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Recovery of the procedure of combined handling of elucidation methods for interpretable structure elucidation for decreasing frequencies of organic structure revision.

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Abstract

Maybe more than one hundred papers on revision of organic structure appear every year. Most of them derive from unreasonable neglect of correct structures because of picking-up/angling methodology. Antithetically, the present paper recommends scooping-up/netting one as a proper systematic procedure in order to avoid such careless and unreasonable neglect as much as possible by indicating existence of informational homologues, which are answers matching with provided pieces of structure information. This was invented by a Japanese company JEOL for its commercial computer program for automated organic structure elucidation, Combined Handling of Elucidation Methods for Interpretable Chemical Structures(CHEMICS). But the basic policy of CHEMICS has been changed to kinds of picking-up methods by people who carried away the name without understanding importance of the policy. In order to aim to recover scooping-up methodology, the present paper shows four examples of our analysis, exemplifying neglected informational homologues, and demonstrating that scooping-up methodology is better.

Introduction

Maybe more than one hundred papers on structure revision of organic compounds appear every year(Appendix 1). Most of them derive from careless and unreasonable neglect[1] of correct structures because of picking-up/angling approach, where chemists are liable to stop their thinking as soon as they encounter some favorite structures. Antithetically, the present paper recommends scooping-up/netting one as a desirable and reasonable procedure in order to avoid such unreasonable neglect as much as possible, on the basis of a concept of informational homologues (Appendix 2), which are entities matching with a set of provided pieces of information. This idea was invented by JEOL(Tokyo, Japan)[2], an analytical instrument manufacturer, in the process developing its commercial computer program for automated structure elucidation, which was named Combined Handling of Elucidation Methods for Interpretable Chemical Structures (CHEMICS)[2,3](Appendix 3). Although in structure determination, all of the informational homologues should be taken into account, many chemists pick up only some of them as working hypotheses. Synthesis of a compound of the "determined" structure by means of an incontestable reaction from incontestable reactants is frequently used for validation of the structure. However matching of structural data between a sample and a product to be identical with it is only one necessary condition. Only one thing to be done is, not to pick up favorite structures, but to reduce informational homologues into

single correct structures. The name CHEMICS bears this idea. Because JEOL did not protect the name, unfortunately it was carried away by people who will not understand importance of the policy. As a result, they have made their effort to hinder[4] the true CHEMICS(Appendix 3). Naturally, they, as developers of systems imitative of CHEMICS, adopted picking-up methodology. There are some evidences demonstrating that they may not understand the most important feature of CHEMICS[5]. On the other hand, following the true and original CHEMICS, we detect a range of logically correct informational homologues as a substitute of a chemically correct structures because nobody can answer for absolute correctness of chemical criteria which were/are used, and use them as axioms in the axiomatism(Hilbert). In order to demonstrate that scooping-up methodology is more reasonable and useful than picking-up one, the present paper analyses four real articles on structure revision, trying to discover alternative informational homologues.

Method

1. A result of structure determination or structure elucidation is selected from literature.
2. According to only the data utilized by the original authors, detection of other informational homologues is tried.

Results

〔Case study 1.〕 Figure 1(a)shows the set of Problem No. 14 and its answer in the exercise book6. Let Oa/Ob, Ma/Mb, and Pa/Pb be certain ortho-, meta-, and para-hydroxyphenyl groups of diaryl thioethers, respectively. The original solution consists of two candidate structures, Pa2S as[I]and Ma2S as[II]because of the interpretation level of this book for beginners. Our procedure suggests more than forty informational homologues of diaryl thioethers, which are not always symmetry. Figure 1(b)shows six possible 1,2,4,5 -tetra(namely, methyl, *tert*-butyl, hydorxy, and arylthio)-substituted phenyl groups. Using them, we can add 19 more informational homologues. By the original authors, Pa is strongly suggested on the basis of a mass peak, m/z 195. If we follow them, Pb, Oa and Ob are to be suggested as well as Pa. Naturally, any structures containing Pa, Pb, Oa and/or Ob would be more plausible than those without them.

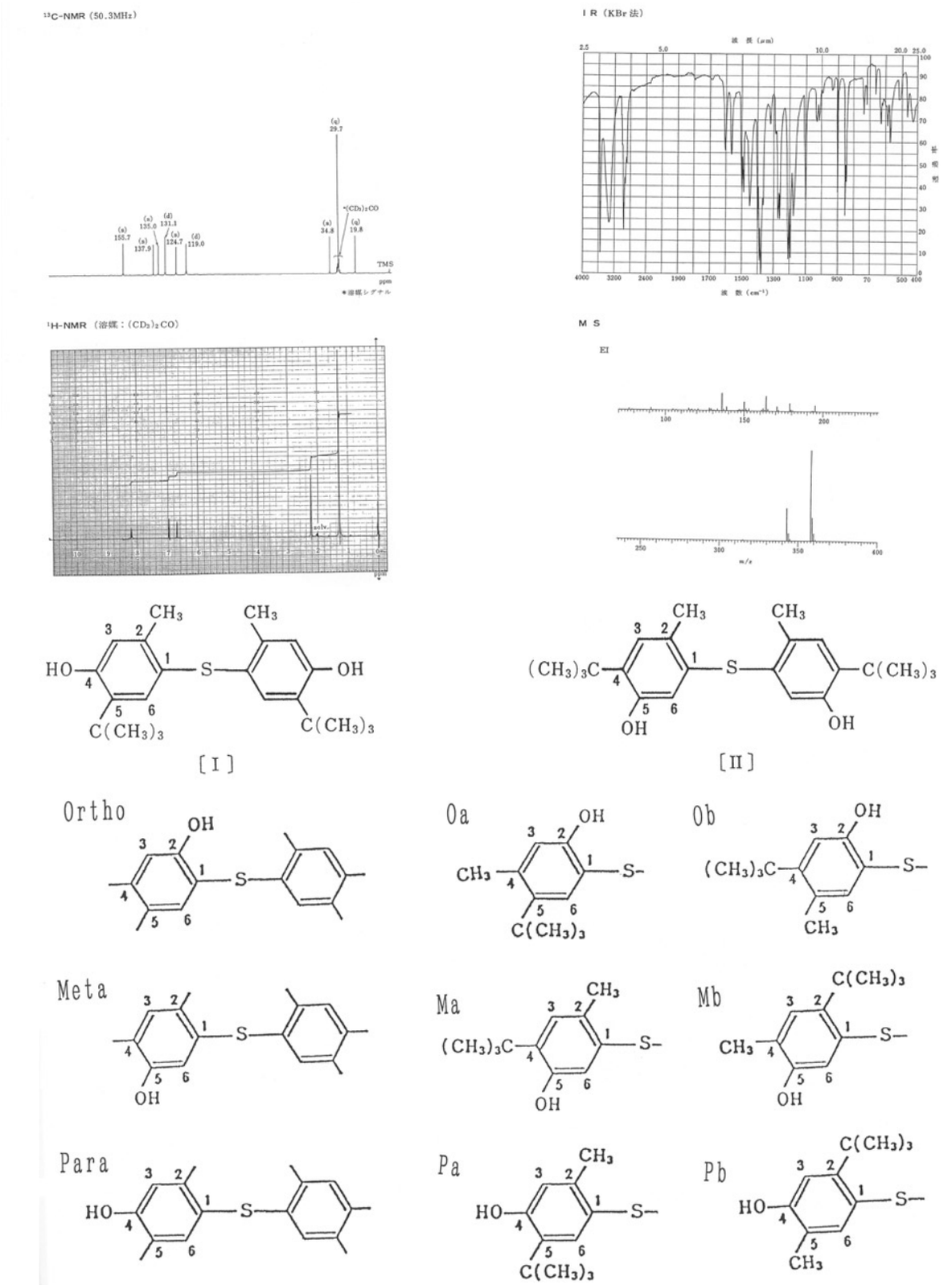

Figure 1. Case study 1.

Upper : Four kinds of spectra as Exercise 14 and the original solution (Two structures, I and II), Lower : Six 1,2,4,5-tetra-substitued thiophenyl groups forming a part of informational homologues derived from the logical analysis by the present paper.

〔Case study 2.〕 Figure 2(a)shows the work[7] on structure determination and revision of one of the five products(Appendix 4)of the reaction of cyclohexyl phosphonic chloride with magnesium in the presence of *trans*-stilbene oxide. The first answer proposed ten years ago was a 1,2-oxaphosphetane derivative, here as (1), whose molecular formula(C20H23O2P・2/5H2O)was estimated from the result of elementary analysis(C, 72. 35 ; H, 7.63 ; P, 8.86%). Finding their mistakes, the authors proposed the first revised answer, Structure A, but, were denied it with ^{13}CNMR. Therefore they chose the second acyclic secondary phosphine oxide(Structure B)as the correct structure. Our procedure can add three more acyclic secondary phosphine oxides, which cannot be rejected with the provided data.

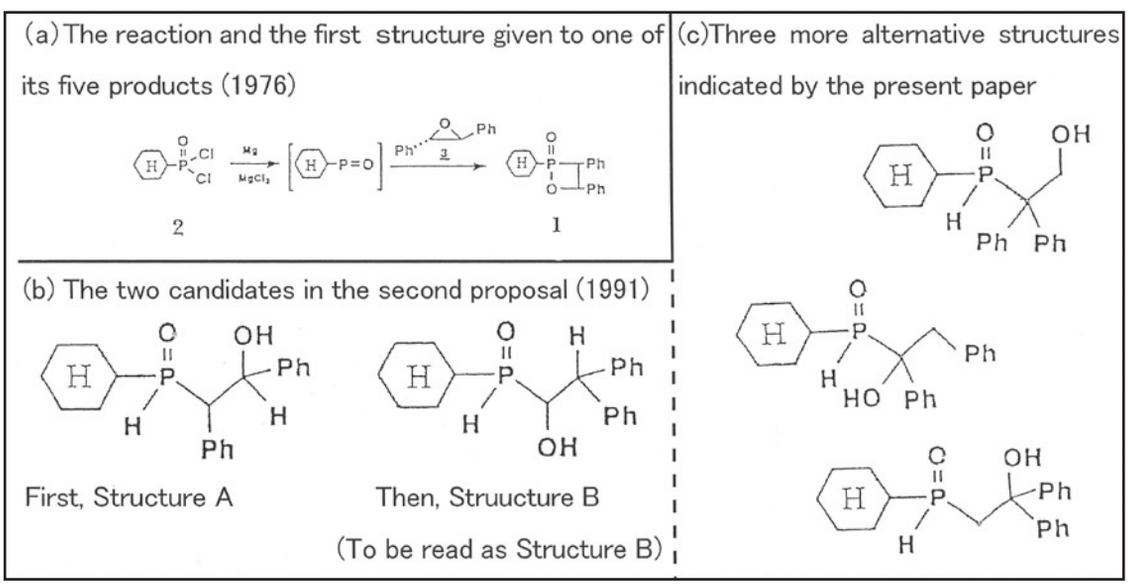

Figure 2. Case study 2.
A typical wrong example of structure determination and revision[7]

〔Case study 3.〕 Figure 3(a)shows a set of structures proposed for robstadials A and B by Nakanishi et al. in 1984[8a]. Lal et al. in 1986[8b], which was cancelled in 1988[8c], and Snyder et al. in 1988[8d]. Other informational homologues which were added by our procedure also were shown in Figure 3(b).

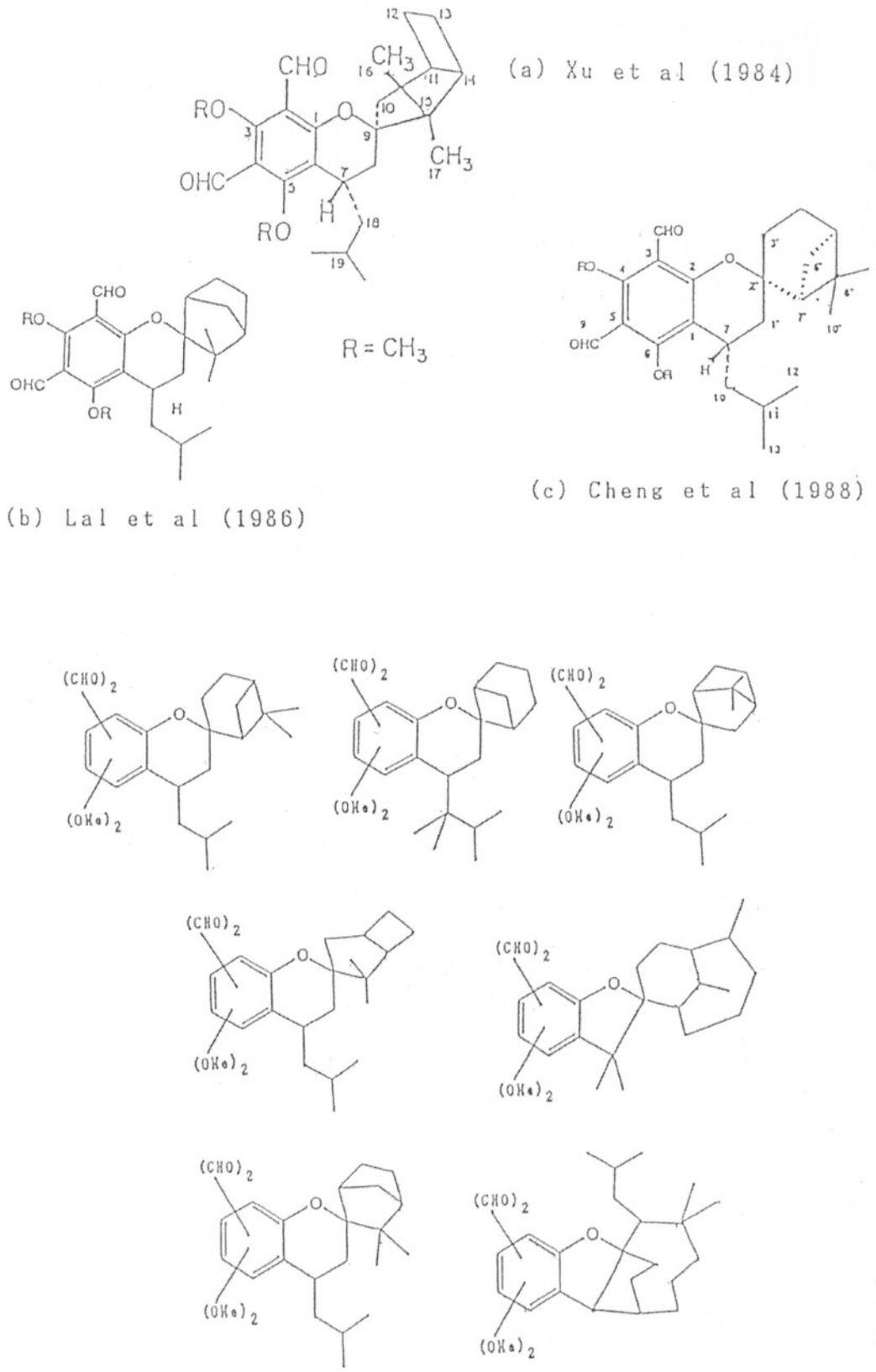

Figure 3. Case study 3.

Upper : The three structures proposed for robstadial B.

Lower : Some of the 20,399 informational homologues derived from the logical analysis by the present paper.

〔Case study 4.〕 Figure 4 shows a story of a series of reactions reported by Bruni et al.[9] They. reported synthesis of a new tricyclic 8H-pyrazolo[5',1',2,3]pyrimido[5,4-d] [1,2] diazepine from a bicyclic 6-acetyl-7-(2-dimethyl-aminovinyl)pyrazolo[1,5-a]pyrimidine. Showing a reaction mechanism, Chimini et al.[10] revised the structure of the final product resulted from cyclization of a substitute, of the same bicyclic system as the starting material. Our procedure can add an alternative reaction path as much more reasonable one.[11]

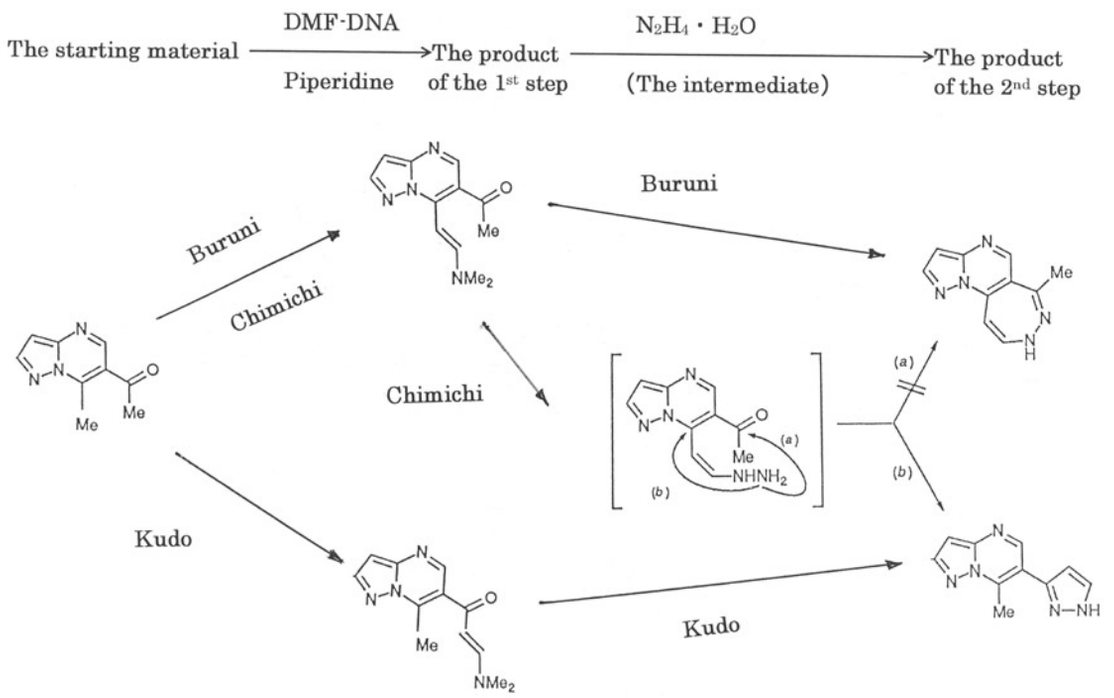

Figure 4. Case study 4.

A set of informational homologues on the reaction series extended by the present paper. Alternative structures and rection pathes as respective informational homologues. Buruni et al. determined structures, and Chimini et al. revised the structure of a reaction product of the second step.

The present paper (Kudo) adds alternative reaction path and a structure of a product of the first step to be examined.

Consideration

Organic structure determination is the base of chemistry, and *vice versa*. However sometimes organic structures seem to be determined and revised in easy going ways of thinking. In fact, we can see more than hundred papers on structure revision ((e.g) Appendix 1). Many chemists know (Appendix 5), but would not criticize such tendency, maybe because they have the same philosophy as chemists who mistake and/or do not know causes of such mistakes. Most of structure revision derive from overlooking of correct structures. The original CHEMICS aimed to reduce frequencies of organic revision by showing all of informational homologues. However, a thing to do is, not perfect enumeration of informational homologues, but warning of more than one informational homologue. There are two typical methodology to know informational homologues : scooping-up and picking-up methods. The former regards all things as informational homologues, and eliminates a thing that proves not to be an informational homologue on the basis of a provided set of criteria. We treat such criteria as axioms of the axiomatism (Hilbert). Any conclusion on a wrong axiom is

and will be wrong. We do not need prove chemical correctness of axioms. We try to guarantee logical correctness of a used procedure. Therefore the criticism by Veszpremi and Gsonka[12] on difference of ranges of chemical shift values among different chemists is irrelevant. Case study 1 shows a typical example of overlooking derived from a strong preconception, although the procedure of data analysis is very good especially for novice chemists because plural spectra are independently analysed. Case study 2 introduces a pitiful behavior. It is very surprised that they estimated a molecular formula containing a fraction number of water of crystallization from a result of elemental analysis! Their measuring range was too narrow to detect a signal of P-H!. Their paper described their action in order of time, and it is not necessary to discuss Structure A before Structure B! Case study 3 warns that our set of structural data of a natural product is usually too poor to determine its complicated structure, and supports more than one structure. Nevertheless many chemists sometimes decide structures roughly and recklessly. In order to prove a structure of a sample correct, synthesis of an organic compound of the structure through incontestable reactions starting from incontestable reactants is performed and their data are compared. If they match within tolernce, it is judged that they are identical. However such exact match of data is only necessary condition. Clearly it is important to know whether more than one informational homologue of a provided data. Scooping-up methodology should be used so as to reduce frequency of structure revision. By the way the problem on correctness of chemical criteria is to be resolved. Veszpremi and Gsonka[12] discussed how to harmonize different knowledges adopted by different chemists. They may consider that such knowledge is to be absolutely correct criterion. But we treat it like an axiom of the Hilbert Axionism, according to which we do not need to prove it correct, and if it is wrong, a resulting conclusion is wrong. What we should do is a logically exact inference in structure elucidation. Our methodologg also has been applied to DNA, RNA and protein sequen ces.[13]

References and comments

1. Other causes of mistakes in structure determination are contamination of samples, artifact in isolation process, clerical careless exchange of structure formulas, and others.
2. a) KUDO Yoshihiro : Kagaku no Ryoiki Zokan, 1972, 98, 115.
   b) Shin-ichi Sasaki and Yoshihiro Kudo : J. Chem. Inf. Comput. Sci. 1980, 25, 252.
3. a) Shin-ichi Sasaki, Hidetsugu Abe, Yoshihiro Kudo, Shukichi Ochiai and Yoshiaki Ishida : Kagaku no Ryoiki, 1972, 26, 981.
   b) Yoshihiro Kudo and Shinichi Sasaki : J. Chem. Doc. 1974, 14, 200.
4. Kimito Funatsu : Private oral communication at their seminor on CHEMICS, Susono, Japan, on 12, November 1991. According to him, they decided to treat a certain paper as the initial and fundamental article of CHEMICS because it cited all of the past relevant papers. He appear to believe that he is the true inventor of CHEMICS because he learned by himself using technical materials described and left by us of JEOL. He complained that what Kudo performed was only decision of the policy of CHEMICS and construction of small prototype systems to Professor K. Zamora, Technical University of Vienna, at the place of 15th International CODATA Conference, Japan, on 3, October 1996. He was proud of contribution to its expansion. and insisted that he was the real developer of CHEMICS (Cf. Ref. 5).
5. a) Shin-ichi Sasaki and Kimito Funatsu : CHEMICS---Structure elucidation by Computer, Kyoritsu Shuppan, 1994, Tokyo, pp. 214 (in Japanese). b) From a viewpoint of policy of CHEMICS, the plural form "Methods" plays the most important role in the correct

full name, Combined Handling of Elucidation Methods for Interpretable Chemical Structures, because it emphasize that CHEMICS aims to use as many available methods as possible. However it is very sad that, this book repeated "Method" (the singular of "Methods") at p.26, p.67, p.209 and p.212(the Index).

6. Seiichi Tanaka et al., Exercises of Organic Structure Determination, Sangyo Tosho, Tokyo, 1983.
7. a)Takayuki Kawashima, Shigenobu Nakayama, Masaaki Yoshifuji, Renji Okazaki and Naoki Inamoto : Bull. Chem. Soc. Jpn 1991, 64, 711. b) Shigenobu Nakayama, Masaaki Yoshifuji, Renji Okazaki and Naoki Inamoto : ibid., 1976, 1173.
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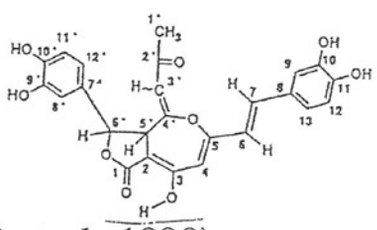
9. a)Fabrizio Bruni, Barbara Cosimelli, Annarella Costanzo, Gabriella Guerrini and Silvia Selleri : Heterocycles 1993, 36, 87. b)F. Bruni, S. Chimichi, B. Cosimelli, A. Costanzo, G. Guerrini and S. Selleri, ibid., 1990, 31, 1141.
10. Stefano Chimichi, Barbara Cosimelli, Fabrizio Bruni, Silvia Selleri, Annarella Costanzo, Gabriella Guerrini and Giovanni Valle : J. Chem. Soc. Perkin Trans. 2 1994, 1657.
11. Yoshihiro Kudo, Noriaki Endo, Takashi Hasegawa, Atsushi Kobayashi, Noriko Sato, Toshitaka Sugai and Haruki Yamagiwa : Anal. Sci. 1991, 7, 765.
12. a)T. Veszpremi and G. Gsonka : J. Chem. Inf. Comput. Sci. 1980, 20, 234.; b)G. Goska and T. Veszpremi, ibid., 239.
13. a)Yoshihiro KUDO, Shigehiko KANAYA, Bull. Yamagata Univ. (Eng.), 1994, 23,39. b) KUDO Yoshihiro, KANAYA Shigehiko, KONNO Tomiharu. Ibid, 1996, 23, 113. c) KUDO Yoshihiro, SAKAI Takamitsu, SATO Noriko, Makoto Kinouchi, *ibid*, 2005,28,65. d) KUDO Yoshihiro, Kennichi HIRAO, SATO Noriko, Makoto KINOUCHI, *ibid*, 2005, 28, 79.

Appendix 1

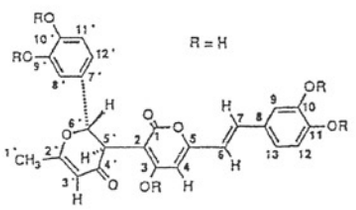
Frequent mention was made of structure revision exemplified in the following Chart.

Appendix. Case study.(KUDO Yoshihiro et al., Xth Intl Conf. Computer in Chem. Res. & Edu., Paris, July 17-21, 1995)

Case 1 . Davallialactone

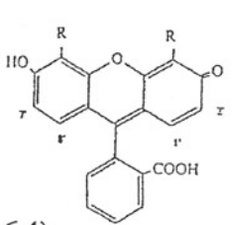


(Cui et al, 1990)

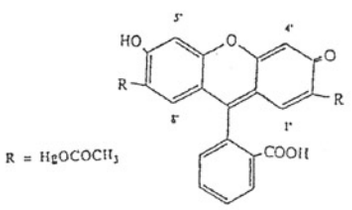


(Cui et al, 1992)

Case 2 . Fluorescen mercuric acetate

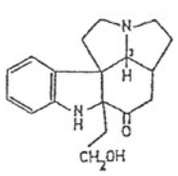


(Karush et al, 1964)

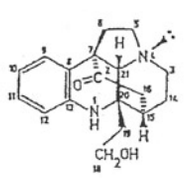


(Shipchandlar, 1986)

Case 3 . Strychnochromine

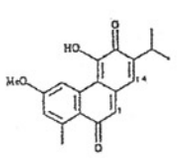


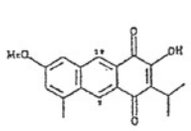
(Angenot et al, 1988)



(Quetin-Leclerq et al, 1991)

Case 4 . Fruticlin B



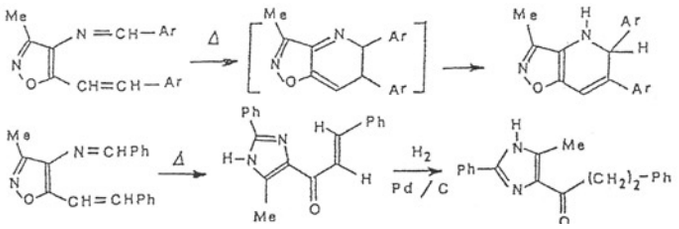


(Rodriguez-Haheal et al, 1986) (Rodoriguez-Haheal et al, 1918)

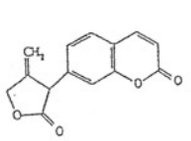
Case 5． The thermal rearrangement Product of 4-benzyliden amino-3-methyl-5-styrylisoxazole

(Murthy et al, 1983)

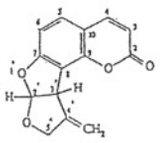
(Coda et al, 1985)



Case 6． Microminitinin

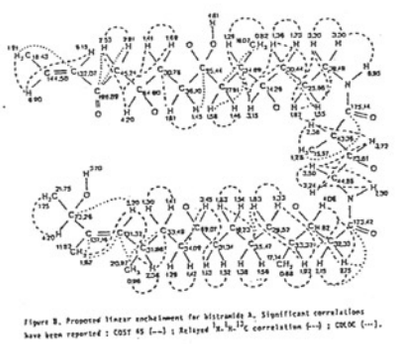


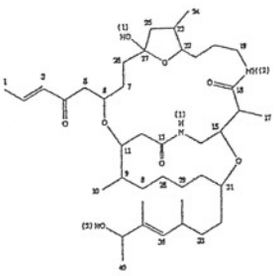
(Rahmani et al, 1993)

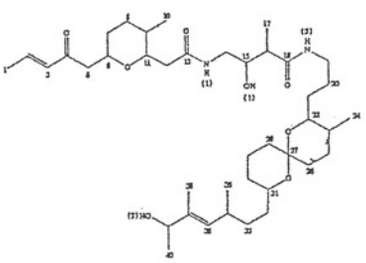


(Rahmani et al, 1994)

Case 7． Bistramide A

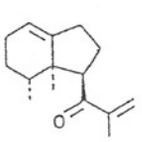


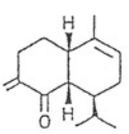




(Gouiffes et al,1988) (Degnan, 1989) (Foster,1992)

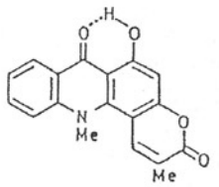
Case 8． Chilocyphone



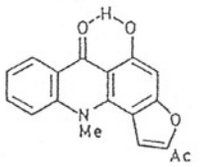


(Matsuo,1972) (Gras, 1981) (Connolly,1982)

Case 9 . Hallacridone



(Baumert et al, 1987)

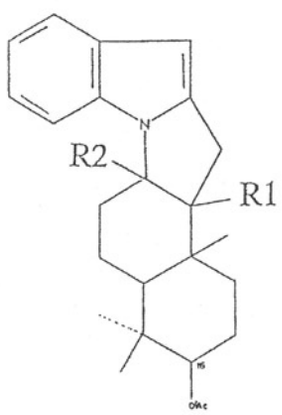


(Reisch et al, 1989)

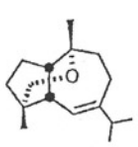
Case10. Polyavolensin

(Okorie,1980) R1=Me, R2=H

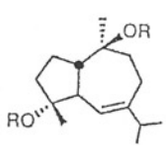
(Falshaw et al, 1982) R1=H, R2=Me



Case11. Alismoxide



(Oshima et al, 1983)

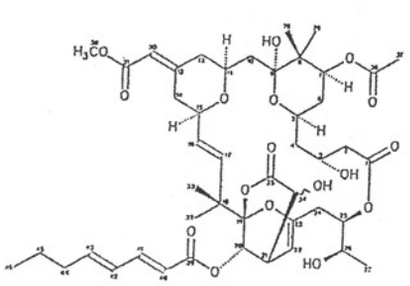


alismoxide : R=H

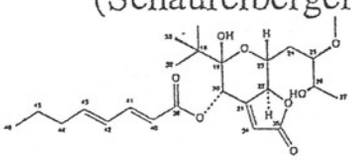
(Yoshikawa et al, 1992)

Case12. Two natural Products named bryostatin 3 and 20-*epi*-bryostatin 3

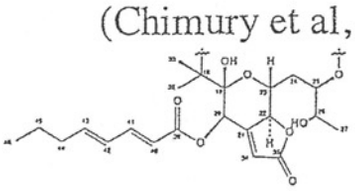
(Petit et al, 1983)



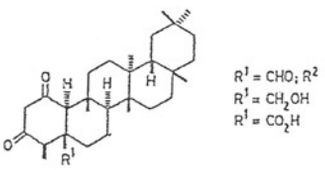
(Schaufelberger et al, 1991)



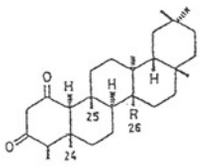
(Chimury et al, 1992)



Case13. Triterpens Q, T and U



(Joshi et al, 1973)

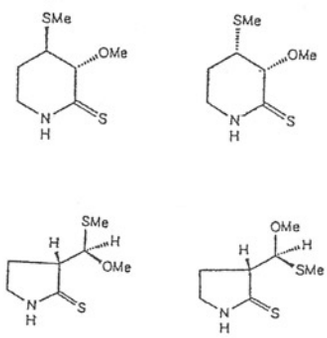


(Rogers et al, 1980)

Case14. Raphanusamins and raphanusamid

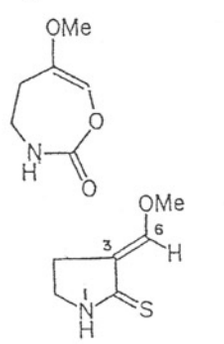
Raphanusamins

(Hasegawa et al, 1982, 1986)



(Nishiyama et al, 1991)

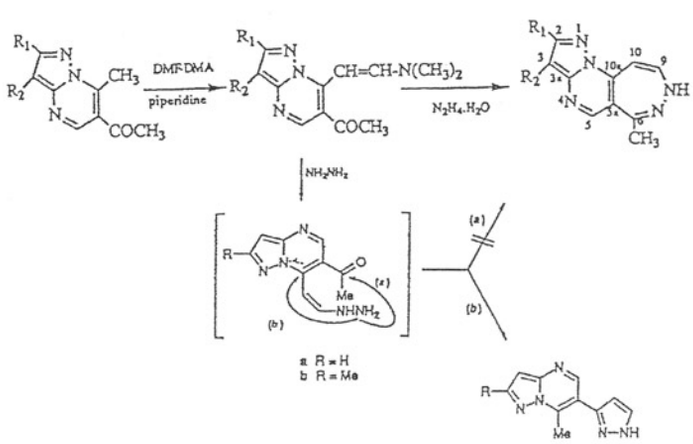
Raphanusamid



(Harada et al,1991)

Case15. A reaction product of a reaction product of a reaction of pyrazolo[1, 5-a]pyrimidines

(Bruni et al, 1993)



(Chimichi et al, 1994)

KUDO has repeatedly warned organic chemists against careless neglect of correct answers in structure determination as improper operation to be avoided. However, though many chemists know that structure revision has been frequently reported, they seem to understand it as commonplace and no exciting matter.

For example :

1) Robert G. Salmon, Samuel M. Mazza, and Kastual Lal, J. Org. Chem. 1989, 54, 1562. Ref. 10 : on Azadirachtin, Stoechospermol, Xylomolin, Specionin, and Robstadials A and B.
2) T. Ross Kelly and Jayanta K. Saha : J. Org. Chem. 1985, 50, 3679. Ref. 3 on patchouli alcohol and Ref. 4 on albene.
3) John W. Blunt, Brent R. Copp, Murray H. G. Munro, Peter T. Northcote and Michele R, Prinsep : Nat. Prod. Rep., 2003, 20, 1. Refs. 186-190(salicylihalmides A and B), 215(artifact methyl esters), 218-221(Haliclorensin), 222-224(enantiomers of stellettadine A), 225-226(stelletamide B), 227-229(Batzelladine F), 243-245(pyrinodemines A and B), 249-251 (renieramycine H(<--cribrostatin)), 286, 300 ((+)-subersin, cacospongin A), 306-307(the C21 norsesterterpenoid), 324-325(two phosphorylated sterol suylfates, haplosamate A), 338-340(hippospongic A), 347-348(gorgonian B. stechei?, solenolide C), 360-361(pseudopteroxazole), 362-364(calyculaglycosides D and E, nephtenol), 376-382(scleophytin A etc.), 383-384(caribaeorane, 15-OH artifact), 453-454 (segoline C, B(C-NMR)), and 480-482(diazonamids A and B).
4) Idem, ibid., 2004, 21, 1. Refs. 44-47, 119-122, 245-246, 249-250, 256-258, 290-291, 381, 406-407, 415-417, 434-435, 467-469, 470-471, 507-508, 538-539, 548-550, and 563-564.
5) Kenji Mori : Chem. Rec. 2005, 5,1. Refs. 1-2, 3-10(Fabrications), 11-17(the Green Flagellate, Chlamydomonas), 18-23(Insect Pheromones), 24-32(Periplanone-A), 33-36(Orobanchol), 37-41(Two marine natural products), 42-44 (Bifurcarenenone), 45-50(Koninginin), 51-55 (alpha-Acordiene), 56-61(Himachalene-type sesquiterpenes), 62-64(Differolide), 85-67(Blattellastanoside A and B), and 68-69(putative antifeedant COMPL).
6) Kumar, D., Heterocycles, 2004, 63, 145. Refs. 3-6, 8, 14-18, 19, 20, 21, 22, 23-25, 28,29, 30-32, 33-37, 46-50, 57-59, 60, 61, 62-64, and 65.
7) And many others.

Appendix 2.

Informational homologues are composed of all answers that match with a set of the provided pieces of information(Chart A2). For example, a complete set of informational homologues for a molecular formula of an unknown sample consists of all of its structural isomers. There are two typical procedures to get informational homologues : Picking-up/angling and Scooping-up/netting methodologies, which would be liable to Type I Error(where true hypotheses are rejected)and Type II Error(where false hypotheses are accepted), respectively. Clearly, in structure elucidation Type II Error is tolerable whereas Type I Error is fatal. This is the reason why scooping-up methodology is good for any chemists and picking-up one is wrong except for excellent chemists. However, many novice chemists used the latter, and often took mistakes in their structure determination.

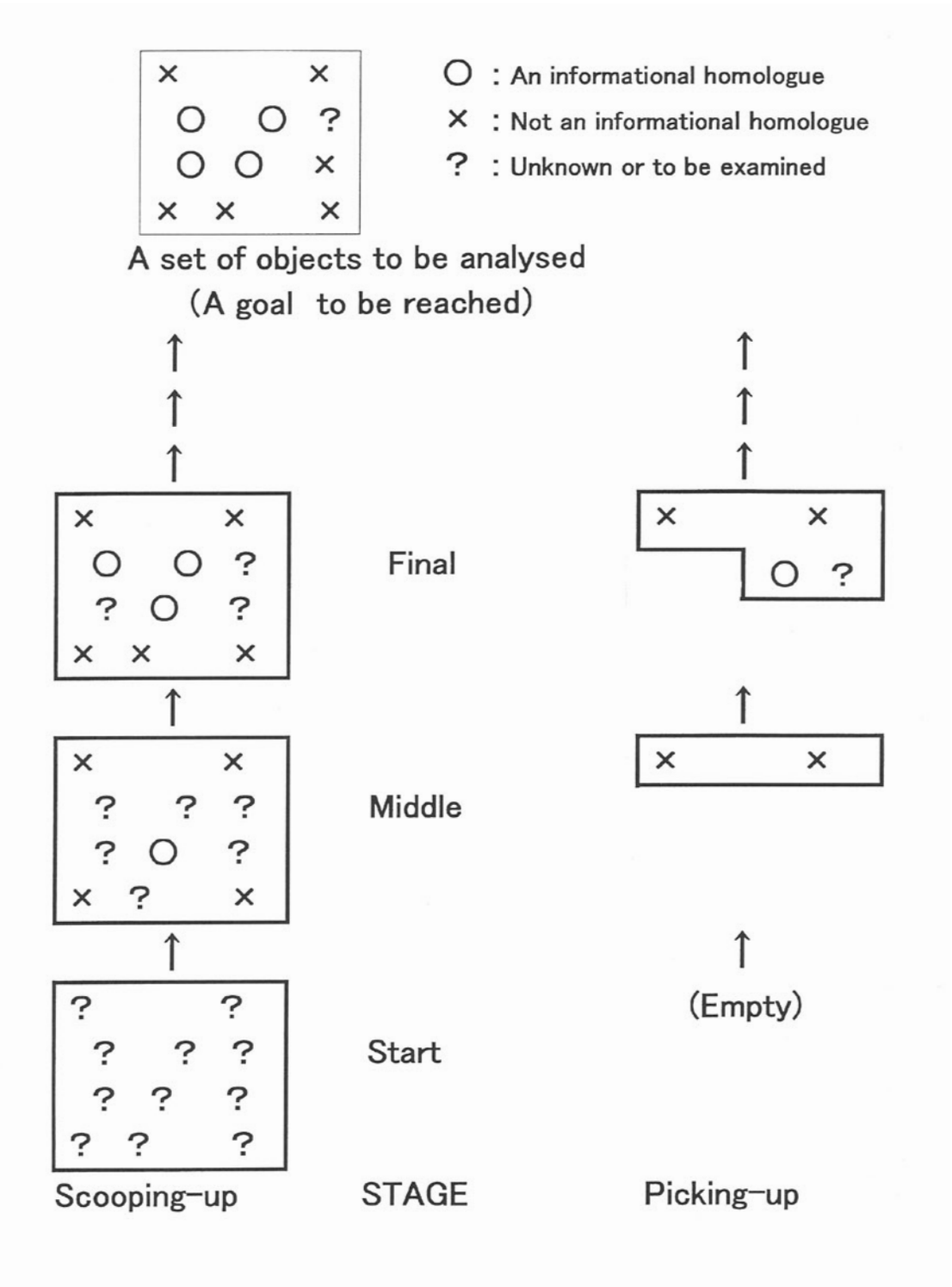

○ : An informational homologue
× : Not an informational homologue
? : Unknown or to be examined
A set of objects to be analysed
(A goal to be reached)
Final
Middle
Start
(Empty)
Scooping-up
STAGE
Picking-up

Chart A2.

Appendix 3

Papers on CHEMICS

Earlier than 1968 when one of the authors (KUDO Yoshihiro) joined to JEOL, a project for development of an automated organic structure elucidation system was established, but its members had no systematic idea. The article-like review[1a)] was written, suggesting informational homologue as a word coined by KUDO. Also the name CHEMICS was proposed by KUDO Yoshihiro in 1972 in the incomplete form, Combined Handling of Elucidation Methods for I. Chemical Structures.

The name CHEMICS was introduced in a review[2a)] and an original article[2b)] on connectivity stack, also which was coined by KUDO.

On July 25, 1975, the incomplete abbreviation I. of CHEMICS was replaced with "Interpretable" by suggestion of Mr. (now Dr.) Sjeold Orlics from the Netherland.

KUDO's method to describe mathematically an organic structure was written as Sasaki's method in Shin-ichi Sasaki : Determination of Org. Structures by Phisical Methods 1973, 5, 285.

(1) Basis papers on CHEMICS of KUDO et al.
a) Shin-ichi Sasaki, Yoshihiro Kudo and Hideaki Abe, Kagaku no Ryoiki 1968, 22, 1070. b) S. Sasaki, Y. Kudo, S. Ochiai and H. Abe : Microchim. Acta [Wien] 1971, 726. c) KUDO Yoshihiro, Kagaku no Ryoiki Zokan, 1972, 98, 115. d) Shin-ichi Sasaki, Hidetsugu Abe, Yoshihiro Kudo, Shukichi Ochiai and Yoshiaki Ishida, Kagaku no Ryoiki, 1972, 26,981. e) Shinichi Sasaki, Shukichi. Ochiai, Yuji Hirota and Yoshihiro Kudo, Bunseki Kagaku 1972, 21, 916. f) Yoshihiro Kudo and Shukichi Ochiai : Bunseki Kiki 1973,11,654. g) Shin-ichi Sasaki, Hidetsugu Abe, Yoshihiro Kudo and Shukichi. Ochiai : Yuki Gosei Kyokaishi 1973, 31,29. h) Yoshihiro Kudo, Toru Yamasaki and Shinichi Sasaki : J. Chem. Doc. 1973, 13, 225. i) Shinichi Sasaki, Yoshihiro Kudo, Shukichi Ochiai and Ichiro Fujioka : Bunseki Kagaku 1973, 22, 25. j) Shukichi Ochiai, Yuji Hirota, Yoshihiro Kudo and Shinnichi Sasaki : Bunseki Kagaku 1973, 22, 399. k) Yoshihiro Kudo, Shukichi Ochiai and Shin-ichi Sasaki : Kagaku to Kogyo 1974, 27, 395. l) Yoshihiro Kudo and Shin-ichi Sasaki : J. Chem. Doc. 1974, 14,200. m) Yoshihiro Kudo Shinichi Sasaki, 1976, 16, 43. n) Yoshihiro Kudo, Yuji Hirota, Shotaro Aoki, Yoshito Takada, Toyoaki Taji, Ichiro Hujioka, Kazuko Higashino, Hisayuki Fujishima and Shin-ichi Sasaki : J. Chem. Inf. Comput. Sci. 1976, 16, 50. o) Y. Yamasaki, Hidetsugu Abe, Y. Kudo and S. Sasaki : Amer. Chem. Soc. Symp. 1977, 54, 108. q) Shinichi Sasaki, H. Abe, Yuji Hirota, Yoshiaki Ishida, Yoshihiro Kudo, Shukichi Ochiai, Keiji Saito and Toru Yamasaki : J. Chem. Inf. Comput. Sci. 1978, 18,211. r) Yasuhiko Yotsui, Hisashi Nomura, Mituji Sano, Yohihiro Kudo and Shinichi Sasaki : Bull. Chem. Soc. Jpn 1978, 51, 1909. s) Yasuhiko Yotsui, Hisashi Nomura, Mituji Sano, Yohihiro Kudo and Shinichi Sasaki : Bunseki Kagaku 1979, 28, 721. t) Hidetsugu Abe, Yoshihiro Kudo, Tohru Yamasaki, M. Sasaki and Shin-ichi Sasaki, J. Chem. Inf. Comput. Sci. 1984, 24, 212. u) Yoshihiro Kudo : Kagaku Kyoiku 1986, 34, 47. v) Yoshihiro Kudo and Takahiro Suzuki, Bull. Yamagata Univ. (Engineering) 1989, 20, 207. w) Yoshihiro Kudo: Memoirs of the Integrated Course, Akita University, A special issue on how to live in an information society, 1991, 33. x) Yoshihiro Kudo : Bull. Yamagata Univ. (Nat. Sci.), 1991, 12, 377. y) Shin-ichi Sasaki and Yoshihiro Kudo : J. Chem. Inf. Comput. Sci. 1980, 25, 252. z) Yoshihiro Kudo, Noriaki Endo, Takashi Hasegawa, Atsushi Kobayashi, Noriko Sato, Toshitaka Sugai and Haruki Yamagiwa : Anal. Sci. 1991, 7, 765. aa) Yoshihiro Kudo : Computer Aided

Innovation of New Materials II(Eds. M. Doyama et al.), 1993, 949. ab)Yoshihiro Kudo, Shigehiko Kanaya, Nobuyuki Takahashi and Akito Yoshida : 47th FID, 1994, 272. ac)KUDO Yoshihiro and KANAYA Shigehiko : XIth Intl Conf. Comput. Chem. Res. Educ. 1995, A-07.

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Appendix 4

The original authors (Kawashima, et al.) wrote their mistakes as follows :

In order to confirm whether the sample, which was obtained previously, remains unchanged as it was or not, we took a 1H NMR spectrum(90 MHz). Its spectrum showed the same signals as taken previously except a double doublet in the 60 MHz-1H NMR spectrum, because a lower field signal had appeared about δ =9.7 and upper one, which was expected to appear at δ =2.2, was unfortunately superimposed with the signals of the cyclohexyl group. In the IR spectrum the stretching frequencies for O-H and P-H bonds had been observed at 3150 and 2330 cm-1, respectively. However the former band had been assigned to that of water

of crystallization, as expected from the results of elemental analysis, and the latter band had been completely neglected because the presence of P-H bond was beyond the consideration. Judging from the existence of P-H bond we at first presumed Structure A, which is considered to be formed by the rerduction and the subsequent ring opening by hydrolysis of the oxaphosphetane.

The 13C NMR spectrum showed the signals due to three methane groups at δ C=34.54（J=65.4 Hz), 53.31（J=3.4 Hz), and 69.74（J=74.5 Hz). The chemical shifts are reasonable for the carbons bonding to a phosphorus, phosphorus, and oxygen atom, respectively but the magnitudes of coupling constant with phosphorus nucleus cannot be explained for Structure A at all. From a data a phosphorus atom must directly be attached to the carbon bonded with an oxygen atom. Structure B (4) is consistent with these facts（See Fig. 1).

工藤喜弘　　紀要応募論文の和文概略

有機構造解析の修正の頻度を減らすための解析可能な化学構造の複合的な構造解析法という手順の復活

有機化合物の構造決定の誤りを修正する論文の数は年間おそらく100件を越す。これは構造データの解析の誤りによるよりは、つり法（拾い上げ法）手順採用による正しい構造の不当な無視による。つり法手順は見落としをしやすいので初心者が使うべきではない。このような正解の不当な無視をできるだけ減らすために標準的かつ系統的手順として本論文ではあみ法（囲い込みは法）手順を強く推奨する。この方法はもともと日本電子株式会社（JEOL）が自動構造解析システム、商品名Combined Handling of Elucidation Methods for Interpretable Chemical Structures（略称CHEMICS）（解析可能な化学構造のための複数の構造解析法の組み合わせ使用）のために最初に考えだしたものである。四つの事例でこの手順がきわめて有用であることを証明する（実際の文献から拾い出した構造決定の結果は誤まっていて真の正解を見落としている可能性があることを暗示し、真の正解の候補を提示した。）

注：Appendixは「JEOLのCHEMICSの概念と名前がその基本方針を理解できなかった人たちによって他の機関に持ち出され、その方針が歪曲されてつり法に向いていく過程」を公表された文献で追っている。そこで本論文ではあみ法の復活を試みている。

（解　説）

有機構造決定化学者は構造データを解析してある構造を挙げ、構造決定をした、とする。その構造が正しいとする根拠は「データをうまく説明できるから」とする。手順がまちがっていて誤った解に到達しても学術雑誌の査読者も著者と同じ考え方が多いので矛盾に気づかないのが普通である。そして審査は通り、当人あるいは他人によって誤まりがみつかるのは１年後、10年後、20年後になる。誤まりに気づかれるのが遅いほどその構造に寄りかかって行われた研究が多く、それらが全部共倒れとなる。これはたとえば$X^2-1=0$を解くのにX＝１とするようなものである。すなわちX＝-1の見落としである。本論文ではこのようなデータのときには解が２個あると気づくような手順を提示する。これによってデータ不足に気づく。そして見落としが減る。