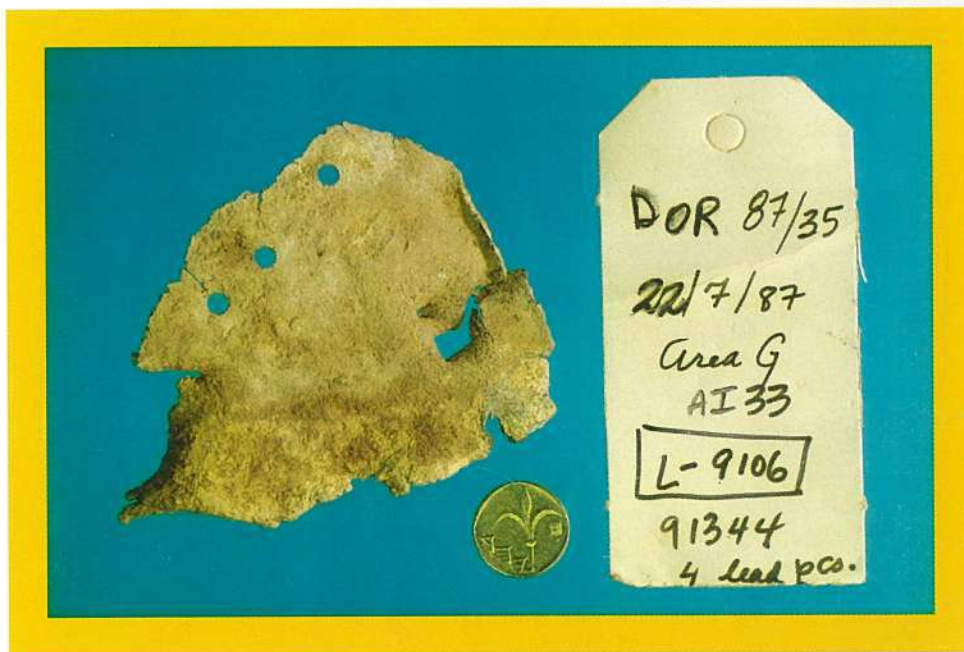


# כימיה בישראל CHEMISTRY IN ISRAEL



בטאון החברה הישראלית לכימיה Bulletin of the Israel Chemical Society

גליון מספר 21, מאי 2006 Issue No. 21, May 2006



**Corroded lead sheet ~ 2500 years old, Persian period.**

See article by Shimon Reich on Superconductivity in the service of Archeology p.9



# כימיה בישראל - בטאון החברה הישראלית לכימיה

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 רמי לידור-הדס, רוני גוימן, מירה פרייבנד, משה קול

## דבר המערכת

פרופ' שמעון רייך ממכון ויצמן, פיתח שיטה חדשנית לתיארוך מימצאים ארכיאולוגיים שמכילים עופרת. הוא גילה שהיות ועופרת עוברת קורוזיה איטית מאד, הכמות של תוצרי הקורוזיה היא פונקציה של גיל הממצא והתנאים באזור. שיטת האנליזה של כמות העופרת המתכתית בתוך הדגם, מבוססת על אפקט מייסנר, דחייה של שדה מגנטי במתכת כאשר היא הופכת למוליכת-על בטמפרטורה של  $7.2^{\circ}\text{K}$ . היות והתחמוצות אינה מוליכת-על, ניתן לבצע מדידה זו בדיוק רב. נמצאה התאמה טובה בין המדידות בשיטה זו לגבי דגמים מאתרים שתקופתם ידועה, ועקרונית ניתן לפתח את השיטה גם לגבי מתכות אחרות וסגסוגות שהיו בשימוש בעבר הרחוק (ראה תמונת השער).

פרופ' ישראל גולדברג, מאוניברסיטת תל-אביב, מנתח את ספרו של פרופ' פרנק הרבשטיין, מהטכניון, על קומפלקסים מולקולריים גבישיים. ספר זה מהווה סיכום מעמיק של הנעשה בשטח וישמש מקור חשוב למדענים וסטודנטים העוסקים במחקר קריסטלוגרפי.

ד"ר בוב ויטראוב, מהמכללה ע"ש סמי שמעון, מביא את תולדות חייה של ליזה מייסטר, האישה שביחד עם אוטו פריש "פתחה את השער של העידן הגרעיני" בשנת 1938, ושעל שמה נקרא אלמנט מספר 94 מייטנריום.

הכינוס השנתי ה-71 התקיים השנה בחסות אוניברסיטת בן-גוריון. הכינוס היה רב משתתפים וכלל מגוון רחב של נושאים הנמצאים בחזית המחקר המדעי. במסגרת הכינוס חולקו פרסי החברה וכן פרסים לסטודנטים ותלמידי תיכון מצטיינים. עם סיום הכינוס השנתי הסתיימה כהונתו של פרופ' שמאי שפיזר כנשיא החברה והחלה כהונתו של פרופ' שלמה מרגל.

כינוס אחר שעליו מדווח בגליון הנוכחי הוא כינוס "מלטה 2" שאורגן ביוזמת פרופ' צפרא לרמן ממכללת שיקגו. הכינוס שכתרתו *Frontiers in chemical sciences II: Research and education in the Middle East* הוא המשך לכינוס הראשון שהתקיים לפני שנתיים, ומטרתו להביא לשיתוף פעולה מדעי בין מדינות המזרח התיכון. בכינוס השתתפו 56 מדענים מ-12 מדינות באזור, כולל 13 מדענים מישראל. כמו כן הוזמנו מדענים מפורסמים מארצות הברית ואירופה. כתוצאה מהכינוס נוצר קשר בין מדענים ממדינות שונות באזור, ואנו תקווה שקשרים אלו ילכו ויתחזקו בעתיד.

התאגיד של האגודות לכימיה באיחוד האירופי EuCheMS, שבו חברה גם ישראל, החל בפרסום ידיעון. הפרסום הראשון מובא בגליון זה, וגם באתר החברה. במידה ויש לחברים ידיעות או הודעות שמן הראוי לפרסם בידיעון, יש להעבירן בדואר אלקטרוני לפרופ' משה לוי [Moshe.levy@weizmann.ac.il](mailto:Moshe.levy@weizmann.ac.il), שמונה לנציג הישראלי לידיעון.

לציון 40 שנה לייסודו של בית הספר לכימיה באוניברסיטת תל-אביב, הובא לדפוס "ספר ההרכבה והתפרדה", שיצא לאור בוויילנד בשנת 1876. צלום של כריכת הספר מובא בשער האחורי של הגליון. השפה המדעית המיוחדת, ההיגיון הפנימי, וההסברים שניתנים לתופעות שונות, בעזרת הידע המצומצם שהיה קיים לפני 130 שנה, הופך את הספר למרתק לכימאי בימינו. אנו נביא פרקים נבחרים מהספר ההיסטורי הזה בגליונות הבאים של הבטאון.

# תמונת מצב עדכנית על לימודי הכימיה בבתי הספר התיכונים אפריל 2006

ד"ר ניצה ברנע, מפקחת מרכז על הוראת הכימיה, משרד החינוך

אנחנו נמצאים בעיצומה של שנת הלימודים תשס"ו ומתקרבים לבחינות הבגרות, שיא הפעילות והמאמץ הן של המורים והן של התלמידים. השנה חלים מספר שינויים במבנה הבחינה אשר נובעים מהחלטות ועדת המקצוע. תלמידי כיתות י' יצטרכו להיבחן בהיקף של 1/2 יחידת לימוד (יח"ל) או 1 יח"ל במעבדה כשיגיעו ל"ב. שינוי זה מחייב כמו כן היערכות רצינית, ויישום החל כבר משנת הלימודים הבאה, שכן יחידת המעבדה היא יחידה מתמשכת על פני כיתות י"א וי"ב ויש ללמד אותה במשך שנתיים. בתי הספר אשר מתחילים ליישם את השינוי, חייבים להתארגן בהתאם, ולהקצות מספיק שעות למעבדה, במידה והקבוצה מונה יותר מ-25 תלמידים ויש צורך לחלק את הכתה.

בהרבה בתי ספר המעבדות היו מוזנחות וצריך להשקיע ברענון ובשדרוג המעבדה, וזה מחייב כמו כן היערכות ותקצוב נאות. למרות הקשיים, יש חשיבות עצומה בתהליך זה שכן לדעתנו חלק מ"יופיה" של הכימיה הוא באפשרות שילוב המעבדה כחלק בלתי נפרד מההוראה, הלמידה וההערכה.

לא בכל מקום הנהלות בתי הספר מסייעות בנושא מבנה, הצטיידות ותמיכת לבורנט, ושם יש צורך בהתערבות הפיקוח או הרשות המקומית. מתוך מעקב אחר המתרחש בבתי הספר ניתן לראות כי נעשים מאמצים בכל המגזרים: בערים הגדולות ובפריריה להקצות את השעות ואת התנאים להחזרת "עטרת המעבדה" לתפארתה. שינוי כזה מחייב קודם כל את המורים למאמץ רציני, הן בהשקעת שעות בחשתלמויות, הן בהיערכות לדרכי הוראה והערכה חדשות והן בדרישה לקבל בבית הספר את התנאים המינימאליים. בימים אלה, כאשר מתחילים להיערך לשנה הבאה, לקראת חילופי השרים במשרד החינוך, כאשר לא ברור מה יהיה הקיצוץ הבא, ומי יפגע בגל הפיטורים המתקרב, יש חשש גדול במערכת. מצד אחד המורים מעוניינים לקדם את המקצוע, ולהכניס בו את השינויים הנדרשים ומצד שני הם חרדים למקום עבודתם, שמא תיגזל פרנסתם. כמפמ"ר הממונה על ציבור מורי הכימיה, זה המקום לציין כי זהו ציבור של מורים מעולים ורציניים שעושים את מלאכתם אמונה ומשקיעים מעל ומעבר למתבקש לפי תקן השעות והמשכורת. המורים משקיעים אנרגיה ורצון רב בעבודה רצינית בהוראת המקצוע, ובהכנסת השינויים בתכנית הלימודים החדשה. ניתן לראות את תוצאות העבודה הפורייה במספרי הנבחנים בבחינות הבגרות, כפי שמופיעים בטבלה שלהלן. בעשור האחרון היינו עדים בתחילה לירידה משמעותית במספר בוחרי הכימיה בין השנים 1996-2001. החל משנת 2002 יש עליה מתונה במספרי הנבחנים וכמעט חזרנו למספרים של שנת 1996-1999 לפני "הבום" הגדול של עידן ההיי-טק. לפי מסמרי המחברות שהוזמנו לקראת הבחינה השנה, יש לצפות להמשך מגמת העלייה ואני תקווה שמגמה זו תמשך גם בעתיד.

| שנה  | תלמידי תיכונים (יח"ל) | תלמידי תיכונים (יח"ל) |
|------|-----------------------|-----------------------|
| 1996 | 6674                  | 8136                  |
| 1997 | 6414                  | 8120                  |
| 1998 | 6356                  | 8068                  |
| 1999 | 6137                  | 7734                  |
| 2000 | 5972                  | 7275                  |
| 2001 | 5459                  | 6616                  |
| 2002 | 5608                  | 7166                  |
| 2003 | 5818                  | 7535                  |
| 2004 | 6300                  | 7280                  |
| 2005 | 6757                  | 8103                  |

נתון נוסף חשוב שמצביע על התקדמות השינוי בהכנסת יחידת המעבדה הוא כי מבין התלמידים שנבחנו ב-5 יח"ל 4121 כבר נבחנו על 1/2 או 1 יח"ל במעבדה, כלומר, לאט לאט המערכת עוברת את השינוי הנדרש, ושינוי זה מסייע לקידום מקצוע הכימיה בבתי הספר. התלמידים הלומדים את יחידת מעבדת החקר בשיטות השונות, משפרים את מיומנויות החשיבה והחקר שלהם, מרגישים תרומה עצומה ומביעים זאת במשובים ובמחקרי הערכה שנערכו.

תכנית הלימודים החדשה שנכתבה ע"י ועדות התכנית נמצאת כבר באתר האינטרנט של האגף לתכניות לימודים, ואני ממליצה להיכנס ולקרוא אותה. התכנית מפורטת בכתובת: [http://cms.education.gov.il/EducationCMS/Units/Tochniyot\\_Limudim/Portal/TochniyotLimudim/CativaElyuna/Chemya.htm](http://cms.education.gov.il/EducationCMS/Units/Tochniyot_Limudim/Portal/TochniyotLimudim/CativaElyuna/Chemya.htm)

במרכזי הפיתוח השונים עובדים במלוא הקיטור לפיתוח היחידות של תכנית הלימודים החדשה וחלקן מנוסות השנה במספר בתי ספר, השנה ייבחנו כ-500 תלמידים על חלק מהמבניות שנמצאות בשלב מתקדם של הפיתוח. בשנה הבאה תהיה קבוצת ניסוי שתיבחן על כל התכנית החדשה ל-3 יח"ל.

התקדמות נוספת היא ההחלטה לאחד את כל המסלולים של כימיה ברמה של 3 יח"ל. החל משנת תשס"ז כל הנבחרים בהיקף של 3 יח"ל יבחנו בשאלון אחד לכימיה 3 יח"ל ולא יהיו יותר שאלונים בכימיה חקלאית, כימיה טכנולוגית וכימיה לביולוגים. למרחיבים ב-2 יחידות נוספות יהיו שני מסלולים אפשריים:

1. המסלול של לומדי הכימיה הרגילה שבו מבנית חובה, 1/2 או 1 יחידה מעבדה חוקרת ונושאי בחירה.
  2. המסלול ללומדי מגמת ביוטכנולוגיה שבו תהיה בחינת חובה של 2 יח"ל ביוכימיה.
- לכלל התלמידים הנבחרים באחת הגרסאות מקצוע זה נחשב 5 יח"ל כימיה. תלמידים במגמת ביוטכנולוגיה לומדים בנוסף עוד מקצוע של בין 1 ל-5 יח"ל שנקרא מערכות ביוטכנולוגיות.

גם השנה חולקו שני פרסים למורים מצטיינים בכימיה. ד"ר יהושע סיוון קיבל את הפרס ע"ש ד"ר ורה מנדלר בכנס הארצי של מורי הכימיה וגב' רות שטנגר זכתה בפרס המורה המצטיין של החברה הישראלית לכימיה. ברכות לזוכים, שהם באמת מורים משכמם ומעלה ואכן ראויים לפרס. בבתי הספר מלמדים הרבה מורים מצוינים לכימיה ואין ספק שיש הרבה יותר מורים מצוינים מאשר פרסים. מורים אלה מתבלטים בהישגים גבוהים של תלמידיהם בבחינות הבגרות, בהגדלת מספר הלומדים את מקצוע הכימיה בבתי הספר שלהם, בעידוד תלמידים להשתתף בכימיאדה ובהעשרת ציבור המורים בפעילויות הוראה והערכה מגוונות.

חובת לימודי המדעים מוצהרת באופן רשמי ומחייבת לימודי שלושת מקצועות המדעים: ביולוגיה, כימיה ופיזיקה בכיתות י' בהיקף של 8 שעות לפחות, אולם אינה מיושמת. בשנים האחרונות עקב הקיצוצים הנרחבים שהתקיימו במערכת החינוך נשארו מעט מאד בתי ספר אשר אכן מקיימים חובה זו כלשונה. רוב בתי הספר מתחילים את בחירת המגמות כבר בכיתות י', כך שרק הנוחרים במגמה לומדים את מקצוע הכימיה. תלמידים רבים, שלא נחשפו למקצוע אינם מכירים את "הכימיה" 2002, וקשה להם כמובן לבחור במקצוע כמגמה. זהו חלק מהמאבק של הפיקוח ושל המורים בשטח בכל בית ספר כדי לשמר את הקיים, ולאפשר לתלמידים את החשיפה ל"כימיה" בדרכים מגוונות. לפעמים לומדים רק סמסטר אחד בכיתה י' ולפעמים מתחילים את הוראת הכימיה בכיתות ט', כדי לתת לתלמידים מושג כלשהו על מהות המקצוע. חוקת הזכויות החדשה, שאמורה לטפל בחובת לימודי מדעים בהיקף נאות בכיתות י', מתגבשת, אולם כנראה לא תיושם בשנה הבאה, הן כתוצאה מחילופי השרים והן כתוצאה ממאבקים בארגוני המורים. למרות כל הקשיים ניתן לומר בסיפוק כי יש התקדמות הן בשיפור דרכי הוראה והערכה, והן בהתייחסות המשרד ותמיכתו במקצוע.

זו השנה השביעית שמתקיימת הכימיאדה בטכניון בתמיכת משרד החינוך, והשנה לראשונה יצאו 4 מצטיינים מבין הזוכים במקומות הראשונים לייצג את מדינת ישראל בתחרות הבינלאומית של הכימיה בדרום קוריא. סוף-סוף גם אנחנו על המפה של תחרויות בינלאומיות ונקווה שנחזור משם עם מדליות, ברכת הצלחה למתחרים.

לכל המתעניינים בלימודי הכימיה בתיכון, ניתן להיעזר באתר מפמ"ר הכימיה שנמצא באתר או"ח של משרד החינוך ובו מופיעים חוזרי המפמ"ר, עדכונים למורים על דרכי הוראה והערכה, וכן דוגמאות של מבחנים, ופעילויות, כמו גם קישורים לאתרים של קבוצות הפיתוח השונות ואתרים רלבנטיים נוספים. באתר קבוצות דיון שונות, פורום פתוח לקהל הרחב, קבוצת דיון למורים, וקבוצת דיון למדריכים. כמרכז ישנו פורום מבחנים שבו מורים מחליפים ביניהם דוגמאות לבחינות מתכונות לקראת בחינות הבגרות. האתר והפורומים השונים פעילים מאד ויש מספר גבוה מאד של כניסות לחודש.

ציבור מורי הכימיה מברך את פרופסור שלמה מרגל עם כניסתו לתפקיד נשיא החברה הישראלית לכימיה. בעבר כיהן פרופסור מרגל כיו"ר ועדת מקצוע הכימיה, ויש לו אהדה רבה לקידום נושאי הוראת הכימיה בתיכון. אנחנו מאחלים לו הצלחה רבה בתפקידו ומצפים להמשך שיתוף פעולה בין החברה למורים.

# תחרות ה"כימיאדה" לשנת תשס"ו 2005/6

חירה ר. כ"ץ, מנהלת אדמיניסטרטיבית, כימיאדה-ארכימדס

ביום חמישי, ח' ניסן תשס"ו (6.4.2006), לקראת שעה 19:30, אולם בטלר בטכניון היה מלא עד אפס מקום. כ-200 איש - תלמידי כתות י"ב, הוריהם, מוריהם, חברי סגל ההוראה ועובדי הפקולטה לכימיה, נציגי משרד החינוך, נשיא החברה הישראלית לכימיה, עיריית חיפה ומפעלים כימיים מובילים - התאספו כאן לטכס הסיום של "הכימיאדה" - התחרות הארצית בכימיה לתלמידי בתי-ספר לשנת תשס"ו 2005/06. נזכיר, שרעיון "הכימיאדה" (במקור "כימידע") אותו הגתה החברה הישראלית לכימיה, התקיימה לראשונה באוניברסיטת בן-גוריון והיתה אמורה להתקיים כל שנה באוניברסיטה אחרת. כאשר בשנת תש"ס 1999/2000 הגיע תור הפקולטה לכימיה בטכניון לארח את ה"כימיאדה", דקן הפקולטה דאז, פרופ' נמרוד מוסיסייב הציע שהיא תתקיים בטכניון באופן קבוע.

המתאספים באולם בטלר חגגו את הסיום המוצלח של התחרות השביעית בטכניון (התחרות התשיעית בסדרה כולה). את באי הטכס ברכו מטעם הפקולטה לכימיה שלושת הדקנים מהתקופה האחרונה - הפרופסורים נמרוד מוסיסייב, אהוד קינן ומנחם כפתורי. מטעם ההנהלה, דקן למודי הסמכה פרופ' אלן פינקוס, מטעם החברה הישראלית לכימיה - נשיא החברה פרופ' שלמה מרגל, מטעם מפעלי תעשייה - מנכ"ל "בזן" מר ישר בן מרדכי והכימאי הראשי של חברת החשמל ד"ר אהוד סוצקובר, מטעם עיריית חיפה - סגן ראש העיר מר שמואל גלבהרט. נציגי משרד החינוך: הגב' ריבי לקריץ - מנהלת מחלקה לנוער שוחר מדע וד"ר ניצה ברנע מפמ"ר כימיה חילקו תעודות הוקרה למורים ובתי-ספר מצטיינים. פרופ' גבריאל קוונצל האחראי האקדמי של התחרות חילק תעודות ופרסים לכלל המתמודדים ומלגות לימודים לששת הזוכים במקומות הראשונים. טכס חגיגי זה היווה את סיום של המסלול השנתי המורכב והדחוס של תחרות ה"כימיאדה", כפי שהיא מתקיימת בשנתיים האחרונות, כלומר, מתבצעת בשני מסלולים. המסלול העיקרי מיועד לתלמידי כתות י"א-י"ב והמסלול המשני לתלמידי כתות ט'-י'.

המסלול העיקרי כולל שלושה שלבים:

**שלב א'** מתקיים בבתי-הספר בחודש נובמבר ומיועד לכל התלמידים הרוצים לקחת בו חלק. הוא מכיל מבחן בעל כ-20 שאלות בתחומים שונים של הכימיה, הבנוי בשיטה האמריקאית ונשלח על-ידינו לכל בתי-הספר לפי רשימות ממשרד החינוך.

החשתתפות בשלב זה מתרחבת משנה לשנה והשנה הגענו לכ- 4000 משתתפים מכ- 150 בתי-ספר לעומת אשתקד, בה נבחנו 2155 תלמידים מתוך 139 בתי-ספר מכל רחבי הארץ (מתוך 350 בתי-ספר שבהם לומדים כימיה). הטבלה להלן מראה את ההתפתחות המרשימה במספר הנבחרים - גידול פי ארבעה משנת 2002/3.

| שנה          | משתתפים | מספר בתי-ספר |
|--------------|---------|--------------|
| תשס"ג 2002/3 | 1088    | 96           |
| תשס"ד 2002/4 | 1500    | 108          |
| תשס"ה 2004/5 | 2155    | 139          |
| תשס"ו 2005/6 | 4000    | 150          |

המבחנים נכתבים ונבדקים על ידינו וכ- 10%-7 המצטיינים מוזמנים להשתתף בשלב ב' של התחרות. השנה, תוצאות שלב א' היו טובות מאוד. כל תלמיד י"ב שפתר נכונה לפחות 14 וכל תלמיד י"א שפתר לפחות 10 מתוך 17 שאלות עלה לשלב ב'. מספר התלמידים שהצליחו לעשות זאת היה כ-250.

**שלב ב'** מתקיים בחודש דצמבר בטכניון ונמשך יום אחד. במסגרתו התלמידים נבחרים פעם נוספת, שומעים הרצאה והדגמות בנושא: "תחומים חמים בכימיה", הרצאה הניתנת על ידי פרופ' אורי פסקין בלווי הדגמות בעזרתה של הגב' אמה גרץ. התלמידים עורכים סיור במעבדות המחקר של הפקולטה לכימיה.

מספר התלמידים שהעפילו לשלב זה לעומת שנים עברו:

| שנה          | משתתפים | מספר בתי-ספר |
|--------------|---------|--------------|
| תשס"ג 2002/3 | 1088    | 116          |
| תשס"ד 2002/4 | 1500    | 143          |
| תשס"ה 2004/5 | 2155    | 174          |
| תשס"ו 2005/6 | 4000    | 250          |

הבחינה כשלב זה הרבה יותר מורכבת מבחינה בשלב א', וכוללת שאלות בחומר שלא נלמד בבית-הספר, בצד שאלות "מחקריות" אשר אמורות לבדוק יותר יצירתיות החשיבה מאשר רמת הידע של תלמיד. הבחינה קשה ולחוצה בזמן ולמעשה אין סיכוי שמישהו יוכל לקבל ציון 100.

השנה הציונים גם בשלב זה היו גבוהים יותר מבעבר (לדברי המורים התלמידים מתכוננים לתחרות במלוא הרצינות במשך זמן רב). תלמידי י"ב עם ציונים מעל 70 ו- י"א עם ציונים מעל 60 (סה"כ 25 מצטיינים) עלו לשלב השלישי, שלב הגמר.

**שלב ג' -** שלב הגמר נמשך יומיים והוא מורכב משלושה חלקים: תחרותי, מדעי וחברתי והופך להיות חגיגת "הפנינג" של כימיה. החלק התחרותי כולל בחינה (ברמה המתקרבת לרמה של בחינות באולימפיאדות הבין-לאומיות), תרגיל מעבדה והרצאה של תלמיד בנושא שהוא בחר.

ההרצאה ניתנת בפני קהל של תלמידים אחרים, מורים שבאו ללוות את חניכיהם וצוות הערכה הכולל חבר סגל ושני סטודנטים לתארים גבוהים מהפקולטה. חלק זה של תחרות נושא אופי של כינוס מדעי לכל דבר, ותקצירי ההרצאות מופרסמים בחוברת שמקבל כל אחד מהמשתתפים בשלב זה.

בחלק המדעי מתקיימות 2-3 הרצאות של חברי סגל של הפקולטה. השנה נתנו על ידי פרופ' טימור באזוב בנושא "גישות חדשות לתכנון תרופות" ופרופ' נמרוד מויסייב בנושא "מכאניקת הקוונטים: דמיון ומציאות". ההרצאות זכו להצלחה והתעניינות רבה מצד התלמידים. החלק החברתי מכיל סיור במקומות נבחרים בחיפה, בלוי בבריכת שחיה, צפייה בסרט, לינה בבית מלון וטכס סיום.

לטכס הסיום מוזמנים חברים והורים של התלמידים המתחרים, מורים, חברי סגל הפקולטה נציגים של הנהלת הטכניון ועוד. במהלך הטכס התלמידים, פרט לברכות, מקבלים מידע תמציתי על אפשרויות לימודים בטכניון ופרטים והסבר על תוכנית המצוינים בטכניון מפיו של פרופ' נמרוד מויסייב, העומד בראשה. כמו כן צופים במצגת המתעדת את ביצועיהם ביומיים של התחרות, שומעים קצת מוזיקה ועוד. החלק העיקרי של הטכס מוקדש לחלוקת הפרסים: תעודות הוקרה לבתי-ספר והמורים המצטיינים על ידי נציגים של משרד החינוך, ממשיכים בפרסים (בדרך כלל ספר) לכל משתתפי שלב ג', ומסיימים בפרסים לזוכים בתחרות. מספר הזוכים הוא 6 (שלושה תלמידי י"א ושלושה תלמידי י"ב), וגובה הפרס הוא מלגת לימודים בטכניון למשך שנה או סמסטר. כמו כן, זוכים ששת חתני הפרסים לפטור מבחינת בגרות בכימיה בציון 100.

המסלול המשני לתלמידי כתות ט'-י' מורכב משני שלבים (אחד בבית-הספר והשני בטכניון), והוא מכיל בעיקר בחינות. המצטיינים של השלב השני משתתפים גם במחנה קיץ ומוזמנים ישירות לשלב ב' של ה"כימאדה" הבאה.

#### **אולימפיאדה בינלאומית בכימיה**

השנה הוחלט, ע"י פרופ' אהוד קינן, הדקן היוצא, ופרופ' גבריאל קוונצל, האחראי האקדמי על ה"כימאדה", להרחיב את הפעילות כדי להתכונן לקראת האולימפיאדה הבינלאומית לכימיה. יוזמה זו זכתה להתלהבותם ולתמיכתם של כל הנוגעים בדבר, וכרגע אנחנו נמצאים בשלב גיבוש ואימון הנבחרת אשר תצא לראשונה לתחרות הבינלאומית המתקיימת השנה בדרום-קוריאה בתחילת חודש יולי.



# תעסוקת כימאים בתעשייה הכימית בארה"ב

אנון שני, אוניברסיטת בן-גוריון בנגב

שנתיים משמעותיים בהקפי כח אדם מתרחשים בתעשייה הכימית בארה"ב. אמנם אין להקיש מן הנעשה שם על הנעשה בארץ, אך המגמות הבולטות מעידות על מהפכה זוטא בתעשייה הכימית, ובעיקר בתחומים המרכזיים, מחד גיסא, ובתעשיות התרופות, מאידך גיסא. הטבלה שלהלן מראה על השנתיים בתעסוקה, הן בכמות והן במגמה.

| שנה                 | 2000-2005 |        | 1995-2000 |       | 2005  | 2000  | 1995  |
|---------------------|-----------|--------|-----------|-------|-------|-------|-------|
|                     | שינוי     | עונה   | שינוי     | עונה  | מספר  | מספר  | מספר  |
| התעשייה הכימית כולה | -18.0%    | -8.4   | -5.3%     | -2.6  | 38.3  | 46.7  | 49.3  |
| תעשיית הפלסטיק      | -19.2%    | 36.1   | -17.3%    | -39.5 | 152.3 | 188.4 | 227.9 |
| תעשיית המכונות      | -12.6%    | -10.0  | 0.1%      | 0.1   | 69.6  | 79.6  | 79.5  |
| התעשייה             | 6.1%      | 16.8   | 20.9%     | 47.6  | 292.7 | 275.9 | 228.3 |
| תעשיית המכונות      | -22.5%    | -30.7  | -3.5%     | -4.9  | 105.5 | 136.2 | 141.1 |
| תעשיית המכונות      | -10.6%    | -13.4  | -1.9%     | -2.4  | 112.9 | 126.3 | 128.7 |
| תעשיית המכונות      | -14.5%    | -18.4  | -7.2%     | -9.9  | 108.6 | 127.0 | 136.9 |
| תעשיית המכונות      | -16.6%    | -117.0 | -7.8%     | -59.2 | 587.2 | 704.2 | 763.4 |

העליה המרשימה במספר הכימאים העובדים בתעשיות התרופות באה, כנראה בחלקה, על חשבון תחומי התעשייה הכימית האחרים, אך אינה מונעת את הירידה הכללית במספר הכימאים בתעשייה הכימית. במילים אחרות, אלמלא העליה במספר הכימאים המועסקים בתעשיות התרופות, מספר הכימאים בתעשייה הכימית היה קטן עוד יותר. אולם, גם הגידול המרשים במספר הכימאים בתעשיות התרופות נעצר מאז תחילת שנת 2004. מענין ללמוד על תעסוקת כימאים בארץ בתעשייה הכימית. על כך ברשימה נפרדת.

Chem. & Eng. News, Nov. 7, 2005 המקור:

# טיטור חי-חמצן

ד"ר חגית אונג'ר, שהושג על-ידי ברוך ברזל, האוניברסיטה העברית, ירושלים.

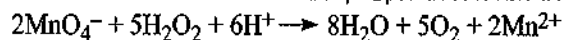
## מבוא:

אילו קולמוסין לך, כעצים אשר ביער סדורים ומחודדים, כדוק אשר לתער ולו נוצות היו לך, מכל בעל כנף ולפני ייפרסו, עבי השחקים לקלף ואף אם הימים-דיו, וכל הגיא-קסת ומילים לי אינספור - כמניין שרי הכנסת ולשוני לשון מלאך, המרחף עלי ענן לא אוכל תאר בואת, את טיטור הפרמנגן כי מה נפלא הוא הדבר - נשגב, לא בר-תיאור מעשי ניסים ממש - גם החימצון גם החיזור! ייקבצו מאפסי הארץ, לראות האת האטרקציה מקצועי ביתן 2 - יבואו לטיטורציה כל עין משתאה, כל לב לא מאמין למן גדול ועד קטן - למן זאבו עד קליין!<sup>(1)</sup>

ויעקו בקול גדול: הוי מי הסוד יתשוף! כיצד בלי אינדיקטור, נוהה את שעת הסוף! או אז תצא בת-קול, עפר מעין לגול לאמר: הסוף נכיר, בהיצבע הנוזל בסגול הן לא דרוש פה pHmeter, אף לא לקמוס - הנייר זהו אוטואינדיקטור - אכן חומר מן המובחר! אך הינה צרה אחת לו - כשמים בסביבה או יבואו  $MnO_2$  - לקלקל את התגובה וזה החומר הנורא - אל לנו לקיימו למרות שסביבתנו - רווית  $H_2O$  והנה יבוא מזור - לצרה ולמצוקה הן אנו נטטרה, בסביבת חומצה חזקה!

## התגובה:

והנה בזה הפרק, הבא עלינו לטובה אותיות לוועזיות, עלינו לכותבה משימת חריזתן - הכל ייכשלו בה או הנה היא הריאקציה, הלא היא התגובה:



## מהלך הניסוי:

ויחלו אז הכל, למלחמה להתכונן ויתבצרו בכיורטות - המחזור והמחמצן הסגול והשקוף - ישנו חרבותם למשיסה לקראת מפגש הטיטור - מלחמת תמיסה בתמיסה וימודו את מי החמצן: 25 מ"ל במספר ועוד 25, חומצת גופרה 3 מולאר ואף הפרמנגן - מחוזק ומבוצר הוא כי ג' פעמים, מי החמצן יטוטרו וירק את חניכיו - צבועי הארגמן אל קרבי הנוזל השקוף - אל תמיסת מי-החמצן וייכנעו מי-החמצן - אחרי מנת מנגן הגונה הסגול את השקוף הכריע, במיליליטרים ארבעים ושמונה ותהיינה עוד שתי מערכות, ועוד שני קרבות ניטשים באחת - 49%, ובשניה ימדדו חמישים וידעו אז כל העם, ויעקו בקול גדול יחי ה-  $MnO_4$ , יחי הפרמנגן הסגול 49 מיליליטרים, חוזרו למנגן  $2^+$  אך המיליליטר החמישים, מאימת המחזור לא ינוס בצאתו מן הביורטה, כארי שואג יתגבר ומי חמצן כבר אָן, את צבעו העז לחזר "לא תודה" הוא יאמר - ברוב הדר ופסון "טוב לי עם  $7^+$ , לא דרוש לי אף אלקטרון!"

ויעשו משתה גדול, ברחבי ממלכת הביתן ותהי שמחה וצחלה - למגדול ועד קטן ובכלים מכלים שונים - ישתו יין מלכות רב בפיפטות של בהט ושש, ובארלנמאייר מזהב חור כרפס ותכלת, בחבלים של בוך אחוז וירון כל אבל - וישמח גם כל שבז

ויתר דברי המנגן, כל דברי גדולתו ותוקפו קיראו נא היכן שתרצו, אך מה שבטוח לא פה...

(1) שמות של מדריכים

הביא לדפוס: פרופ' דוד אבניר, האוניברסיטה העברית, ירושלים.

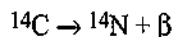
# **SUPERCONDUCTIVITY IN THE SERVICE OF ARCHAEOLOGY; A METHOD FOR THE DATING OF LEAD ARTIFACTS**

**Shimon Reich, Dept. of Materials and Interfaces, Weizmann Institute of Science, Rehovot.**

e-mail: shimon reich@weizmann.ac.il

In dating of archaeological artifacts, observing the details of the object is very important, though it may be deceiving, as the art of forgery is old, and lately became sophisticated. Physical and chemical methods are the key for objective dating in modern archaeology [1].

The most important dating method is based on monitoring of the amount of carbon 14 radioactive isotope in organic artifacts. The concentration of  $^{14}\text{C}$ , present mostly as carbon dioxide, in the atmosphere, and as dissolved carbonates in the soil and in the sea, is in a steady state, one atom of  $^{14}\text{C}$  in  $\sim 10^{12}$  atoms of carbon  $^{12}\text{C}$ , the stable common isotope. This concentration remained approximately constant through the millennia. Plants, animals, as well as the rest of the biosphere, exhibit this concentration of  $^{14}\text{C}$  during their lifetime, by equilibrating it with the surroundings, through uptake of  $\text{CO}_2$  by the plants, in the photosynthesis process, followed by the rest of the food chain in the animal kingdom. Upon their death the uptake and the exchange stop. From this moment, the dating clock is set on, as the concentration of  $^{14}\text{C}$  decreases through the radioactive decay



The half life of this process is 5730 years. In this time period there is a decrease to one-half of the number of  $^{14}\text{C}$  atoms initially present. The decay is spontaneous and proceeds at a immutable rate being totally unaffected by climate and environment. The clock ticks in the heart of the atom, the nucleus. The tiny nuclear size, as compared to the atom and the enormity of the nuclear force, make the  $\beta$  decay rate totally impervious to the outside world. The  $^{14}\text{C}$  dating method was developed by a team of scientists led by Willard F. Libby of the University of Chicago, in the immediate post-WW2 years, [2], and he received the Nobel Prize in chemistry, in 1960. The limit of this dating technique is about 60,000 years, and its accuracy is better than 5%.

Dating procedures for archaeological artifacts made of copper, iron, tin, gold or lead do not exist. Occasionally iron artifacts were dated by the  $^{14}\text{C}$  method performed on the traces of charcoal found in those objects.

In this article a new method for the dating of lead artifacts is presented. This method was described for the first time by Reich, Leitus and Shalev in 2003 [3].

Lead smelting goes back to the sixth millennium B.C. and is probably one of the earliest metallurgical processes. It can be smelted at  $800^\circ\text{C}$  in a simple cooking fire. The most common ore of lead is galena,  $\text{PbS}$ . In an oxidizing atmosphere, the sulfide is roasted to  $\text{PbO}$ , also called litharge, than it is reduced by carbon to lead metal. The melting point of lead is  $327^\circ\text{C}$  so that by smelting at  $800^\circ\text{C}$  it is formed in the liquid state and thus it is easily extracted and cast. Production levels of lead during the Roman Empire, peaked at about 80,000 metric tons per year. This is why lead has been referred to as the Roman metal [4]. On top of its simple metallurgy, lead is ductile and exhibits a very slow corrosion process. Lead's corrosion resistance accounts for its successful use in many environments, such as the atmosphere, soil, fresh water and seawater [5]. Its good resistance in contact with many corrodents is due to the formation of relatively insoluble films, of corrosion products, deposited on the metal in the initial stages of exposure, which then protect it from further attack. These properties made it useful in the antiquity for many applications. It was used in large quantities for plumbing, lining on the hulls and keels of ships, roofing, coinage, projectiles, vat linings, coffins, kitchenware, wine vessels, weights for fishing and anchors for ships. Lead impact absorbers were used in the antiquity to enable slow and careful alignment of very massive stone monoliths. This is probably the origin of the lead pieces found between the stones

in the Wailing Wall. Lead sleeves were used in Hansa ships to reduce friction of moving ropes under high stress. During the early Olympic games lead weights were used in the long jump competition [6]. The sportsman held the weights in his hands, and after takeoff moved them up and in front of his body. Before landing, the weights were swung down and backward. In doing so the feet of the jumper were more forward of the center of mass, than they are for modern athletes, thus a longer jump was achieved. This technique was forgotten with time, and in the modern Olympic games "chemical" methods became popular to achieve the same goal.

The hypothesis behind the dating method for lead is that the mass of corrosion, per unit area of the lead artifact, is related to its archaeological age. Two facts support this hypothesis:

1. The resistance to corrosion of lead in soils is usually good, and it varies with the acidity of the soil. In a controlled corrosion experiment of lead pipes, in a number of soils, for periods of up to 10 years [ 7 ], it has been found that for soils with pH above 6.5 the rate of corrosion was between  $4 \times 10^{-5}$  and  $6 \times 10^{-5}$  cm year<sup>-1</sup>. In acidic soils, pH 4–5, the rate was about 50 times higher. Thus, we may assume that lead buried in sites with similar low acidity will have comparable rates of corrosion, over very long time periods. Also it is assumed that the geological conditions, such as soil conductivity and water table, must have remained relatively constant throughout the archaeological time.

2. The corrosion products of lead in soil, are mainly lead oxide PbO, and lead carbonate PbCO<sub>3</sub>. The solubility of these compounds in water at room temperature is very low,  $2.3 \times 10^{-3}$  and  $1. \times 10^{-4}$  g/100 ml respectively, thus the accumulation of these products on the surface of archaeological artifacts in soil over hundreds of years could be expected. The problem is then to find a method of measuring the mass of corrosion per unit area, in an archaeological artifact. Most of the non-magnetic metals when cooled to low enough temperatures, enter into the superconducting state, in which they exhibit infinite conductivity; simultaneously, they show ideal diamagnetism for small magnetic fields. In this so-called Meissner state, the external magnetic field does not penetrate the sample. The resulting diamagnetic moment is proportional to the volume and thus to the mass of sample.

Lead metal at room temperature exhibits diamagnetic susceptibility of the same order of magnitude as its salts and oxide. However, when cooled below 7.2<sup>0</sup>K it enters into the superconducting state in which it exhibits the ideal diamagnetic susceptibility. The value of this susceptibility is  $10^4$ – $10^5$  higher than that of its oxide and salts, which are not superconductors (s.c.). The value of the volume susceptibility ( $\chi_v$ ) of lead in the Meissner state, i.e. a state in which there is a total expulsion of the magnetic field from the volume of the lead sample, is  $-1/4\pi = -0.0796$ . This value translates to a molar susceptibility ( $\chi_M$ ) of -1.453 cgs. The molar susceptibility of lead oxide and lead salts is of the order of  $-10^{-5}$  to  $-10^{-4}$  cgs at room temperature and down to cryogenic temperatures. Thus the contribution to the diamagnetic signal of these compounds at cryogenic temperatures is negligible in comparison to the diamagnetic signal of lead.

The volume magnetic susceptibility measured in the s.c. state of a corroded lead sample is

$$(1) \quad -1/4\pi = M \rho (1 - \eta) / H_0 m_{pb}$$

where M is the magnetic moment in emu;  $\rho = 11.34$  g cm<sup>-3</sup> the density of lead,  $m_{pb}$  is the mass of the lead metal in the sample and  $\eta$  is the demagnetizing factor.  $\eta$  is shape dependent.  $H_0$  is the value of the external magnetic field. Substituting the measured experimental values of M,  $H_0$ ,  $\eta$  and  $\rho$  into equation (1) we obtain the mass of the lead metal  $m_{pb}$ . We thus use the magnetic measurement of the corroded sample to determine the mass of the uncorroded lead. This procedure yields the total mass of lead in the sample and does not depend on the spatial distribution of the corrosion materials in the sample, their connectivity

and shape, provided this corrosion is on top of a continuous sheet of lead. Knowing the total mass of the sample,  $m$ , the mass  $m_c$  of the corrosion products is determined:

$$(2) m_c = m - m_{pb}$$

Experimentally we find that this procedure has an accuracy of ~1% in samples of ~100 mg.

The samples used in our study are 3 mm in diameter discs, punched out with a special instrument [ 3 ], see Fig. 1.

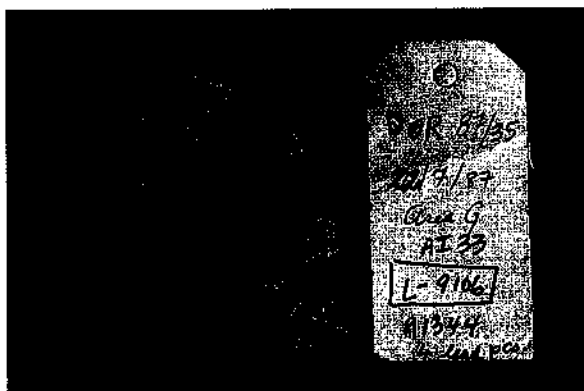


Figure 1. Corroded lead sheet ~ 2500 years old, Persian period.

For measuring the demagnetizing factor  $\eta$ , the magnetization in small enough fields is measured in two configurations: discs parallel and perpendicular to the external field. From these two measurements  $\eta$  is calculated [ 8 ]. In Figure 2 the magnetization vs. field and vs. temperature for a corroded lead disc punched out from the sheet shown in Figure 1 is presented. The mass of the uncorroded lead is calculated from the initial slope of  $M$  vs. field measured in a configuration parallel and perpendicular to the external field. By measuring the transition temperature to the s.c. state we can distinguish between the

relatively pure lead metal phase,  $T_c = 7.2^\circ\text{K}$ , and homogeneous lead alloy phases which exhibit different values of  $T_c$ . Inclusions of a diamagnetic non-superconducting phase in the lead phase will not affect the  $T_c$  value.

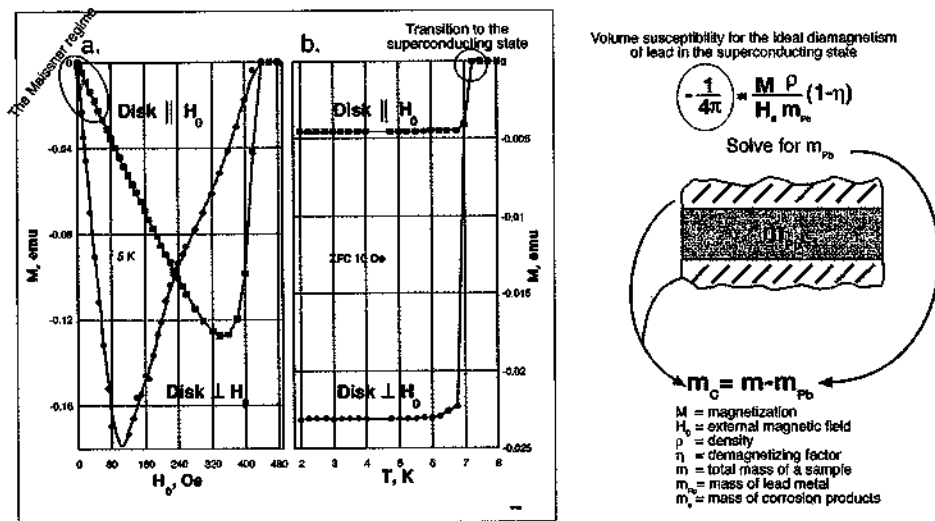


Figure 2. (a) Magnetization versus field of a corroded lead disc from the Persian period measured at  $50^\circ\text{K}$ . The disc is measured in two configurations; parallel and perpendicular to the external magnetic field. (b) Magnetization versus temperature for two configurations measured in an external magnetic field of 10 Oe in zero field-cooled experiments.

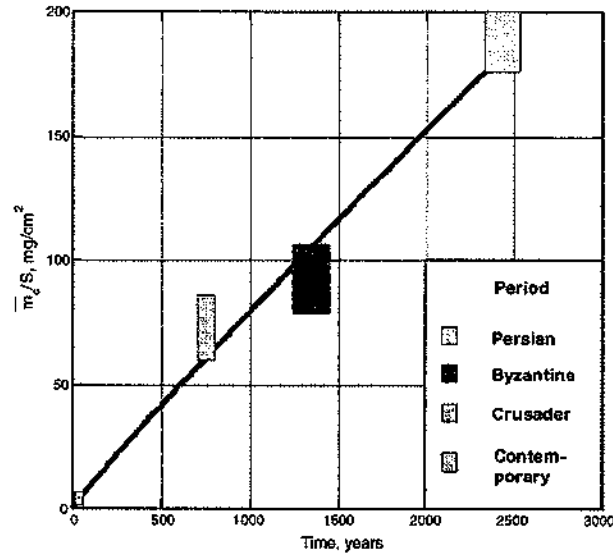


Figure 3. Average corrosion mass  $m_c$  per unit nominal surface area of the discs as function of time. The power law curve is the best fit to the experimental points.

In Figure 3 the corrosion mass per unit surface area vs. archaeological time for samples from well-dated archaeological contexts is presented. The power law curve

$$y(t) = m_c(t) / \text{cm}^2 = Kt^{1/(\alpha+1)}, \quad \alpha = 0.07, \quad K = 0.12 \quad (3)$$

is the best fit to the experimental points. A power law dependence of  $y$  on  $t$  is reasonable (see [9]). In a very general way the act of corrosion is based on the local existence of an electrochemical cell, which comprises a junction of a metallic oxide to a metal surface on the one hand and to oxygen and water on the other. This cell is characterized by certain potential difference  $\varepsilon$ , that drives a current  $I$ , through the cell:  $dy/dt \sim I = \varepsilon / R(y)$ ; assuming  $R(y) \sim y^\alpha$  we get

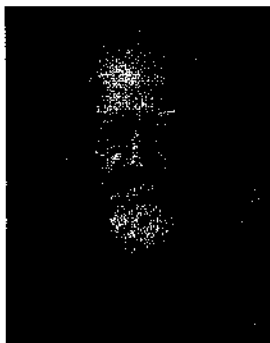
$$y^\alpha dy = K_1 dt \rightarrow y^{(\alpha+1)} / (\alpha+1) = K_1 t + K_2 \quad \text{since at } t=0 \quad y=0 \rightarrow K_2=0$$

$$y = Kt^{1/(\alpha+1)}; \quad K = (\alpha+1) K_1 \quad \text{which is equation (3).}$$

The power law fit is close to a rectilinear line. Such a behavior is characteristic for a corrosion process in which the continuity of a thin protective layer of oxide on the surface of the metal is controlled by stress. When the layer reaches a certain thickness it breaks down and the metal surface is re-exposed to the environment. More oxide is then formed in contact with the metal, and, after a similar time interval, the thin film of corrosion is again disrupted, and then the process is repeated. The net result of such behavior is the production of an oxidation curve, which is virtually a straight line (see [9]). This curve may serve for the approximate dating of lead archaeological artifacts buried in soils of relatively high pH, such as carbonate buffered soils, where the corrosion rate is comparable and relatively slow so that time averaging of external conditions does occur. As the relevant corrosion signal grows in time the relative dating accuracy should improve with the age of the sample. Thus the 2500-year span, dictated by the availability of samples, is not an upper limit of our method. The new method presented here for the determination of lead metal content in a nonmagnetic artifact is in principle non-destructive, as it does not require any chemical or mechanical separation of the corrosion products from the lead metal. Therefore, lead inclusions in copper, silver and gold ancient coins can also be studied.

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- [3] Reich S Leitus G Shalev S 2003 New Journal of Physics **5** 99
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**Prof. Shimon Reich** was born in 1938, in Krakow, Poland. He received his B.Sc. in Physics and Mathematics in 1962, from the Hebrew University, Jerusalem, his M.Sc. in 1964, working with Prof. S. Shtrikman on Magnetism, and his Ph.D. in Polymer Physics in 1969, working with Prof. A. Katzir, both at the Weizmann Institute of Science. He was a Postdoctoral Research Fellow with Prof. A. Eisenberg in McGill University, Montreal, and joined the Weizmann Institute in 1970. In 1980 he was a Visiting Professor in the department of Materials Science and Engineering of the University of Florida, and in 1981 and 1984, a Visiting Scientist in the DuPont Central Research Laboratory in Wilmington DE. In 1998 he spent a sabbatical leave in the National High Magnetic Field Laboratory, Tallahassee FL.

Prof. Reich conducted basic investigations on cryogenic relaxation in polymers, dynamic viscoelastic properties of non-crystalline polymers and biological solid polymers, polymeric ionic conductors and semiconductors. He developed polymers for dye lasers and photo dielectric materials as storage devices in holographic applications, investigated phase stability and spinodal decomposition in polymeric solids and melts, and developed polymer metal composites. He studied noble metal high  $T_c$  superconductor composites, melt textured HTC materials, mercury cuprates and  $MgB_2$  superconductors.

He is presently engaged in the study of superconductivity in surface alkali doped bronzes, superconductivity of metallic nano-particles and magnetic properties of thin gold films.

# THE 71<sup>TH</sup> ANNUAL MEETING OF THE ISRAEL CHEMICAL SOCIETY

Was held on February 27 and 28, 2006  
At the David Intercontinental Hotel in Tel-Aviv

Under the auspices of the Chemistry Department of Ben-Gurion University.

Organizing Committee:  
Raz Jelinek, Chairman,  
Amichay Vardi, Haim Cohen, Gertz Lichtenshtein,  
Gabriel Lemkof, Micha Polak, Ehud Pines

## Program

### Plenary Lectures

Inorganic Nanotubes and Inorganic Fullerene-Like Materials: State of the Art (from Concept to Applications)

*R. Tenne (Weizmann Institute of Science)*

Polychromophoric Compounds for Photochemical Generation of Nitrogen Monoxide by Single and Two Photon Excitation

*P. Ford (University of California, Santa Barbara)*

Self-Assembling Monolayers in the NANO Age: Flavors from an Israeli Cuisine

*J. Sagiv (Weizmann Institute of Science) ICS PRIZE*

From Diffusion to Anomalous Diffusion: A Century after Einstein

*Yossi Klafter (Tel Aviv University) ICS PRIZE*

Controlling Emergent Nanoscale Structure in Materials Synthesis

*G. Stucky (University of California, Santa Barbara)*

Chirality: A Guided Tour

*D. Avnir (The Hebrew University of Jerusalem)*

Communicating Chemistry: The Challenge

*P. Atkins (Lincoln College, University of Oxford)*

Correlations between Friction and Tribochemical Reactions at Shearing Junctions

*J. Israelachvili (University of California Santa Barbara)*



## PARALLEL SESSIONS

### S1: Drugs - From the Drawing Board to the Physiological Target

**[Keynote Speaker]** Nucleic Acid Microspheres for Type 1 Diabetes Intervention

**L. Brown** (*Epic Therapeutics-Baxter Inc*)

Nanoparticles for Vascular Therapy

**G. Golomb** (*The Hebrew University of Jerusalem*)

Intracellular Oathways As Novel Targets for Treatment after Traumatic Brain Injury

**E. Shohami** (*The Hebrew University of Jerusalem*)

Patents, Trade Secrets and Timing: Impact on the Pharmaceutical Industry

**R. Teitelbaum** (*Pearl Cohen Tzedek Laster LLP*)

### S2: The Chemical and Biophysical World of Single Molecules

**[Keynote Speaker]** Direct Measurement of Protein Energy Landscape Roughness

**Z. Reich** (*Weizmann Institute of Science*)

Polymer-like Expansion of Protein Denatured State

**E. Sherman** (*Weizmann Institute of Science*)

Elasticity and Topology of Wormlike Loops

**Y. Rabin** (*Bar Ilan University*)

Mesoscopic Molecular Cluster V15: Crossover of the Magnetic Levels and Adiabatic Magnetization

**B. Tsukerblat** (*Ben Gurion University*)

Transistor in a Test Tube and Antibodies to Semiconductors

**U. Sivan** (*Technion-Israel Institute of Technology*)

### S3: Biomimetic Systems

**[Keynote Speaker]** From the Lotus Effect to Nanoscale Muscles: Biomimetic Nanoscale Machines and Circuitry

**I. Willner** (*The Hebrew University of Jerusalem*)

Prevention of Protein Aggregation by Designed Beta-Sheet Binders

**T. Schrader** (*Universitat Marburg*)

Synthetic Probes for the Elucidation of Molecular Mechanisms in Bacterial Quorum Sensing

**M. Meijler** (*Scripps Research Institute*)

Structural Insights on Designed Amphiphilic Beta-Sheet Peptides at Interfaces

**H. Rapaport** (*Ben-Gurion University*)

### S4: Catalytic Systems

Catalytic NH Activation by Corrole Metal Complexes

**Z. Gross** (*Technion-Israel Institute of Technology*)

Titanium Complexes of Oxygen-Based Ligands: Structure and Hydrolytic Stability

*E. Tshuva (The Hebrew University of Jerusalem)*

(Eta-4-Dienyl)Fe(CO)<sub>2</sub>L (L = CO or PPh<sub>3</sub>) Phosphonium & Arsonium Salts. Synthesis, Deprotonation & Reactivity Features toward the Carbonyl Group

*J.P. Lellouche (Bar-Ilan University)*

Transition Metal Complexes Bearing Novel Strongly Bent Trans-Spanning Diphosphine Ligands: Synthesis, Characterization and Catalytic Activity

*D. Gelman (The Hebrew University of Jerusalem)*

#### Development of Advanced Analytical Methods

*A Symposium Dedicated to the Memory of Prof. Chava Lifshitz*

**[Keynote Speaker]** Visualizing Structure and Kinetics in Heterogeneous Polymer Systems: From the Mesoscale to Single Molecules

*G. Krausch (Universitat Bayreuth)*

Dynamically Coated Chromatographic Columns for Selectivity Modifications

*E. Grushka (The Hebrew University of Jerusalem)*

Determination of Mass/Thickness of Gold Nanostructures

*A. Vaskevich (Weizmann Institute of Science)*

Monitoring of Deposition Mechanism during Chemical Solution Deposition of PbSe Using Light Scattering

*M. Shandalov (Ben-Gurion University of the Negev)*

#### Carbon Nanotubes, Nanowires, Nanoparticles, and Nanosensors

**[Keynote Speaker]** Single-Nanowire-Based Field Effect Transistors for Sensing and Catalysis

*M. Moskovits (University of California, Santa Barbara)*

Epitaxial Approaches to Carbon Nanotube Organization

*E. Joselevich (Weizmann Institute of Science)*

Engineering Neural Networks with Carbon Nanotube Templates

*Y. Hanein (Tel-Aviv University)*

Inorganic Fullerenelike MoS<sub>2</sub> Nanoparticles under Extreme Hydrostatic Pressures: A Combined Raman and HRTEM Study

*T. Livneh (NRCN)*

Encoding Morphology in SnO<sub>2</sub> Nanowires During Their Growth

*Y. Lilach (Pacific Northwest National Laboratory)*

#### Self-Assembled Lipid Phases and Membrane Biology

**[Keynote Speaker]** Self Assembled Lipid Phases and Membrane Biology

*E. Landau (University of Texas Medical Branch)*

Retroviral Protease Domains They're Not Just for Retroviruses Anymore

**D. Fass** (*Weizmann Institute of Science*)

The 3D Structure of the Small Regulatory Subunit of E. Coli Acetohydroxyacid Synthase Isozyme III at 1.75 Å Resolution: Small But Very Important

**B. Shaanan** (*Ben-Gurion University of the Negev*)

Structure and Dynamics of the Nuclear Pore Complex as Revealed by Cryo-Electron Tomography of Intact Nuclei

**M. Beck** (*MPI Biochemistry, Munich*)

#### 10. Surface Chemistry, Films and Devices

[Keynote Speaker] Bio-Inspired Surface Engineering – Mimicking Nature by Technologies Appropriate for Industrial Application

**G. Tovar** (*University of Stuttgart & Fraunhofer IGB*)

Chemical Control of Monolayer Functionalized Surfaces

**C. Sukenik** (*Bar-Ilan University*)

Epitaxial Growth and Analysis of Ultrathin Cobalt and Iron-Silicide Layers by Bias-Dependent Scanning Tunneling Microscopy

**I. Goldfarb** (*Tel Aviv University*)

Design of Sub-Micron to Nanometer Size Metallic Structures on Solid Surfaces via Weakly Bound Buffer Layer

**M. Asscher** (*The Hebrew University of Jerusalem*)

Compositional Structures and Thermodynamic properties of Nanoclusters Computed by means of the FCEM/NRL-TB Method

**L. Rubinovich** (*Ben-Gurion University*)

#### 11. PART 4: DISCUSSION: Industry and Academic Mutual Benefit or Just Opportunism?

**Chair: R. Frim (TAMI)**

Participants:

**M. Hershkovitz** (*Vice president R&D, Ben Gurion University*)

**R. Gidron** (*Prologue*)

**D. Zaslavsky** (*Chairman of National Council for R&D, MolMop*)

**Y. Sasson** (*The Hebrew University of Jerusalem*)

**A. Teuerstein** (*V.P R&D and HSE, Israel Chemicals Ltd.*)

**D. Vilenski** (*Ex Chairman, Applied Materials Israel*)

#### 12. Nanoscale Electronics and Spintronics

Controlling the Structure of Complex Nanocrystals: From Chemistry to Magnetism

**G. Markovich** (*Tel-Aviv University*)

The Life of an Exciton in Semiconducting Polymer Nanocomposites

**G. Frey** (*Technion-Israel Institute of Technology*)

Coordination Self-Assembly of Branched Multilayers on Gold

**I. Rubinstein** (*Weizmann Institute of Science*)

Nano Electro Mechanical Systems based on Carbon Nanotubes

**Y. Yaish** (*Technion-Israel Institute of Technology*)

#### SI1: Control of Chemical Reactions – Theory and Practice

*A Symposium Dedicated to the Memory of Prof. Bilha Segev*

Bilha – A Scientist and a Friend

**N. Brenner** (*Technion-Israel Institute of Technology*)

**[Keynote Speaker]** Exploring Nonclassical (Tunneling) Aspects of Radiative and Radiationless Transitions

**E. Heller** (*Harvard University*)

Non-Adiabatic Propagation of Light Pulses and Frequency Conversion in Coherently Prepared Media

**A. Wilson-Gordon** (*Bar-Ilan University*)

The “Standard Model” of Chemical Reactivity: How Well Does It Describe Reactions at Metallic Interfaces?

**A. Wodtke** (*University of California, Santa Barbara*)

Spin Controlled Geminate Recombination of Photogenerated Radical Ion Pairs

**A. Burshtein** (*Weizmann Institute of Science*)

#### SI2: “Big Molecules” – Polymers and Dendrimers

**[Keynote Speaker]** Polyelectrolyte Brush Layers in Various Ionic Environments

**M. Tirrell** (*University of California, Santa Barbara*)

Polymer Crystallization: Old Problem-New Observations

**M. Gottlieb** (*Ben-Gurion University of the Negev*)

Molecular Recognition in Block Copolymer Matrices: Controlling Morphology using Dendronized Guests

**R. Shenhar** (*The Hebrew University of Jerusalem*)

Designing Elastomeric Polypropylene

**M. Eisen** (*Technion-Israel Institute of Technology*)

#### SI3: Biophysics – Spectroscopy and Dynamics

**[Keynote Speaker]** Shedding light on isolated building blocks of life

**M.S. de Vries** (*University of California, Santa Barbara*)

The Mechanical Properties of Retrovirus: A View into Their Structure and Function

**I. Rouso** (*Weizmann Institute of Science*)

Polymer micro lenses with Nano Fountain Pen

**L. Gheber** (*Ben-Gurion University of the Negev*)

Biomolecular Identification and Material Characterization Based on Nanomechanical Measurements

**O. Sahin** (*Rowland Institute at Harvard University*)

Structural and Kinetic Studies of Zinc- and Copper- Induced Aggregation and Fibrillation of the Amyloid Beta 1-40 Protein

**D. Noy** (*Weizman Institute of Science*)

#### Session 10: Application of Advanced Analytical Methods

Development of a Feasible HPLC Method for Testing the Purity of Oleyl Alcohol

**V. Ioffe and M. Kaadan** (*Teva Pharmaceutical Industries Ltd.*)

Criteria for Positive Identification of Organic Compounds in Forensic Analysis

**S. Zitrin** (*Israel National Police*)

High Temperature Polymer Electrolyte for Fuel Cells

**A. Schechter** (*College of Judea & Samaria*)

Analysis of Phosphorous Content (P2O5) in Phosphate Rock and Gypsum in the KH2PO4 Process

**S. Atlas** (*Rotem Amfert Negev*)

#### Session 11: New Developments in Organic Chemistry

*A Symposium Dedicated to the Memory of Prof. Shimona Geresh*

**[Keynote Speaker]** Catalysis. Making Bonds Quickly, Efficiently, & Almost for Free

**B.H. Lipshutz** (*University of California, Santa Barbara*)

Cyclic 1,3-Diketones: Enols Or Charge Transfer Complexes?

**V. Khodorkovsky** (*Ben-Gurion University of the Negev*)

Self-Immolative Dendrimers

**D. Shabat** (*Tel-Aviv University*) **ICS YOUNG CHEMIST AWARD**

Microwave Assisted Organic Reactions: A versatile Tool for Fast Synthetic Methodology Development

**G. Byk** (*Bar-Ilan University*)

Total Synthesis as a Tool for Elucidating the Mechanism of Action of Amphotericin B

**A.M. Szpilman** (*ETH Zurich, Swiss Federal Institute of Technology*)

#### Session 12: Applied Chemistry: The High-Tech Interface

FT-NMR, MRI and RF Sensing The Three Modalities Concept

**U. Rapoport** (*Aspect Magnets Technologies Ltd.*)

Lectin Arrays: Carbohydrate Analysis on A Chip - Applications in Bio- Health- and Food-Sciences

**O. Markman** (*NutriCognia Ltd.*)

Patent: A Bridge between Academic Research and Industry

**E. Luzzatto** (*Luzzatto & Luzzatto*)

Transdermal Delivery of L-DOPA Prodrugs for the Treatment of Parkinson's Disease

**E. Heldman** (*NeuroDerm Ltd.*)

Novel Nano-Sized Self-Assembled Structured Fluids for Improved Solubilization of Non-soluble Active Compounds

**E. Pimthus** (*Adumim Food Ingredients Ltd and Nutralease Ltd*)

#### **S17- Top-Down or Bottom-Up: Advanced Materials**

*A Symposium Dedicated to the memory of Prof. Shlomo Efrima*

**[Keynote Speaker]** Hierarchical Templating of Silica

**B. Chmelka** (*University of California, Santa Barbara*)

Pharmaceutical Nanoparticles

**A.J. Domb** (*The Hebrew University of Jerusalem*)

Facile Synthesis of Nano-Titania

**Y. Tsur** (*Technion-Israel Institute of Technology*)

Production of Nano Particles By Metallurgical Process and Its Application

**C. Rottman** (*Cima NanoTech Israel Ltd.*)

#### **S18- Laboratories and Experimentation in Chemical Education**

Chair: N. Barnea (Chemistry Supervisor, Ministry of Education, and Technion)

#### **CHEMICAL EDUCATION AWARDS**

**[Keynote Speaker]** All You Need Is Light

**M.W. Tausch** (*Bergische Universitat*)

TEVA-CHEMISTRY - Motivating Secondary School Students to Major in Chemistry

**O. Palmer Granot** (*Teva Pharmaceutical Industries Ltd*)

**Z. Scherz** (*Weizmann Institute of Science*)

Cognitive Coaching as Means of Improving the Teaching Quality of Laboratory Instructors

**R. Blonder** (*The Hebrew University of Jerusalem*)

Trends in the Undergraduate Laboratories Entering the 21st Century: Microscale, Green and Computerized Experiments

**M. Livneh** (*Bar-Ilan University*)

# FRONTIERS OF CHEMICAL SCIENCES II: RESEARCH AND EDUCATION IN THE MIDDLE EAST

**Zafra M. Lerman and Jeffrey S. Wade**

**Institute for Science Education and Science Communication, Columbia College, Chicago IL**

The second conference "Frontiers of Chemical Sciences II: Research and Education in the Middle East" (commonly called "Malta-2") was held from 5 to 10 November 2005 on the island of Malta. Following the success of the first conference ("Malta-1", held in December, 2003), participants recommended strongly that a second conference be convened to maintain the momentum created in Malta-1.

The vast majority of participating scientists in Malta-2 came from the Middle East: Bahrain (1), Egypt (10), Iran (6), Israel (13), Jordan (3), Kuwait (1), Lebanon (3), the Palestinian Authority (11), Qatar (1), Saudi Arabia (3), Turkey (2) and the United Arab Emirates (2). Issues of mutual concern, such as the environment, medicinal chemistry, nanotechnology, energy and education were the focus of the meeting.

The Malta-2 conference was cosponsored by the American Chemical Society (ACS), the International Union of Pure and Applied Chemistry (IUPAC), the Royal Society of Chemistry (RSC) and the Gesellschaft Deutscher Chemiker (GDCh). An international organizing committee was convened with representatives of the sponsoring societies, chaired by the author Zafra Lerman, who conceived the idea of holding a series of conferences involving Middle East scientists.

A number of invited plenary lectures were delivered during the conference. These included presentations by six Nobel laureates (as in Malta-1), and other distinguished speakers.

- Peter Atkins (United Kingdom) delivered the first plenary lecture of the conference, titled "Galileo's Finger: The Ten Great Ideas of Science" in a session chaired by Ameen Farouk Fahmy (Egypt).
- Nobel laureate Yuan T. Lee (Taiwan) spoke on "Energy, Environment and the Responsibilities of Scientists" in a session chaired by Alfred Abed Rabbo (Palestinian Authority). In his talk, Prof. Lee emphasized that borders are only lines on a map, and that nature does not recognize borders. He added that resources, such as clean water and clean air, must be dealt with involving full cooperation of all occupants of the region.
- "Ozone Depletion, Global Warming, and Smog" was presented by Nobel laureate F. Sherwood Rowland (USA). Fawwaz Jumean (United Arab Emirates) chaired this session.
- Nobel laureate Aaron Ciechanover (Israel) spoke on "Intracellular Protein Degradation: From a Vague Idea through Basic Mechanisms and onto Human Diseases and Drug Targeting", in a session chaired by Dincer Ulku (Turkey).
- A lecture on "Supramolecular Chemistry: Concepts and Perspectives" by Nobel laureate Jean-Marie Lehn, Universite Louis Pasteur (France) was chaired by Sultan Abu-Orabi (Jordan).
- David Reinhoudt (Netherlands) presented: "Writing with Molecules on Molecular Printboards" in a session chaired by Mehdi Jalali-Heravi (Iran).
- Michael Graetzel (Switzerland) addressed: "Generation of Electricity from Sunlight by Mesoscopic Solar Cells" with Arie Zaban (Israel) as chair.
- Nobel laureate Richard Ernst (Switzerland) spoke on "Science and Heritage: Analysis and Conservation. The Example of Tibetan Painting Art" in a session chaired by Hassan Zohoor (Iran).
- The final plenary lecture was "All the Ways to Have a Bond," presented by Nobel laureate Roald Hoffmann (USA), and chaired by Venice Gouda (Egypt).

Five workshops were held during the conference, each with multiple sessions, which provided the Middle East participants opportunities to share their work, and to discuss challenges and areas for future

development and research. During the final session of the conference, recommendations for future actions emerging from each specific workshop were discussed.

- The Environment: Air and Water Quality workshop formulated a task force to work together following the conference on environmental issues. One of the participants -- from Bahrain -- was elected to chair this task force, which will establish a website and e-mail listserve to facilitate communication and information exchange.
- The Energy and Solar Cells workshop group recognized the need to develop inexpensive solar energy in the Middle East, as well as identifying potential funding for basic research and equipment; support for training and international exchange; awareness of opportunities for research collaboration; access to journals and scientific literature; transfer of know-how; and a forum to publicize the work of individuals and centers.
- The Medicinal Chemistry workshop participants suggested that medicinal chemistry should be emphasized further in future conferences, with the program expanded to include bioinorganic chemistry.
- The Nanotechnology workshop group agreed to plan and hold a follow-up meeting to discuss aspects of this field in greater detail. This meeting will tentatively be held in Turkey -- a country that all the participants can reach without great difficulty.
- The Science Education workshop identified the strong need to establish educational standards for all the Middle East countries, and to identify those aspects which they all have in common. The workshop participants decided to formulate a web page, which will be in four languages, as well as an e-mail listserve to accommodate the sharing and dissemination of educational ideas and information throughout the region.

A poster session was held for the duration of the conference featuring 40 poster presentations, mostly by Middle Eastern scientists. Discussions and networking took place around the posters and during conference breaks, some extending well into the evening. During one evening poster session, Professor Hoffmann coaxed the participants into a lively impromptu session of Middle Eastern music and dancing.

From every point of view, Malta-2 was more successful than its predecessor. There were more people involved from more Middle East countries. There were only four women participants in Malta-1; there were sixteen in Malta-2. There was a nucleus of people who had attended Malta-1 and therefore knew each other well. For them, it was like a family reunion. From the first moment of Malta-2, there was no hesitation in the interaction between the "old hands" and the "newcomers" who joined right in from the outset. The conference ended with a new larger family of friends and collaborators.

Seven of the Malta-2 participants were presidents of chemical societies in their countries. Ann Nalley (president of the ACS) convened a special meeting during the conference for these society presidents to exchange ideas.

During Malta-2, a special concert was held with a trio of Arab and Jewish musicians performing on stage in the historic Manoel Theatre. The concert, featuring arrangements for violoncello, piano and oud, was organized by Maria E. Michele-Beyerle, a chemistry professor and musician from the Technical University of Munich (Germany), who had attended Malta-1. Professor Michele-Beyerle raised the funds needed to bring the musicians to Malta, and to rent the historic theater.



During the conference, participants were able to learn of the various outcomes that resulted from the Malta-1 conference. A few of these successes included:

- Funding for workshops in the region for graduate students and post-docs was received by Nobel laureate Roald Hoffmann (Cornell, USA) from the U.S. National Science Foundation (NSF). The first workshop, "The Electronic Structure of Molecules," held 12-19 January 2006, was led by Prof. Hoffmann in Petra, Jordan. A second workshop will be held in Egypt on nanotechnology, led by George Whiteside (Harvard, USA), and a third workshop will be held in Qatar on bioinorganics led by Harry Gray (Caltech, USA).
- A symposium on "Scientific Exchange in an Insecure World" was organized during the February 2005 national meeting of the American Association for the Advancement of Science AAAS), and featured scientists who attended Malta-1.
- The U.S. National Science Foundation (NSF) also recognized the Malta-1 conference as one of the ten best examples of "thinking outside the box," which was highlighted in a special poster symposium at the Fall 2005 national meeting of the American Chemical Society (ACS).
- In Malta-1, Professor Yuan T. Lee offered full fellowships for three Middle Eastern scientists to study the use of synchrotron technologies at the Taiwan synchrotron facility. Professor Lee announced that the first group has completed its studies, and in Malta-2 he extended an invitation for three more scientists.
- It was announced that fifteen scientists from eight countries met in Istanbul, Turkey, during the August 2004 IUPAC-sponsored International Conference on Chemical Education (ICCE) to discuss the program for Malta-2.

While the participants unanimously voted to hold a Malta-3 conference in approximately two years, many of the participants made plans to meet before that to continue the scientific exchange. There was among the Middle East participants a virtual covenant that collaboration must continue, despite the geopolitical boundaries. They all agreed that smaller "Mini-Maltas" should be held wherever possible, and that the reports of these smaller meetings should be reported in Malta-3.

The conference was rated by the participants as being successful beyond anyone's expectations.

## References

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2. Malin, J. M.: "Frontier Science in the Middle East,"  
Chemistry International, 28, 2, 9-11 (2006).

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**Zafra M. Lerman** is Distinguished Professor of Science and Public Policy, and Head of the Institute for Science Education and Science Communication, Columbia College Chicago. She is the Chair of the Malta Conference Organizing Committee.

**Jeffrey Wade** is Director of Operations of the Institute for Science Education and Science Communication, Columbia College Chicago. He serves as Associate Organizer of the Malta Conference Organizing Committee.

## **PRIZES PRESENTED AT THE ANNUAL MEETING OF THE SOCIETY**

### **Prof. Joseph Klafter**

School of Chemistry, Tel-Aviv University

**was awarded the Israel Chemical Society Prize for the year 2005**

Joseph Klafter born in Tel Aviv (1945), received his Ph.D. from the Tel Aviv University (1978) under the supervision of Professor J. Jortner. After a postdoctoral position at MIT and a research position at Exxon he returned to the Tel Aviv University. Since 1989 he is a full professor in the Department of Chemistry and in 2003 he was nominated as Heinemann Professor of Chemistry in that department.

Prof. Klafter served as visiting researcher in several universities and research institutes in the USA, Europe and Japan. Among the prizes that he was awarded are the Humboldt (1996), Weizmann (1999), Kolthoff (2003) and Rothschild (2004) prizes. Professor Klafter was (or is) on the Editorial Board of several important scientific Journals such as the Journal of Physical Chemistry. He published about 330 articles and several book chapters.

Prof. Joseph Klafter is a leading theoretical chemist known worldwide for his seminal contributions to the important research field of molecular-scale processes in complex systems, exploring the fundamental concept of anomalous transport and related chemical reactions, and of molecular motions in restricted geometries. His work generalized the concept of Brownian motion to include anomalous diffusion, and has a profound influence on a broad range of areas such as fluid dynamics, transport in nonlinear systems and biological processes. His contributions in the area of physical chemistry led to the understanding of processes that govern the dynamics of molecules, nanoparticles and atomic scale machines.

### **Prof. Jacob Sagiv**

Faculty of Chemistry, the Weizmann Institute of Science

**was awarded the Israel Chemical Society Prize for the year 2005**

Jacob Sagiv was born in Romania and immigrated to Israel in 1961.


He received his B.Sc. degree in Chemistry and Physics from the Hebrew University of Jerusalem in 1969, after which he moved to the Weizmann Institute for his Ph.D. studies in the field of "Linear Dichroism in Organic Chemistry", under the supervision of Prof. Amnon Yogev.

In the years 1975-1978 he performed post-doctoral studies with Professor Hans Kuhn at Max-Planck-Institut für Biophysikalische Chemie in Göttingen (Germany), where he was exposed to the field of Langmuir-Blodgett monolayer assemblies.

Upon joining the Weizmann Institute in 1978, where he is currently a Full Professor in the Department of Materials and Interfaces, he introduced the power of the concepts of "Self-Assembled Monolayers" on solid surfaces and "Constructive Lithography".

During the years Prof. Sagiv has had close and very fruitful scientific collaboration with his colleague and wife, Dr. Rivka Maoz.

Prof. Jacob Sagiv was awarded the 2005 Prize of the Israel Chemical Society for his pioneering contributions to modern surface science, by developing methods for planned self-assembly of ordered arrays of molecules on surfaces, exemplified by the layer-by-layer assembly of amphiphilic silanes on silica, and by constructive nanolithography, which allows bottom-up fabrication of nanometer-sized structures using spatially defined, tip-induced nano-electrochemical oxidation of self-assembled monolayers.



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**Dr. Doron Shabat**  
School of Chemistry, Tel-Aviv University  
was awarded the Annual Prize of the Israel Chemical Society  
for Outstanding Young Scientists, for the year 2005

for his outstanding achievements in the development of drug delivery systems. These approaches, that include smart chemical adaptors and self-immolative dendrimers, may find their application in cancer chemotherapy and diagnostics.

**Mrs. Ruth Stanger**  
Municipal High School Gimel, Haifa  
was awarded the Israel Chemical Society Prize  
for Excellence in Chemistry Teaching for the year 2005

for innovation in teaching chemistry and leadership in the chemistry teachers community.

## OTHER PRIZES

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**Prof. Zvi Rapoport**, Institute of Chemistry, the Hebrew University, Jerusalem, received the Israel Prize for Exact Sciences, for 2006.

**Prof. Reshef Tenne**, Department of Materials and Interfaces, the Weizmann Institute of Science, received the Landau Prize in Nanotechnology, for 2006.

**Prof. Dan Yakir**, Department of Environmental Science and Energy Research, the Weizmann Institute of Science, received the Landau Prize in Environmental Science, for 2006.

**Prof. Ada Yonath**, Department of Structural Biology, the Weizmann Institute of Science, received the Rothschild Prize for Life Sciences, for 2006.

She was also awarded the Paul Ehrlich and Ludwig Darmstadter Prize for 2007, "for her outstanding contributions to the three-dimensional molecular characterization of the complex protein-synthesizing apparatus of cells, the ribosome - an unexpected insight into the RNA world".

**Prof. Meir Lahav**, Department of Materials and Interfaces, the Weizmann Institute of Science, received the Chirality Medal 2006.

"Prof. Lahav is recognized as an original thinker with many important contributions to the deeper understanding of issues relating to crystals and chirality.

The first recipient of the Chirality Medal was Prof. Emanuel Gil-Av from the Weizmann Institute, in 1991, for the design of the first chiral column of gas chromatography for separation of enantiomers".

# CRYSTALLINE MOLECULAR COMPLEXES AND COMPOUNDS, VOLS. 1 & 2

by Frank H. Herbstein, Technion.

Oxford University Press 2005.


Reviewed by Israel Goldberg – Tel Aviv University

This two-volume set is the latest addition to the reputable book series of *Monographs on Crystallography* sponsored by the International Union of Crystallography. The distinguished author, an Emeritus Professor of Chemistry at the Technion in Haifa, is one of the most enthusiastic teachers and promoters of chemical crystallography in Israel for the last forty years or so, and a worldwide renowned expert in the field. A major part of his flourishing academic career has been devoted to investigations of the crystal chemistry of *Molecular Complexes and Compounds* and his rich expertise imparts to the contents of this publication an authoritative perspective. The monograph covers decades of scientific achievements on the structural principles and properties of crystalline binary molecular adducts, materials that are gaining an increasing attention in basic as well as applied science and often play an important role in the development of new chemical technologies and devices. It represents an admirable task and a remarkable effort to provide the reader, whether an experienced researcher, a young student, or just a science admirer, with both the fundamentals and the most important corner stones that line the marvelous path of never ending scientific discoveries in this field over the years.

The author was confronted with an obvious dilemma of whether to present an encyclopedic coverage of this enormously wide subject, or just focus on representative systems of the different types of materials. He chose the middle road, by providing a comprehensive review of some issues and a more concise one of others. Still, the vast amount of information covered in this account extends over about 1300 pages, divided for practical purposes into two volumes. The emphasis lies on structural descriptions of the different classes of crystalline molecular complexes and compounds and generalizations of the structural principles whenever possible, placing more emphasis on organic than on inorganic aspects of the subject. Yet, in order to gain a broader insight the structures are often discussed together with comparable physical and thermodynamic characterizations. The extensive bibliography that accompanies the text at the end of every chapter (close to 4000 references in total) allows the reader to dwell even deeper into any specific subject of interest.

The introductory section outlines a systematic classification of the A-B binary compounds into different structural families, to lead the reader through the versatile structural concepts involved in the respective materials. The authors' choice is based on the relative structural importance of the interactions between the components. Volume 1 relates to materials in which interactions between the same component moieties (A...A and possibly also B...B) are of dominant significance in the crystal formation – defined as *molecular complexes*, while Volume 2 is devoted to *molecular compounds* where the structures are controlled primarily by effective A...B interactions between the different constituents. The very high information content of these two volumes can overwhelm any reader. Therefore, the short overview summary-sections provided by the author at the beginning of every chapter, prior to the tables of contents, are a valuable and useful addition, introducing the reader at the outset to the key points of the particular subject to be discussed.

Following the Introduction, the contents of the 1<sup>st</sup> volume are divided into three main thematic sections. The first section relates to structural chemistry of supramolecular "host-guest" complexes, where the large host molecular framework (acting as a container entity) hosts/includes a smaller suitably sized and shaped guest component nesting into, or perching on, its concave surface in a lock-and-key manner. It reflects on the remarkable advancement of the chemistry of the non-covalent bond, near the end of the past century, under the leadership of two Nobel laureates D. J. Cram and J.-M. Lehn. Different types of such enclosure hosts of varying rigidity, dimensionality, functionality, complexity and degree of pre-



organization towards complex formation are described, including crown ethers, spherands, cancerands, cryptands, cyclophanes and related molecules. Macro-cyclic oligosaccharide hosts consisting of six, seven or eight glucose units (the cyclodextrins) represent another family. Shapes of the latter molecules often resemble toroid bodies, which have hydrophobic inner and outer surfaces, and hydrophilic upper and lower faces. Correspondingly, they have the capacity to encapsulate hydrocarbon guest (such as drugs) within their interiors, as well as to interact with other species (including metal ions) through their hydrophilic functionalities and exhibit catalytic behavior. The author discusses in considerable detail the complexation behavior of the cyclodextrins and related hosts, emphasizing the different possibilities of their (either columnar or offset) aggregation modes in crystals and (intra-host or inter-host) guest binding. Subsequently, the crystal chemistry of some oligo-nucleotides and their complexes mostly with small drug compounds is reviewed, relating also to abundant phenomena of isomorphism and polymorphism. It is associated with appropriate base pairing of hexa-, octa-, deca- and dodeca-meric DNA oligomers. These synthetic DNA mimics reveal helical structures (similar to the double-helix pattern initially determined by Watson and Crick for the natural DNA), as well as minor and major grooves to which a guest component (e.g., a drug molecule) can bind. Possible applications of the above host-guest systems are indicated.

In the next part of the 1<sup>st</sup> volume attention is shifted from the crystal chemistry of molecular host-guest complexes that exist (to greater or lesser extent) in solution as well as in the solid, to lattice inclusion compounds that prevail as distinct materials only in the organized solid state. The driving force for inclusion of guests in the lattice may originate in the inefficient crystal packing of the host species and/or the additional stabilizing interaction of the guest with the host lattice. Such inclusion materials fall into two main categories, namely channel inclusion compounds or cage-type clathrates, depending on whether the guest components are accommodated in elongated tunnel voids created between adjacent domains of the host or propagating through columnar arrangements of open host frameworks, or in localized intra-lattice cages of confined volume formed between the host entities. Separate chapters are devoted to hosts that reveal significant conservation of their intermolecular organization, versus hosts that exhibit higher versatility and give rise to "breathing" host-guest inclusion materials. In the latter, the architecture of the crystal lattice made by a given host unit adapts readily to the shape and nature of the guest. The above concepts are exemplified by a large variety of organic host molecules. The discussion is further expanded to intercalation solids that consist of two-dimensional sheets of covalently bound networks (e.g., as in graphite or zirconium phosphates) that are interlinked by weak van der Waals interactions. The latter allow facile insertion of differently sized guest moieties between the layers, affording new composite materials of anisotropic properties. Evaluation of structural models for such intercalate materials by diffraction techniques resorted mostly to the investigation of their polycrystalline forms, in conjunction with thermodynamic and spectroscopic investigations. The unique stability and transport properties of the intercalation complexes, and the ability to control them by programmed insertion of various guest components, make these materials very attractive for technological applications.


The third section of the 1<sup>st</sup> volume deals with a variety of binary complexes where there is no apparent preferential binding between types of components (termed packing complexes). Moreover, they are characterized by the apparent absence of a decisive chemical reason for their existence. The text addresses the structural and thermodynamic features of a wide range of selected examples. The crystals of these complexes often reveal a high degree of constitutional, compositional and structural isomerism, including polymorphism, as they are stabilized by a collection of weak and non-directional intermolecular interactions. Appearance of optical isomerism is abundant as well, which calls for a

comparative discussion of the relative stability of the conglomerate and optically resolved compounds. Detailed studies of phase diagrams are thus often carried out here in order to distinguish between solid solutions and discrete phases of the system and to evaluate their relative stability. Due to the high chemical diversity of these compounds, they exhibit a wide variety of structural habits.

The 2<sup>nd</sup> volume is more uniform in its content, being devoted in its entirety to donor-acceptor molecular compounds of organic or hybrid organic-inorganic content. The first thematic section relates to materials with localized interactions (of charge transfer and hydrogen bonding categories), which usually involve direct association between one atom belonging to the donor molecule and another atom belonging to the acceptor moiety. The author surveys the accumulated knowledge on the diverse groupings and classes of materials and their structural descriptions, the versatile synthons of donor-acceptor interaction they exhibit, and their significance in directing the structural patterns. As in previous sections, he addresses also the significance of other physical data, mostly of thermodynamic and spectroscopic nature, to rigorous interpretation of the materials properties. Interesting reference is made near the end of this section to the subject of designing crystal structures by self-assembly of components in specific ways, a process known as crystal engineering.

The second thematic section is devoted to charge transfer  $\pi$ -molecular compounds with delocalized donor-acceptor interactions composed in most cases of aromatic components. Structural features are discussed along with the relevant physical properties evolving from the charge-transfer and/or proton transfer phenomena that are associated with the crystal formation. Different structural classes, namely mixed stacks, segregated stacks, or salts are related to. Further outlined are the various means used to assess the strength of the interaction between the donor and acceptor species and the amount of charge transfer between them. Phase diagrams of various systems provide additional information on the composition and stability of the different phases that can form. The author presents numerous examples of popular donors and acceptors that are frequently utilized in the formulation of charge-transfer compounds, followed by an extensive discussion of their interesting structural chemistry. For the mixed-stack class of molecular compounds he surveys the crystal physics of these materials as well, describing the thermodynamic parameters (most of these materials are enthalpy-stabilized with respect to the individual components) and relating to phase transitions and order-disorder transitions of selected systems. Experimental estimates of the degree of charge-transfer and models of the ground (in neutral or ionic form) and excited states from optical spectroscopic and electron spin resonance measurements are related to predictions based on the Mulliken charge-transfer theory. Reference is made also to characterization of order-disorder behavior observed in some mixed-stack systems upon changing the temperature or pressure conditions, and its interpretation with the aid of known theoretical models for first- and second-order phase transitions.

The focus then moves to a variety of chemical types of segregated stack  $\pi$ -molecular complexes. They became subject of intensive investigations after the discovery in the 1960's-1970's that such-structured solids may reveal high electrical conductivity (some revealing even metal like conductivity between room temperature and 56K). This relates in particular to complexes composed of the tetra-thia-fulvalene (TTF)-type donor and tetra-cyano-quinodimethane (TCNQ)-type acceptor, which involve partial charge transfer between the donor and the acceptor and arrange in segregated stacks of the cation and anion constituents. Their various chemical modifications and additional donor and acceptor types that can participate in the formation of segregated stack complexes are also addressed. The extensive discussion divides the different materials into three main groups, structures of cation-radical salts (with poly-cyclic aromatic hydrocarbons and TTF-type cations), structures of anion-radical salts (with TCNQ as an anionic moiety), both with closed-shell counter ions of different types, and structures of the less abundant cation-

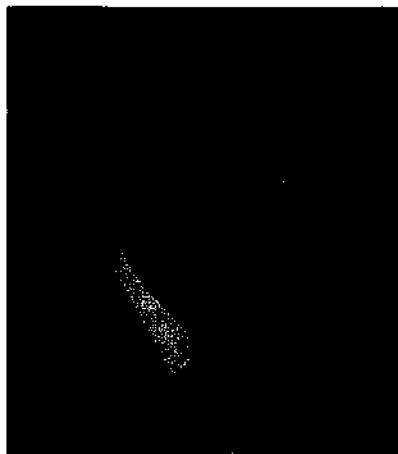


radical anion-radical salts. These are further classified into subgroups according to the amount of charge-transfer, periodicity and regularity of the stacking organization of the different components, referring to the particular details that affect the cation-anion interaction and the overlap mode between neighboring components within the stacks. It has been shown that the conductivity features are affected mostly by the degree of charge transfer (higher conductivity being induced by partial rather than full electron transfer) and the electrostatic repulsion within the anion-radical stacks (disordered array of molecules or ions favoring higher conductivity). At the end the author relates to additional investigations of these uniquely interesting materials, including electron density and electronic structure studies, and dependence of structural, mechanical, electron conductivity and magnetic susceptibility features on temperature variation.

In summary, this publication is an invaluable resource of information on, and an excellent reference to, *Crystalline Molecular Complexes and Compounds*. It contains a broad-scope coverage of the structural chemistry and physical properties of such materials, aiming at a wide academic audience. The well-organized text presents the scientific evidence and the author's perspective on the subject in an attractive manner and easy to read language, while avoiding as much as possible the use of too specific technical terms. Clear definitions and classification of the discussed compounds into sub-classes at the outset, accompanied by instructive introductory background sections on these groups in the respective chapters as well as by concise conclusion paragraphs, ease on the reader to grasp step by step the information wealth contained in this account. The nearly 600 illustrations and diagrams in the text are an excellent aid in this endeavor. This account is a glamorous achievement on the occasion of the author's 80<sup>th</sup> birthday.



Dear Readers,



Europe is composed of many countries of very diverse size, with different cultures, languages, social and political systems. Each country has its own chemical society (sometimes more than one) and additional non-profit professional organisations, with their own publications, conferences and activities. The European Association for Chemical and Molecular Sciences (EuCheMS) wants to bring European chemists together, and its registration in Belgium as an "Association internationale sans but lucratif" is aimed at providing a legal framework that can operate in a sustainable fashion to help to increase European interaction in the field of chemical and molecular sciences.

EuCheMS puts European chemistry as an entity on the map, very much as the American Chemical Society does for its continent. It aims to be a voice for chemistry in Europe, both inside and outside the European Union. In August of this year, EuCheMS will run its 1st European Chemistry Congress in Budapest, to gather chemists from across Europe and overseas in a single venue. It will be a showcase of chemistry in Europe but it will also provide a real chance for communication, interaction, innovation and starting of new projects. The Congress, taken together with many other initiatives (including the

Newsletter), is intended to create a more coherent chemical community in Europe.

In Brussels we need to speak one voice, otherwise chemistry could be bypassed. European chemists have to develop their own field and generate new knowledge in core chemistry. However, they must also pay attention to new emerging chemistry, especially at the interfaces with physics and biology; such interface areas are becoming more and more important.

EuCheMS must assess the direction chemistry will be taking during the next decades, promote the views of the chemical and molecular sciences community within key bodies of the European Parliament and Commission, and negotiate at all levels emerging legislation, regulation and initiatives that may impact the chemical science community.

European chemistry is marching forward and the launching of the Newsletter can greatly assist in this process. The Newsletter, prepared and produced by the Gesellschaft Deutscher Chemiker (GDCh, German Chemical Society), will initially be published four times a year and will report on the activities of EuCheMS and its Divisions and Working Parties. In addition, it will inform about developments on the European level that are relevant for the chemical and molecular sciences. We are indebted to the Gesellschaft Deutscher Chemiker, Ernst Guggolz, editor-in-chief of *Nachrichten aus der Chemie*, and Alexander Lawson for the enthusiasm they have put in this initiative.

Warm thanks to all contributors, and to everyone: enjoyable reading!

Giovanni Natle  
President of the European Association for  
Chemical and Molecular Sciences

## Welcome to the EuCheMS Newsletter!

At its last General Assembly in Nicosia/Cyprus the European Association for Chemical and Molecular Sciences (EuCheMS) decided to establish a EuCheMS Newsletter. This newsletter will be the prime source of communication between the EuCheMS Divisions and Working Parties, the Executive Committee and other EuCheMS bodies on the one side and you, the members of the EuCheMS member organisations on the other side. In addition the newsletter will report on developments and initiatives at the political level relevant to the chemical and molecular sciences. In particular it will be a source of information about chemistry related activities emerging from the European Union, such as the research framework programs, the European Research Council, the SusChem Technology Platform and themes such as the new chemistry legislature (REACH) and related topics. The newsletter will offer the individual members of the EuCheMS member societies an overview of what EuCheMS is doing for their benefit and the benefit of chemistry in Europe and will provide a genuine European perspective.

As decided in Nicosia, the newsletter will be produced and coordinated by the Gesellschaft Deutscher Chemiker (GDCh, German Chemical Society). It will initially appear four times a year with at least four pages per issue. The overall coordination rests with Alexander Lawson, who will be supported by the editorial staff of the GDCh membership magazine *Nachrichten aus der Chemie*.

If you have comments or want to get in touch with the newsletter team, please send an e-mail to Alexander Lawson (alawson@euchems.de).

Wolfram Koch  
GDCh Executive Director



### ERA Chemistry awards

ERA Chemistry, a co-operative venture supported within the European Commission's Framework Programme 6, includes national science organisations from Austria, Belgium, Finland, France, Germany, Hungary, Ireland, The Netherlands, Poland, Portugal, Spain and Switzerland that seek to develop a European funding instrument for the chemical sciences. A first call for proposals resulted in nine being selected for funding by a panel of European experts. The long-term ambition of the network is to establish a European Research Area for the chemical sciences.  
[www.erachemistry.net](http://www.erachemistry.net)

### EuChemS Divisions, Working Parties and Committees

Divisions and Working Parties in EuChemS represent specific subject areas and are coordinated by the Executive Committee (24 members), which in turn represents the EuChemS General Assembly from 50 National Societies.

The current Divisions and Working Parties (WPs) are:

- Analytical Chemistry
- Chemical Education
- Chemistry and the Environment
- Chemistry in Life Sciences
- Electrochemistry
- Food Chemistry
- Organometallic Chemistry
- WP Chemistry in Microsystems
- WP Computational Chemistry
- WP History of Chemistry
- WP Inorganic Chemistry
- WP Nuclear and Radiochemistry

Further Committees include the ProChem Standing Committee (educational, professional and ethical issues) and the European Chemists Registration Board (maintains and awards the designation "European chemist" as a common standard across Europe).

Details of the Divisions and Working Parties may be found at [www.euchems.org/Divisions/](http://www.euchems.org/Divisions/)

## European Technology Platform "Food for life"

European Technology Platforms, ETPs, are initiatives of the European Commission to stimulate industrial innovation. The intention is to unite stakeholders in a specific economic sector into a public-private partnership to better define the activities required. The goals are to first develop a "road map" addressing key challenges, and then to put it into practice so as to stimulate growth and thus benefit both employment and consumers in the community.

The Technology Platform "Food for life" ([www.ciaa.be](http://www.ciaa.be)) involves chemists in six areas of food science. Recently, expert groups met to define thematic research requirements, and the resultant "road map" (Stakeholder Strategic Research Agenda, SSRA) will be delivered to the European Commission to inform the agenda of Framework Programme 7 (2007–2013).

The ETP Board is chaired by Peter van Bladeren (Research Director, Nestlé) and its Secretary is Daniela Israeliwichi (Confederation of Food and Drink Organisations of Eu-



Photo: CIAA

rope, CIAA). The support and commitment of all food chain stakeholders across all of Europe is needed to maximise the impact of the ETP "Food for life". The SSRA "road map" will therefore be available for national-, regional- and web consultation until early 2007.

Further information on ETP "Food for life" is available from Willem deVos ([willem.devos@wur.nl](mailto:willem.devos@wur.nl)) or Roger Fenwick (Secretary EuChemS Food Chemistry Division, [roger.fenwick@bbsrc.ac.uk](mailto:roger.fenwick@bbsrc.ac.uk)).

### Working Parties

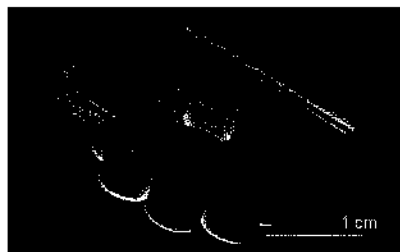
The Working Party on Chemistry in Microsystems currently has eleven members representing nine countries and covers a broad range of chemical and biochemical interests. To date the main interest of the Working Party focuses on micro reactor and "lab on a chip" methodology, but the Working Party is keen to hear from people with other areas of interest in this growing subject area. In order to stimulate current interests and welcome new collaborators the Working Party is planning a special semi-

nar on the afternoon of 30th August at the 1st European Chemistry Congress entitled "The application of micro- and nanofluidics to (bio-) chemical analysis and processing".

Steve Haswell, Chairman of the Working Party on Chemistry in Microsystems  
[s.j.haswell@hull.ac.uk](mailto:s.j.haswell@hull.ac.uk)

The Working Party on Computational Chemistry (WPCC) is devoted to promoting research and education in computational chemistry. The WPCC currently has delegates from 19 member societies of EuChemS. The main activity of WPCC is to organise conferences and workshops on computational chemistry, but the working party is also active in the development of European Masters- and Ph.D. programmes in theoretical and computational chemistry.

Tore Brinck, Chairman of the WPCC  
[tore@physchem.kth.se](mailto:tore@physchem.kth.se)



## Chemists meet in Hungary

The 1st European Chemistry Congress (Budapest, 27th to 31st August 2006) will undoubtedly be the major chemistry event of the year in Europe. Besides the six plenary lectures delivered by Nobel laureates (Paul J. Crutzen, Jean-Marie Lehn, George A. Olah, John E. Walker, Kurt Wüthrich, Ahmed H. Zewail), the meeting will run in parallel sessions covering 17 Special Topic Symposia:

- New Developments in Theoretical and Computational Chemistry
- Cutting Edge Spectroscopy
- New Concepts and Methods in Catalysis
- Frontiers in Supramolecular Chemistry
- New Frontiers in Medicinal Chemistry
- 3D Chemical Imaging in Analysis
- Materials and Nano-Materials for Devices
- Environmental Chemistry
- Chemistry, Food and Health
- Chemistry Meets Biomolecules
- Teaching Chemistry
- Green and Sustainable Chemistry and Processes



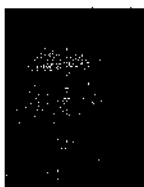
- Polymer Architecture – From Structure to Functional Control
- New Frontiers in Organic Synthesis
- Novel Multifunctional Ligands in Coordination Chemistry
- Structure and Function of Biomolecules
- Nuclear- and Radiochemistry

Prior to and after the conference a series of satellite events will be organised, a list of which is available at the conference website. The European Chemistry Congress will be held every two years. The second Congress will take place in Turin (Italy) in September 2008.

[www.euchems-budapest2006.hu](http://www.euchems-budapest2006.hu)

### EuCheMS Award

In recognition of his contributions to European cooperation Reto Battaglia will receive the EuCheMS Award for Service during the 1st European Chemistry Congress. Reto Battaglia has made an exceptional contribution to the transformation of the former Federation of European Chemical Societies (Fecs) into EuCheMS. A Past President of Fecs and a member of the EuCheMS Executive Committee, Reto Battaglia has also held office as Chair of the Fecs Food Chemistry Division. He is the Director of Swiss Quality Testing Services, the quality control laboratories owned by Migros. He is a member of the Board of the Swiss Chemical Society and lectures at ETH Zurich.



### EuCheMS Lecture

Dieter Seebach will deliver the 2006 EuCheMS Lecture on "Do beta-peptides have a biomedical potential?" at the 1st European Chemistry

Congress. The EuCheMS Lecture forms part of the symposium *New frontiers in medicinal chemistry*. Dieter Seebach is Emeritus Professor of Chemistry at ETH Zurich. The EuCheMS Lecture honours outstanding achievements by a European chemist. It rotates among EuCheMS member societies and is delivered at a scientific event outside the lecturer's own country.

### Young Chemist Award

On behalf of EuCheMS, several Younger Chemists representatives from different European chemical societies (Muriel Hissler/SFC, Stefan Picker/GDCh, Bruno Pignataro/SCI, Clare Viney/RSC, Tamas Kovacs/MKE) have organised a competition for the 2006 European Young Chemist Award. A number of finalists will deliver a talk at the European Young Chemists Award Competition Session during the 1st European Chemistry Congress. A panel of judges will then decide on the winners. The Italian Chemical Society has sponsored the medals. The gold medal winner will receive 1800 Euro, the two silver medal winners will each receive 800 Euro.

### African Societies

Simon Campbell, President of the RSC, delivered congratulations from the EuCheMS President Giovanni Natile to the President of the new Federation of African Societies of Chemistry (FASC), Temediegn Engida, at the inaugural event in Addis Ababa in February. In wishing FASC every success, Natile stressed the promotion of the chemical sciences by worldwide collaboration and creating educational opportunities for young people.

### The nascent ERC

The creation of a European Research Council (ERC) took a major step forward with the EU Scientific Council, but the final structure of the ERC is still unclear. The ERC should be operational in 2007. The Initiative for Science in Europe, a platform of European learned societies and scientific organisations, urges the ERC budget to be at least 1 to 2 billion Euros for the seven-year Framework Programme.

[www.initiative-science-europe.org](http://www.initiative-science-europe.org)

### A new legal status for EuCheMS

EuCheMS has signed an agreement with the European Chemical Industry Council (CERIC) which will strengthen the existing excellent cooperation between the two European organisations. In support of the new legal status of EuCheMS, confirmed by Royal Decree in Belgium in March, EuCheMS will have its registered office in the CERIC headquarters. The agreement will strengthen relationships between industry and academia, said Alain Perroy, Director General of CERIC, who signed the agreement together with Giovanni Natile, EuCheMS President, following the Royal Decree. EuCheMS has the status of an Association in International Law, but without international non-profit making association.



EuCheMS has signed an cooperation agreement with CERIC. Reto Battaglia, Evelyn McEvoy, Alain Perroy, Giovanni Natile, Colin Humphris (from left).



## EuChemS Newsletter

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EuChemS is registered as 'Association Internationale sans but lucratif' (AISBL International non-profit association).  
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## Newsletter Coordinator

Alexander Lawson is an organic chemist born and bred in Scotland, but has worked in Germany for over thirty years, principally in Information Science applied to organic chemistry. He is known as the inventor of the Lawson Number in the Beilstein Database and was instrumental in the creation of the GdCh database. Alexander Lawson is currently Director of the DLR-DFG-MDF-BMBF-IPK-IPD-CFellow and a member of the GDCh.

Contact: [a.lawson@euchems.de](mailto:a.lawson@euchems.de)



Alexander Lawson

## Events

**4 – 8 June, Lisboa/Portugal**

Healthy Buildings 2006, [paginas.fe.up.pt/hb2006/html/hb2006.html](http://paginas.fe.up.pt/hb2006/html/hb2006.html)

**11 – 16 June, Bratislava/Slovakia**

Advanced Polymeric Materials,  
[www.upoldber.sav.sk/](http://www.upoldber.sav.sk/)

**9 – 13 July, Bergen/Norway**

EUCHEM Conference on Organic Free Radicals,  
[www.euchem-radicals.uib.no/](http://www.euchem-radicals.uib.no/)

**30 July – 4 August, Karlsruhe/Germany**  
Humic Substances – Linking Structure to

Functions,  
[www.rz.uni-karlsruhe.de/~ihss2006/](http://www.rz.uni-karlsruhe.de/~ihss2006/)

**24 – 26 August, Szeged/Hungary**

2nd International Szent-Gyorgyi Symposium,  
[www.jgytf.u-szeged.hu/~eu6sciorg](http://www.jgytf.u-szeged.hu/~eu6sciorg)

**27 – 31 August, Budapest/Hungary**

1st European Chemistry Congress,  
[www.euchems-budapest2006.hu/](http://www.euchems-budapest2006.hu/)

**31 August – 3 September, Gödöllő/Hungary**  
History of the Food Chain: From Agriculture

to Consumption and Waste,  
[www.chemhistory2006.mke.org.hu](http://www.chemhistory2006.mke.org.hu)

**3 – 7 September, Tale/Slovakia**

6th European Conference on Computational Chemistry,  
[www.fns.uniba.sk/~eucocc6/index.html](http://www.fns.uniba.sk/~eucocc6/index.html)

**10 – 13 September, Ohrid/Macedonia**

5th International Conference of the Chemical Societies of the South-East European Countries (ICOSEC 5) & The XIX Congress of the Chemists and Technologists of Macedonia,  
[www.hemija.net/icosecs5/registration.php](http://www.hemija.net/icosecs5/registration.php)

**10 – 15 September, Dresden/Germany**

1st International IUPAC Conference on Green-Sustainable Chemistry,  
[www.gdch.de/vas/tagungen/tg/5559.htm](http://www.gdch.de/vas/tagungen/tg/5559.htm)

**10 – 15 September, Wrocław/Poland**

2nd Workshop Modelling & Design of Molecular Materials,  
[www.mml.ch.pwr.wroc.pl/workshop/](http://www.mml.ch.pwr.wroc.pl/workshop/)

**13 – 15 September, Oxford/UK**

10th International Symposium on Environmental Radiochemical Analysis,  
[www.rsc.org/era2006](http://www.rsc.org/era2006)

**16 – 22 September, Hammamet/Tunisia**

EUCHEM Conference on Molten Salts & Ionic Liquids, [iusti.polytech.univ-mrs.fr/EUCHEM2006/](http://iusti.polytech.univ-mrs.fr/EUCHEM2006/)

**29 September – 1 October, Lund/Sweden**

EUCHEM Conference on RNA Chemistry meets Biology, [agneta@chemsoc.se](mailto:agneta@chemsoc.se)

**9 – 12 October, Stuttgart/Germany**

Pigments in Food PF 2006,  
[pigmentsinfood2006.uni-hohenheim.de/](http://pigmentsinfood2006.uni-hohenheim.de/)

## Computational Chemistry

The Working Party on Computational Chemistry (WPCC) is sponsoring three upcoming events.

First, the V.A. Fock Meeting will be held on 3rd to 7th July near Kazan in Russia. With support from the WPCC, the Fock Meeting is now an international event and includes an educational part for younger researchers, with a few scholarships available for European students (see: [www.intas.be/](http://www.intas.be/)).

The 6th European Conference on Computational Chemistry (EuCo-CC6) will take place on 3rd to 7th September in Tale, Slovakia, jointly organised with Comenius University (Bratislava), including theoretical, biological, medicinal aspects. A special section on Grid-computing is also planned.

Finally, the WPCC is sponsoring the workshop on Modelling and Design of Molecular Materials 2006 (MDMM 2006) on 10th to 15th September in Wrocław, Poland. The workshop will be devoted to presenting contemporary

computational methods and their application in molecular modelling and the design of molecular materials.

[www.qcc.ru/~fock/](http://www.qcc.ru/~fock/)

[www.fns.uniba.sk/~eucocc6/index.html](http://www.fns.uniba.sk/~eucocc6/index.html)

[mml.ch.pwr.wroc.pl/workshop/](http://mml.ch.pwr.wroc.pl/workshop/)

## Sustainable Chemistry

The European Technology Platform for Sustainable Chemistry (SusChem) is an initiative of the European Chemical Industry Council and the European Biotechnology Industry Association. It seeks to boost chemical research, development and innovation in Europe. SusChem has identified three key technology areas: industrial biotechnology, materials technology, and the design of reactions and processes, while a fourth area deals with a horizontal approach to innovation. The 4th SusChem Stakeholder event will be held on 27th August in Budapest.

[www.suschem.org](http://www.suschem.org)



# LISE MEITNER (1878-1968): PROTACTINIUM, FISSION, AND MEITNERIUM.

**Bob Weintraub**, Director of the Libraries

Sami Shamoon College of Engineering, Beersheva and Ashdod.

*The door to the nuclear age was opened with the startling interpretation of experimental data in 1938 by Lise Meitner and Otto Frisch that nuclear fission had occurred.*

## **Lise Meitner:**

Lise Meitner was born in 1878 in Vienna to Jewish parents. She finished middle school at age 14. In Vienna at that time women were not permitted to continue on to high school or university. It was later when these barriers fell that Meitner earned her high school qualifications and at age 23 entered the University of Vienna. Here she was influenced by Ludwig Boltzmann. Her nephew Otto Robert Frisch later wrote, Boltzmann "gave her the vision of physics as a battle for ultimate truth, a vision she never lost." She was awarded her doctorate degree in 1906 for work which showed that Maxwell's formula for the conduction of electricity in an inhomogeneous solid also applies to the conduction of heat. (Lise Meitner: R. L.Sime, 1996).

It was around this time on the suggestion of Stefan Meyer that Meitner measured the absorption of alpha and beta radiation emitted by thorium and actinium in foils of various metals. This work served to introduce her to several radioactive substances and to the leaf electroscope.

In 1907 Meitner left for Berlin to study with Max Planck at the university. At the physics department seminars she met Otto Hahn. Both were of the same age. Hahn, with a Ph.D. in organic chemistry from the University of Marburg, was carrying out research on radioactivity in the chemistry institute of Emil Fischer.

Meitner and Hahn started their collaboration which Sir James Chadwick called "one of the most fruitful partnerships in the history of science." Their skills complemented each other, Meitner a physicist who lacked experience in chemistry and Hahn a chemist and a superb experimentalist while lacking strength in theoretical physics. Both together and separately they carried out chemical and physical investigations throughout their 30 year partnership, until interrupted by the Nazi period. At the start of their collaboration women were not allowed into the Chemistry Institute so it was arranged that Meitner work in a basement room accessible by a separate entrance. The restriction on women entering the institute was lifted two years later. In 1912 Meitner and Hahn moved to the new Kaiser-Wilhelm-Institute in Dahlem. Meitner became assistant to Max Planck in 1912 and director of an independent physics department in the chemistry institute in 1917. The work of both Hahn and of Meitner was interrupted by service in the First World War.

## **Protactinium:**

Hahn: "In 1917 I was transferred to Supreme Headquarters, and in this capacity had official contact with the military research carried out in Haber's Institute in Dahlem. This provided an opportunity to look in at the nearby Kaiser Wilhelm Institute and to think about science a little. Lise Meitner had also returned from her war service and we tentatively resumed our work, returning to our search for the mother substance of actinium, the unknown homologue of tantalum.

Our first search was for suitable raw material. We inspected the leftover material that results from the treatment of pitchblende with nitric acid. The substance remaining consists mainly of silicon dioxide, which does not dissolve in nitric acid. Careful work revealed that it contained very small quantities of radium, radiolead, and ionium, but also virtually all the tantalum-like substances of the pitchblende. Therefore the substance we were looking for could be expected to be somewhat more enriched than radium in the same preparation. This suspicion was somewhat strengthened by the observation that the pitchblende residue produced considerably earlier gave off some actinium emanation in addition to weak thorium emanation.

The suspicion that pitchblende residue was a useful raw material turned out to be correct. We succeeded in finding the unknown element and in proving it to be the mother substance of actinium. We proposed the name of proto-actinium (later contracted to protactinium)."

The formation of protactinium was proved by the alpha ray curves that were established; the measurements of actinium emanation, the steady increase of which could be observed daily for a period of several months; and the active deposit which could be found in increasing amounts on negatively charged plates. The search for the mother substance of actinium had taken five years.

In 1926 Meitner became the first woman university physics professor in Germany.

#### **Fission:**

David Nachmansohn: "To return to the research of neutron effects on uranium, Hahn and Meitner's interest was enhanced, as mentioned before, by the suggestion that protactinium might be produced. Hahn was by then one of world's most foremost authorities on radiochemistry. The chemical identification of the elements produced by neutron bombardment of uranium was obviously a great challenge to his ingenuity and skill and promised to clarify the actual effect on the uranium structure. The work eventually became a turning point in science and one of the most fateful experiments ever performed, with effects nobody had foreseen. As we will see, they were destined to change the future of mankind for better or worse; they may lead to devastating effects on our planet and wipe out whole civilizations, or they may open a new era of inestimable benefit for mankind.

For several years Hahn and Meitner, and joined by Fritz Strassmann, devoted their efforts to identify chemically the "transuranium" products. Hahn soon excluded the possibility of protactinium formation. It was in the middle of these activities when Meitner was forced to leave. Hahn and Strassmann continued the work." (German-Jewish Pioneers of Science, 1979.)

Fritz Strassmann is the only German chemist honored with a tree in the Avenue of the Righteous, at the Yad Vashem Holocaust Memorial in Jerusalem. In 1933 he resigned from the Society of German Chemists when it became part of a Nazi controlled public corporation. He was blacklisted. Hahn and Meitner found an assistantship for him at half pay. Strassmann considered himself fortunate, for "despite my affinity for chemistry, I value my personal freedom so highly that to preserve it I would break stones for a living." During the war he and his wife Maria Heckter Strassmann concealed a Jewish friend in their apartment for months, putting themselves and their three year old son at risk.

In July 1937, Lise Meitner with the help of scientist friends escaped to Holland. In the fall of 1938 she received an invitation to continue her work at the Nobel Institute in Stockholm. She remained in Sweden for 22 years. In 1960 she retired to England.

Otto Frisch, himself a Jewish refugee from Germany and then working with Bohr, recalled his visit with his aunt in the small township of Kungälv, near Göteborg, Sweden, during the 1938 Christmas vacation. It was here that she made her most known contribution to science. (O. Frisch: What Little I Remember, 1979).

"Until 1938 nobody dreamt that there was yet another way for a heavy nucleus to react to the mutual repulsion of its many protons, namely by dividing itself into two roughly equal halves. It was mere chance that I became involved in the discovery of that 'nuclear fission', which for the first time showed a way to make a huge number of nuclei give up their hidden energy; the way to the atom bomb and to atomic power.

Let me first explain that Lise Meitner has been working in Berlin with the chemist Otto Hahn for about

thirty years, and during the last three years they had been bombarding uranium with neutrons and studying the radioactive substances that were formed. Fermi, who had first done that, thought he had made 'transuranic' elements—that is elements beyond uranium (the heaviest element then known to the chemists), and Hahn the chemist was delighted to have a lot of new elements to study. But Lise Meitner saw how difficult it was to account for the large number of different substances formed, and things got even more complicated when some were found (in Paris) that were apparently lighter than uranium. Just before Lise Meitner left Germany, Hahn had confirmed that this was so, and that three of those substances behaved chemically like radium. It was hard to see how radium—four places below uranium—could be formed by the impact of a neutron, and Lise Meitner wrote to Hahn, imploring him not to publish that incomprehensible result until he was completely sure of it. Accordingly, Hahn, together with his collaborator, the chemist Fritz Strassmann, decided to carry out thorough tests in order to make quite sure that those substances were indeed of the same chemical nature as radium.

When I came out of my hotel room after my first night in Kungälv, I found Lise Meitner studying a letter from Hahn and obviously worried by it. I wanted to tell her of a new experiment I was planning, but she wouldn't listen; I had to read that letter. Its content was indeed so startling that I was at first inclined to be skeptical. Hahn and Strassmann had found that those three substances were not radium, chemically speaking; indeed they had found it impossible to separate them from the barium which, routinely, they had added in order to facilitate the chemical separations. They had come to the conclusion, reluctantly and with hesitation, that they were isotopes of barium.

Was it a mistake? No, said Lise Meitner; Hahn was too good a chemist for that. But how could barium be formed from uranium? No larger fragments than protons or helium nuclei (alpha particles) had ever been chipped away from nuclei, and to chip off a large number not nearly enough energy was available. Nor was it possible that the uranium nucleus could have been cleaved right across. A nucleus was not like a brittle solid that can be cleaved or broken; George Gamow had suggested early on, and Bohr had given good arguments that a nucleus was much more like a liquid drop. Perhaps a drop could divide itself into two smaller drops in a more gradual manner, by first becoming elongated, then constricted, and finally being torn rather than broken in two? We knew that there were strong forces that would resist such a process, just as the surface tension of an ordinary liquid drop tends to resist its division into two smaller ones. But nuclei differed from ordinary drops in one important way: they were electrically charged, and that was known to counteract the surface tension."

Frisch and Meitner sat down on a tree trunk in the snow and started to calculate on scraps of paper. "The charge of a uranium nucleus, we found, was indeed large enough to overcome the effect of the surface tension almost completely; so the uranium nucleus might indeed resemble a very wobble unstable drop, ready to divide itself at the slightest provocation, such as the impact of a single neutron.

But there was another problem. After separation, the two drops would be driven apart by their mutual electric repulsion and would acquire high speed and hence a very large energy, about 200 MeV in all; where could that energy come from? Fortunately Lise Meitner remembered the empirical formula for computing the masses of nuclei and worked out that the two nuclei formed by the division of a uranium nucleus together would be lighter than the original uranium nucleus by about one-fifth the mass of a proton. Now whenever mass disappears energy is created, according to Einstein's formula  $E=mc^2$ , and one-fifth of a proton mass was just equivalent to 200MeV. So here was the source for that energy; it all fitted!"

The similarity of the picture described for dividing up the nucleus to the process by which bacteria multiply caused them to apply the phrase "nuclear fission" in their first publication.

Frisch rapidly demonstrated experimentally that the uranium atom had indeed been split by the action of neutrons. Two papers were mailed to England on January 16, 1939, the first on the interpretation of the barium appearance as atom splitting by Meitner and Frisch, the second on the experimental confirmation by Frisch. The first paper appeared on February 11, the second on February 28."

Meitner and Frisch were extremely anxious to find out what Bohr's opinion would be. Frisch showed Bohr the notes and interpretations that they had prepared for him.

Bohr immediately grasped the concept—the atom had been split—and appreciated the enormity of the discovery. Bohr promised to keep the information confidential until the publications concerning the breakthrough had appeared. Due to error on his part, other physicists soon learned about the breakthrough and rushed to confirm the findings. One of these had already detected fission fragments by January 25, 1939.

Hahn and Strassmann could not include Meitner's name on the papers of the barium findings, let alone admit that they were collaborating with a Jew in exile. Strassmann later expressed the sentiment about Meitner's role in those key experiments, "Her initiative was the beginning of the joint work with Hahn" and she "was bound to us intellectually from Sweden ... and was the intellectual leader of our team."

Hahn: "The correct explanation was published (*Nature*, vol 143, p 239, 1939), by Lise Meitner and O.R. Frisch, to whom we had communicated our results by letter before they were published. They, in turn, passed on their conclusions to Neils Bohr before their contribution saw print. Neils Bohr mentioned their results at a meeting of the American Physical Society on January 26, 1939, thus enabling several of the scientists present to repeat the experiment of uranium fission the same day, just ten days after Frisch had carried it out. Unfortunately, the report by Frisch and Meitner was not printed until March of that year, while the reports by American researchers, who had done their work later, were published before that date.

Otto Hahn was awarded the Nobel Prize in Chemistry for the year 1944 "for his discovery of the fission of heavy nuclei." Lise Meitner never received this honor. She received numerous nominations for the Prize in both the physics and chemistry categories, including that of Max Planck for physics and that of Niels Bohr for chemistry. In 1948 Otto Hahn nominated Lise Meitner and Otto Frisch for a joint prize in physics. (I. Hargittai: *The Road to Stockholm*, 2002).

Nachmansohn: Unfortunately the claim of Meitner and Frisch to have been the first to recognize and to confirm experimentally one of the most momentous events in the history of science—and mankind—remained unknown and in doubt for a long time. It was many years before they received credit for their brilliant contribution. It was a monumental documentation of the ingenuity and vision of Meitner that she found the right interpretation of experimental facts that seemed incompatible with prevailing concepts. If one accepts Einstein's and Planck's views on decisive importance of intuition and imagination in recognizing the significance of experimental facts, here was a striking example and almost classical confirmation of their ideas."

In 1994, in a tribute to Lise Meitner, element 94 was named *Meitnerium*.



## **SUPERCONDUCTIVITY IN THE SERVICE OF ARCHAEOLOGY; A METHOD FOR THE DATING OF LEAD ARTIFACTS**

**Shimon Reich, Dept. of Materials and Interfaces, Weizmann Institute of Science.**

The anti-corrosive properties of lead, its low melting temperature and good ductility have made it a much-used material since antiquity - for pipes, for example, but the metal does degrade, if only very slowly. We have exploited that characteristic to propose a new dating method for lead archaeological artifacts. Our hypothesis, that mass of corrosion per unit area of a lead artifact is correlated to its "archaeological age", was investigated by using the Meissner effect, the total expulsion of a weak magnetic field from the interior of the lead metal in the superconducting state. This state is obtained for lead at temperatures below 7.2°K. This ideal diamagnetic response serves to establish the volume of the uncorroded lead; knowing the density of lead its mass is obtained. The diamagnetic contribution of the corrosion products is more than 10,000 times smaller than that of lead metal as the corrosion products of lead are not superconductors and thus can be ignored. By weighting the artifact, including the mass of corrosion and the mass of the lead metal, and knowing its surface area, the mass of corrosion per unit area can be established.

Well-dated untreated lead samples from Tel-Dor, the Persian period, Caesarea, the Byzantine and the Crusader periods, as well as contemporary data were used to establish the dating correlation over a time span ~2500 years. This new chemical dating method is apparently applicable to lead artifacts buried in soils with pH > 6.5. In such soils the corrosion process is very slow and the corrosion products, mainly PbO and PbCO<sub>3</sub>, accumulate over hundreds of years. The method is, in principle, non-destructive.

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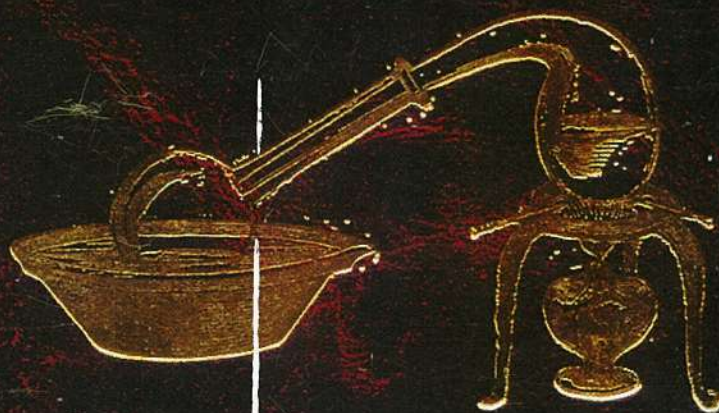


אוצר החכמה והמדע

ספר

# ההרכבה והתפרדה

לרבינאוויץ



וויזנא

תרל"ו 1876

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