirteen page references, type C has a single entry with one page reference. The indexes of types A and B refer clearly to the same information but in the former case it has been subdivided into its varieties but not in the latter. The minimalist type C could suggest that there was very little information about kaolinite in the book. Depending upon the style of index, there will be a difference in the time and effort needed to track down a particular point about kaolinite. It will be easiest with type A, each page reference will have to be checked with type B, and the whole of the book with type C index will have to be read. Another approach, illustrating this general problem of critical comparison between books, is to examine the number of page references in the index relative to the total number of pages. **Table** 4 shows the average number of page references in the index for each page of text for a number of books and journals. They range from ~0.8 to 7.7. The low value for *Clays* should be noted.

The statistics of individual indexes are readily demonstrated in histograms where the relationship is shown between the number of page references associated with each entry in the whole index or a representative part expressed as a proportion of the

Table 3 Examples of three schematic types (A, B, C) of subject indexes for *kaolinite* that could be used by indexers for the same book. 1-13 refer to page numbers.

Type A		Type B	Type C
Most informative		Uninformative	
Misleading			
Kaolinite		Kaolinite, 1, 2, 3,4, 5, 6	Kaolinite 1
structure	1	7, 8, 9, 10, 11, 12, 13	
crystallo-chemistry	2	(or 1-13)	
morphology	3		
solid solution	4		
mixed-layering	5		
geological occurrences			
in soils	6		
sediments	7		
hydrothermal	8		
metamorphic	9		
igneous	10		
conditions of formation	11		
stability	12		
uses	13		

Table 4 Average number of pages referred to in the subject index per page of text (including reference lists) for various books and journals on clay mineral science. For example, *Clays* has 465 pages of text and an index containing 525 page references – an average of 1.13 page references per page of text.

	Average number of page references per page of text
Clay Minerals (volume 39, 2004)	~ 0.8
Clays and Clay Minerals (volume 45, 1997)	~ 1.0
Clays (Meunier, 2005)	~ 1.1
Clay Sedimentology (Chamley, 1989)	~ 1.2
Soils and Sediments (Pacquet and Clauer, 1997)	~ 1.6
Clay Mineralogy (Grim, 1953)	~ 2.9
Handbook of Clay Science (Bergaya et al., 2006)	~ 6.2
Clays in Crustal Environments: isotope dating and Tracing (Clauer and Chaudhuri, 1995)	~ 7.7

total number of entries. Figure 1 displays histograms from a number of well-known books and journals on clay mineralogy including *Clays* and the *Handbook*. It is obvious that the books with the main mode of one-page reference per entry are much more user-friendly than those with a long-tail and subsidiary peaks with five or more page references per entry. The peak of user unfriendliness is in *Clays in crustal environments: isotope dating and tracing* (Clauer and Chaudhuri, 1995; Spinger Verlag) with page numbers per entry reaching a maximum of 133 for a single entry (illite). Just imagine having to check each of the 133 pages and then discovering the point you are interested in is not referred to in the index, but is hidden somewhere in the text. The index for *Clays* falls in the user-friendly group like Grim's well-known textbook *Clay Mineralogy* and the annual indexes for *Clay Minerals* and *Clays and Clay Minerals*. The *Handbook* fares less well with little more than 40 % of the entries with a single page reference, a long-tail leading to a subsidiary peak (11 %) at 11-25 page references per entry with a maximum of 116 page references for the "kaolinite" entry.

4. THE MINIMALISTIC INDEX OF *CLAYS*

Clays has a minimalistic index (type C). Table 4 suggests that the indexer considered there was a low concentration of important and relevant points in the text, just an average of 1.1 per page. The correctness of this deduction has been tested by comparing the two entries for kaolinite (*kaolinite*; *kaolinite-to-dickite transition*) with an examination of the actual text. Table 5 lists 51 page references in which important aspects of this mineral are discussed and these include sections with headings in which kaolinite is included. It is a pleasant surprise to learn that there is over twenty times more information about kaolinite in *Clays* than is suggested by the index. The index may be user-friendly but it fails dismally to represent the contents of the book.

5. CROSS-REFERENCING WITHIN INDEXES

The usefulness of an index is greatly increased by extensive cross-referencing between entries. This allows the reader to approach a subject from at least two directions, thereby finding a network of references to pages, figures and tables to allow the exploration of a particular area of interest. Neither *Clays* nor the *Handbook of Clay Science* have provided such a useful and essential tool for the reader. Table 6 illustrates an example of cross-referencing.

6. THE LAPONITE TEST

Laponite, a synthetic hectorite, is the first commercially successful synthetic clay and is widely used in the public domain because of its exceptional properties and controlled chemical and physical composition. Laponite was patented in June 1962 by Barbara Neumann, a research scientist at Laporte Industries Ltd, U.K. (Figure 2).

The nature of this synthetic hectorite is of great interest and its synthesis is without doubt an important event in the industrial and commercial history of clay science; both aspects should be mentioned in the *Handbook* whereas in *Clays* with its geological bias its mention would not necessarily be expected. The *Handbook* provides 16 page references for laponite (Table 7) but none describe its mineral nature, this is to be found unindexed in Table 1.1 (page 4). There is another entry involving laponite to be found in the index under *delaminated pillared laponite* which is not mentioned in the main entry, suggesting that no

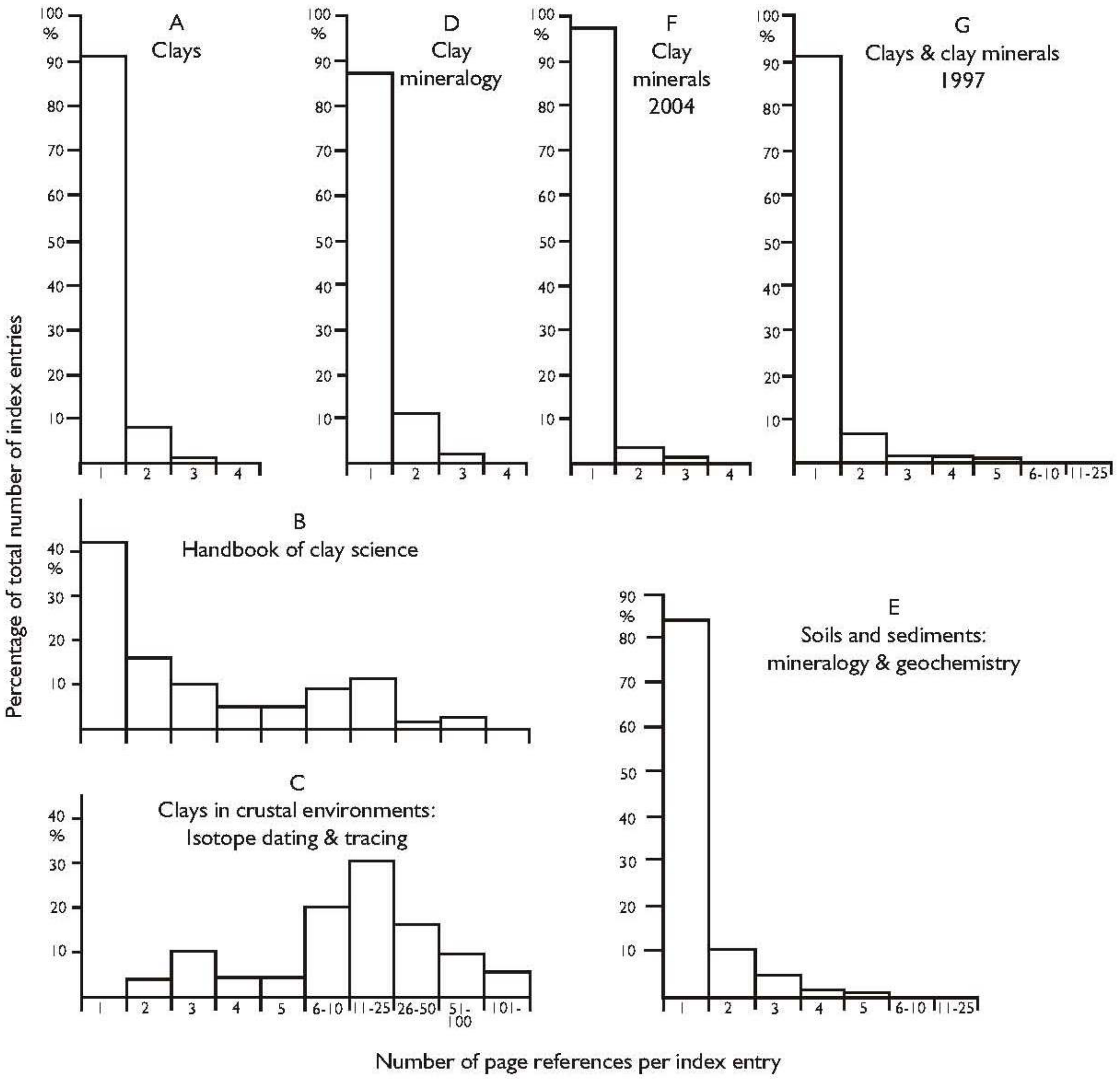

Fig. 1 Histograms showing the quantitative relationship between varying number of page references per subject entry in the general indexes of books and journals on clay minerals. These are expressed as a proportion of the total number (or representative portion) of index entries.

A - ***Clays*** (Meunier, 2005)
B - ***Handbook of Clay Science*** (Editors: F. Bergaya, B. Theng and G. Lagaly, 2006)
C - *Clays in crustal environments: isotope dating and tracing* (Clauer and Chaudhuri, 1995)
D - *Clay Mineralogy* (Grim, 1953)
E - *Soils and sediments: mineralogy and geochemistry* (Editors: Paquet and Clauer, 1997)
F - *Clay Minerals* 2004, volume **39**, annual index
G - *Clays and clay minerals*, volume 45 (1997) annual index

serious attempt has been made to cross reference the index. *Clays* provides a single page reference for *laponite* which refers to a caption for a figure (Figure 5.24) showing the flow curve for a laponite suspension. Nowhere is there a definition of this synthetic phase – a glossary would be the ideal place to find it.

7. WHAT IS A HANDBOOK?

The shorter Oxford Dictionary describes it as "a small book or treatise, such as may be held in the hand", giving as an early example *The Manual of Ecclesiastical Offices and Ritual*, a later example (1836) "A book containing concise information for the tourist". In the United States of America (1903) it

Table 5 Revised *kaolinite* entry for the subject index of *Clays*. There are 51 entries compared to the two (underlined) actually present.

Kaolinite

- <u>**Crystal structure**</u>, 11-12
- Crystal shape, 28, pH influence, 48
- Identification, 33
- Solid solution with Fe, 79
- Mixed layer mineral, with smectite, 104, 288
- Thermodynamics
  - solubility, 110-112; solid solution with Fe, 128-129; kaolinite – Al-goethite system, 131-132; kaolinite – Al-haematite system, 132-133
- Isotopes
  - fractionation, 156-158; for oxygen, 159; for hydrogen, 160; stable isotope values for soils, 166-167; palaeotemperature of formation, 172; palaeotemperature/fluid variation in Viking Formation, 174
- Surface properties
  - water adsorption isotherm, 204; water desorption isotherm, 204; cation exchange capacity value, 211; specific surface area, 217; deformation, experimental, 228-229
- Soils/weathered rocks and minerals
  - dissolution, mechanism, 236; halloysite – transformation, 242-243; development in coherent rocks, 249; development in saprock, 249; development in saprolite, 249; development in fissures, 251; granite weathering, 251-254; SiO_2 activity, effects of, 262; glauconite (limestones, sandstones), 267; illite (marl), 267-268; chlorite, mica (Gossan), 268-272; distribution in world's soils, 285; oxisols/laterites, 285-287
- Sedimentary environments: detrital
  - grain size distribution pattern, 299; suspension stability, 303; sediments, Arabian Sea, 306; interglacial deposits, Mediterranean, 306
- Sedimentary environments: neogenesis
  - salt lakes and sabkhas; relationships with sepiolite/palygorskite, 310; tonsteins, 312-313; reaction with nontronite/Fe oxyhydroxides, 323; reaction with ferric montmorillonite, 323; development in sedimentary basin, 331; reactivity during burial, 343; <u>**transformation to dickite**</u>, 354-356; pseudomorphs, 354, 35
- Geothermal fields
  - acid hydrothermal system, 394-397; hydrothermal veins/mineral zonation 411
- Extreme conditions
  - reactions at extreme pH, 420-421; radiation, 423; interstellar dust, 429

Table 6 Cross-referenced entry for laponite in a subject index of a hypothetical book dealing with smectites and their industrial application. Cross-referencing can reduce the length of an index without loss of information. It is particularly useful in handbooks, manuals or encyclopaedias where individual entries are arranged alphabetically. Cross-references provide an information network that leads the enquiring reader to related topics.

Cross-referencing

Laponite (see also hectorite, fluoro hectorite, Optigel SH, SUPLITE–MP)

- Definition, 1 (see also Neumann, Barbara)
- Structure (see hectorite)
- Chemical composition, 2 (see also hectorite)
- Molecular weight, 3
- Higher hydrates (see water contents)
- Particle shape/size, 4
- Properties; cationic dye loading, 5; self-assembling layers, 6; coagulation, 5, 6-7; thixotropy,8; cation exchange, amines, 9; pillaring host, 10; catalyst, 11; gel-sol structure and transition, 12; adsorption effects, 13.
- Uses; general, 14; cosmetics, 15; routing, 16; paints, 17; polymeric nanocomposites, 18.
- Manufacture, 19 (see also Fuller's Earth Union, Laporte Indusries Ltd, FCC INC No. 79 Moganshan R.D., Süd Chemie AG)

Barbara Neumann, Inventor of Laponite

Neumann, Barbara (born 30 November 1914, died 25 November 2002), clay scientist, inventor of laponite, a synthetic hectorite, the first and for a long time the only completely synthetic clay mineral of commercial success and widespread use (patented 1962). Leading authority on the physical properties of powders, and on the analysis, processing and application of clay minerals, in particular, montmorillonite. Responsible for great improvement of English activated fuller's earth during the Second World War (1939-45) and the later development of highly successful commercial products called *Fulmonts.*

Born Barbara Zsusana Beer at Szolnuk, Hungary, of Jewish parentage. Fled to Budapest. Entered Budapest University, experienced monetary and anti-semitic pressure to abandon studies. Completed degree in Physics and PhD in X-ray crystallography (~1939). Married (~1939) Gyorgy Emode, conscripted (1939) and died of typhus at the Front during the early stages of the war. Successfully applied (1939) to join the Fuller's Earth Union Ltd (merged with Laporte Industries 1954) where she remained until retirement. Remarried (21 April 1949) to Franz Neumann (born 11 February 1911, died 30 September 1971). Two children (Peter, born 14 April 1950, and Vera, born 16 June 1952). Lived at Redhill, Surrey, UK. Well-known in the humanist circles of this area of south London favoured by the British Government for the settling of refugees during and after the Second World War.

[Sources: Neumann 1967; Robertson, 1986; Vera Goldman (née Neumann)]

Fig. 2 Any handbook, manual or collection of reviews (e.g. *Handbook of Clay Science*) about applied clay mineralogy and its historical development should identify the scientists responsible for major advances in the discovery and use of clay minerals. Barbara Neumann (1914-2002) was such a scientist; here are provided brief biographical details a reader might expect, as background for the history of the commercial development of synthetic clay minerals.

Table 7 Laponite (p. 1211) in the subject index of the *Handbook of Clay Science*, showing actual entry and suggested changes to improve its user- friendliness.

Actual entry in subject index

Laponite 100, 105, 163, 168, 217, 329, 327, 396, 560, 585, 719, 886, 892, 896-903, 927, 1119

Suggested improvement

Laponite (see also hectorite) definition 4: cationic loading, 100; self-assembling layers, 105; coagulation, 163, 165,168; sol-gel phase diagram, 217; thixotropy, 219; cation exchange, amines, 327; pillaring host, 396; catalyst, 560; polymer nanocomposites, 586; cosmetic use, 719; small angle scattering study, gel-sol structure 893, 893, 894, gel-sol transition, molecular wt 896-903; NMR spectroscopy, pillared, adsorption effects, 827; cf calcium silicate hydrate, 1119.

is used for a betting book. *Chambers 20th Century Dictionary* refers a handbook to "a manual or a bookmaker's book of bets (U.S.)". A manual is described as "a handbook or handy convenient compendium (shortening or abridgement) of a larger subject or treatise". The *Handbook of Clay Science* is clearly not a betting book, but is it a convenient shortening of a large subject? Clearly the *Handbook* is a shortening of part of the extensive primary literature on clay and clay minerals, but is it handy? Clay science is a large subject but the book covers an even greater area, bringing in topics that are little related to the main thrust of the book. For example Chapter 7.4 on *Clay minerals and the origin of life* and Chapters 13.1, 13.2 and 13.3 on, respectively, *Layered double hydroxides*, *Parallels between clay minerals and zeolites*, and *Cement hydrates*. However interesting the subjects, they would have been better omitted with more attention being given to clay minerals and clay science.

My first impression of the *Handbook* is that it resulted from a well-financed United Nations Conference reviewing clay mineral science and peripheral areas. The long list of authors arranged by country gives the flavour of a very international get-together. The perfunctory contents list stretching over three pages contains the titles and authors of 39 review papers grouped nominally into sixteen chapters. Casting his eye over this list, the reader might be surprised at some of the titles. Are they anything to do with clay science, or do they just represent papers necessary to obtain financial support to help with registration fees, travel and accommodation at this international conference? Examination of individual articles suggests very variable approaches and various states of completeness as well as misleading titles – a typical feature of conference volumes that are put together under intense time pressure. There was no conference, these are no conference proceedings. This is supposed to be handbook or manual on clay science under strict editorial control, and authoritative and concise in approach and content. What has happened? Let us look further at the structure of the book. This is no academic matter, because the success of a manual does not just depend upon what is inside it, but how easily it can be accessed by the user, independent of whether the manual is being used as a dictionary/encyclopaedia or a series of extensive account of some aspects of clay science. The editors have avoided taking the most obvious and helpful approach, which would have been to construct a handbook with concise entries arranged alphabetically. Given the chosen structure, they have failed to make this as user- friendly as possible. Other than for the initial list of chapter titles, there is no indication of the contents of each chapter. French authors are expert at giving a list of meaningful headings in the contents list for each chapter. This has been put into excellent effect by Masson and Cie in Millot's *Géologie des Argiles* (1963), Caillére and Hénin's *Mineralogie des Argiles* (1963) and in Duchaufour's *Précis de Pédologie*: a more recent example is the Geological Society of London publication *Clay material used in construction*, edited by Reeves, Sims and Cripps (2006). This approach is suitable when the number of headings for each chapter do not exceed more than about ten. If headings are more numerous – for example in Grim's *Clay Mineralogy* (1953) the contents list may become rather cumbersome, particularly if the typesetting is not sufficiently imaginative. Grim's book gets away with it because of the skill of the type setter. Another approach taken by Brindley and Brown's *Crystal structures of clay minerals and their X-ray identification* (1980) is somewhat different; there is a simple contents list of chapters and their authors, but then every chapter begins with a comprehensive list of contents showing each subdivision, heading and subheading.

I can possibly understand why the editors of the *Handbook of Clay Science* have not attempted the "French approach". First, the layout of the contents list suggests little use of the typesetter's skills, and second the number of subdivisions, headings and subheadings in individual sections are rather more numerous than is suited for this approach (Lagaly's article has ~ 30 headings) and the contents list would end up unwieldy and difficult to appreciate. However, the editors, instead of utilising the approach taken in Brindley and Brown (1980), which is well suited to the *Handbook of Clay Sciences*, have left the reader with little aid. The only help given to the reader is a general index. This is accurate in so far as it goes, but its structure is far from user-friendly. The large number of page references found with each entry provides no indication to which chapter or topic each refers and there is a minimum of cross-referencing within the index. The editors could have chosen an alternative approach for indexing: a separate index for each chapter or group of chapters which intrinsically acts as a simple type of cross-referencing. Such an approach has been used in *Clay minerals in onshore and offshore strata of the British Isles* (C.V. Jeans and R.J. Merriman, editors, 2006) with a separate index for each major stratigraphic unit.

8. A TEXTBOOK AND READERS' CONFIDENCE

Textbooks used for teaching undergraduates and other students are an important source of information that will be passed on to future generations. Not only has a textbook to be clearly written and be reliable concerning the facts, theories and hypotheses it deals with, it also has to present an overall view of each topic under discussion demonstrating important differences of interpretation that prevail at the time of writing. The author may indicate or argue that he supports one hypothesis in preference to others but he must not ignore their plurality. Included with this even-handedness – comparable to the role of a judge in a civil or criminal trial – is the need to deal at least briefly with the historical aspects of a topic. It is important to know about hypotheses and theories that have been overturned by the advancement of research, fully realising that new observations and arguments may revive a previously discarded hypothesis. It is clear that the authors of textbooks bear a heavy responsibility for the future well-being of a subject. Alain Meunier's *Clays* sets out to be a textbook that is much needed in clay mineral science. Its list of contents (Table 1) suggests that it covers very adequately the areas of clay science which are intended to be dealt with. Detailed examination suggests that the author is writing an account of the subject "à la Meunier" ignoring historical dimensions and alternative hypotheses, giving the reader a one-sided view of important topics. Particularly important is the near-complete omission of the role or possible role of biological activity in influencing and controlling the neoformation and weathering of clay minerals in those parts of the earth's crust which are under the influence of the biosphere. This biological influence has been discussed in the scientific literature during the last three decades (e.g. Curtis, 1987, 1995; Folk and Lynch, 1997; Fletcher and Knox in Gaunt et al., 1992; Jeans, 1980, 2006; Kantorowicz,1990) although it has only appeared in the clay mineral literature in more recent years. This non-biological approach may be related to the influence of the school of clay mineralogy which has evolved from the metamorphic concept of mineral assemblages and their thermodynamic stability. These metamorphic practitioners have extended their field of interest up to the water/sediment interface without realising they have entered a world where biological control or influence may be a dominant factor. Two examples. It has been demonstrated that the zeolite facies of metamorphism in parts of New Zealand was set up within a few metres or so of the seawater/sediment interface in the Triassic seas under microbial influence and that the basic pattern has little to do with metamorphism (Jeans et al., 1997). The general distribution of neoformed iron-rich and iron-poor 2:1 clay minerals in marine sediments reflects the distribution of oxic, suboxic, and anoxic environments of diagenesis. Iron-rich 2:1 clay minerals (glauconite *sensu lato*) develop under suboxic conditions whereas Fe-poor 2:1 clays are formed in the sulphate reduction part of the anoxic zone. Attempts to untangle this metamorphic invasion within the concepts of diagenesis have introduced new terms (Jeans, 1984) which are useful in providing a philosophical basis in predictive lithofacies modelling for hydrocarbon exploration in areas such as the North Sea, where clay mineral cements are widespread and the sediments are affected predominantly by intrinsic diagenesis.

In the foreward to *Clays*, the author pays homage to Millot's (1964) famous book *Géologie des Argiles* and Velde's (1985) book entitled *Clay Minerals*: *a physico-chemical explanation of their occurrence*. However, it appears that the influence of Velde's book dominates. In addition, when there is a well-established argument about the origin of certain clay assemblages, for example, the corrensite-mixed layer chlorite/smectite-sepiolite-palygorskite assemblages of the Trias – the alternative explanation to the Velde's school is ignored in spite of the balance of evidence favouring it (Jeans et al., 2005).

Another aspect of *Clays* that counts against it becoming an established and satisfactory textbook is the result of its translation from the original language, French. There is some doubt in my mind whether the ground rule for scientific translation has been adhered to: literal translation by a bilingual French person, followed by a native English speaker, well-versed in the topic as well as the English terminology which is used in the particular area of scientific endeavour. The text is all too frequently scattered with problems. Many of the errors are obvious and would been have picked up and corrected by a competent reader familiar with the subject. In other instances new words have been invented to describe situations where there are familiar and perfectly adequate English terms available. In places the text is beyond comprehension even to someone familiar with the subject. A couple of examples:

Section on *Clay gouges* (p. 229)

- "These studies are doomed to a great future because they will allow for a better understanding of the behaviour or faults (hence earthquakes) or ground movements".
- Section on Geochemistry of organic substances (p. 338)
- "During the burial process, these three types (Types, I, II, III kerogen) form separate mineral sequences of increasingly short products (reduction of the H/C or O/C ratios) thus retaining the signature of the initial OM".

In the English speaking world such problems are likely to lead to misunderstandings and a loss of confidence in the book as a source of reliable information, however good were the intentions of the author. Unfortunately these abundant problems resulting from inadequate checking, cross-checking and sub-editing are to be found also in the figures and their captions.

9. TITLES THAT MAY MISLEAD

A title of a book, or of a chapter within it, or of a scientific article has two purposes: first to draw the potential reader to the general topic, and then more specifically to the subject. For example, a review of advances in clay science in Japan should not just be entitled *Recent advances in clay science*. If so the reader will expect a worldwide review and will be disappointed if only work in Japan is considered. My own experience of editors of academic journals of learned societies is that they are very keen to avoid such misunderstandings. So it is rather surprising to find that the editors of the *Handbook of Clay Science* have not been as diligent as they might have been, considering that all three of them are academics, although the publisher is definitely commercial. The problem of the title has already been raised. A more accurate title would be *Reviews in Clay Science and related areas*, as this would not necessarily raise hopes of concise authoritative accounts of terms, topics, etc. that are easy to find and to comprehend without being interrupted by excessive references. Some of the chapter headings are also misleading, claiming their contents to be more extensive than they are. For example, Chapters 6, 9, 11.4 and 15 do just this. Chapter 6 is entitled *Mechanical properties of clays and clay minerals*. The author has restricted his coverage to conventional areas of near-surface civil engineering making no mention of the problems encountered at depth during deep drilling. A more realistic title would have been *Mechanical properties of clays and clay minerals in the near-surface environment*. Chapter 9 entitled *Clays, micro-organisms and biomineralisation* raises expectations of a broadly-based survey of the long-established ideas on the influence of microbial activity on mineralization. The reference list suggests that this area of investigation is of recent development. It fails to make the rather fundamental difference between mineral - forming reactions that may or may not be influenced by microbial activity and those that are an integral part of their life cycle. A much more realistic title would have been *Micro-organisms and mineralisation; a review of some recent research on the formation of clay minerals.* The chapter (11.4) entitled *Clays and nuclear waste management* would be expected to discuss the research and progress that is being made in a number of countries around the world where this problem is of major concern and is under study. However, discussion is limited to Sweden alone, leaving the reader wondering whether this is the only country where clays are used or being considered in the management of nuclear waste. *Clays and nuclear waste management in Sweden* would have been a more accurate title. Chapter 15, *History of clay science: a young discipline*, takes a narrow and incomplete view not only of what science is about, but also of the subject of clays and clay minerals as a whole. It is a form of conceit of modern science and many scientists that what has been done in the past, sometimes very far back in history, is of lesser significance than what is being done today. The discovery of the properties of fuller's earth for cleaning wool, perhaps at least some 7000 years ago by an unknown Neolithic person in Cyprus (Robertson, 1986, p. 9) is a major scientific discovery, just as the making of the first commercially important synthetic clay mineral – laponite – by Barbara Neumann is of equal significance in more recent times (1962). Neither is mentioned in the chapter. The circumstances and name of the Neolithic wool technologist have probably been lost forever, but for the inventor of laponite it is known (**Table 8**). I can recall in my research student years (1960s) the dogmatism that kaolin – organic molecule intercalates did not exist, only to discover that the Chinese were using the kaolinite-urea reaction many hundreds of years ago to improve greatly the properties of their ceramic clays (Weiss, 1963). No doubt the authors of *History of clay science: a young discipline* would claim this as a modern discovery. Another very surprising omission from this chapter is a mention of Georges Millot's *Géologie des Argiles* (1964), a very significant textbook which set the scene for much future research – perhaps these authors consider that the geology of clays and clay minerals do not fall within clay science, in spite of including a review *Genesis of clay minerals* based upon this area of research. The chapter on the history of clay science is a considerable disappointment, much of this could have been avoided by a title such as *History of recent clay science: some notes*.

10. CONCLUDING COMMENTS

Problems with books such as those associated with *Clays* and the *Handbook of Clay Science* are the

Table 8 Extract from *A woman in the world of R & D, an interview with Barbara Neumann*, published in *Newslink* (late 1972 or 1973) describing the circumstances of the invention of laponite.

One day, important representatives of a large international company came to ask our advice on hectorite deposits, as they had a use for it in a new product which they wanted to market worldwide. At the time it seemed like a big market for a material which was rare and expensive.

I gave them all the information I had on hectorite and said that there wasn't anything available anywhere except in America where the material was both expensive and impure.

At that time, natural clays would cost something like £5 to £30 a ton, but hectorite in its purified form would be about £600 a ton. So clearly the proposition to synthesise it was very worthwhile.

I set to it and produced a form of synthetic hectorite in about 6 months. But for two reasons this application didn't come to anything. First, the company which originally asked for it decided not to market the hectorite containing product after all, except for small and special uses; and secondly they found that the synthesised hectorite wasn't quite as good as the natural for this particular application which involved gelling in organic systems.

Nevertheless, it was found to be extremely good in something for which it was never intended – as a gelling agent for aqueous systems.

direct responsibility of the authors, editors and publisher. The high proportion of problems in the output of commercially published books on clay science reflects the lax approach taken by all those involved. Often included are the preface writers and reviewers, perhaps who wish not to be seen to criticise openly or adversely (or bite the hand that feeds them) the writings of their colleagues. However, their reputation is at stake. One cannot but admire those reviewers (e.g. Cuadros, 2005) who take "the bull by the horns" and tell the public exactly what the situation is. These book problems reflect the publish-or-perish atmosphere of present science that has increasingly embraced the clay world. Making use of this are publishers playing on the weakness of many scientists, who are flattered to be involved in such major projects, and can see considerable profit in such ventures. They rely rather on the power of their well-oiled publicity department than on the accuracy, quality, or user-friendliness of their product. The ease with which conference proceedings can be turned into a book is another temptation for the academic and an easy opportunity for the profit-hungry publishing house. Such shortcomings tend to be much less frequent in the publications of learned societies and university publishing houses.

Both *Clays* and the *Handbook of Clay Science* have involved the authors and editors in a lot of work even in getting their books into the parlous state in which they were published. How much better would it have been if more effort, time and advice would have been used in creating books which could be relied upon by the reader and could be used as reliable sources for the education of students, researchers and the scientific public, for which there is a desperate need. Until we put our own house in order clay scientists cannot expect our science to thrive. To build up a good reputation requires skill and a lot of time and hard work, to lose it takes little effort. Perhaps we should heed J.H. Taylor's wise observation before signing on for the next book contract.

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