ON A CERTAIN VIEWPOINT OF PROFESSOR NATHAN JACOBSON
-A MATHEMATICAL HISTORY ASSOCIATED WITH JAPAN –

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ABSTRACT

In this note, I will discuss the 20th century history of non-associative algebras in Japan, in particular of Jordan algebra associated with Prof. N. Jacobson. Of course, it will be no more than to just open the door a bit into this topic.
Keywords: *Algebra's history of 20th century*

1. INTRODUCTION

The main purpose of this paper is to consider why the history of Jordan Algebra is not discussed much in Japan although I believe that time is ripe now for us to discuss this area of the 20th century algebra. We will start form Prof. N. Jacobson (Hereafter all honorifics will be omitted) research job. N. Jacobson taught for many years at Yale University and I would like to refer to his research work of Jordan Algebra as the key to the history in question. (Of course, the objective is not to arrive at any specific conclusion.) Also I will discuss a little the topic from a viewpoint of mathematical results. The following are the content of the topics discussed.

1. Introduction
2. Chronology of N. Jacobson s
3. Publications on the books of N. Jacobson
4. List of Doctoral students of N. Jacobson
5. Math. Review Classification
6. Discussion and Conclusion
7. References

The field of algebra (ring) includes such fields as the number theory and group theory, but please note that the algebra that I will mainly describe to be non-associative algebra in a form of its history focusing particularly on non-associative algebra of associated with N. Jacobson. It is my wish that it would be a first step in providing a clue to elucidate the reason why there are only a few researchers in the non-associative algebra, in particular Jordan algebra in comparison to researchers in commutative or associative ring, in Japan. I therefore took the liberty to put a spotlight on N. Jacobson, a pioneer and an outstanding mathematician of the 20th century. In fact, there are many researchers of Lie algebras especially in representation theory in Japan, but the question is why there are not many mathematicians in algebras that generalizes Octonion numbers? I would like to present my point of view for this field. The solution is yet to be found and therefore it will be a starting point of the discussion. I will begin by unravelling the history through Nathan Jacobson as a clue to the elucidation of this puzzle. Thus, it seems that his achievements will become the center of an important topic of discussion.

2. CHRONOLOGY of N. Jacobson

September 8, 1910	Born, Warsaw, Poland (U.S. Citizen)-Died in Connecticut (Dec.5, 1999)
1930	A.B. University of Alabama
1934	Ph.D. Princeton University
1934-1935	Assistant, Institute for Advanced Study
1935-1936	Lecturer, Bryn Mawr College
1936-1937	National Research Council Fellow, University of Chicago
1937-1938	Instructor, University of North Carolina
1938-1940	Assistant Professor, University of North Carolina
1940-1947	Visiting Associate Professor, Johns Hopkins University
1941-1942	Associate Professor, University of North Carolina

1942-1943	Associate Ground School Instructor, University of North Carolina
1943-1947	Associate Professor, Johns Hopkins University
1947-1949	Associate Professor, Yale University
1949-1961	Professor, Yale University
1961-1963	James E. English Professor, Yale University
1963-1981	Henry Ford II Professor, Yale University
1981-	Henry Ford II Professor Emeritus, Yale University
Summer 1947	Visiting Professor, University of Chicago
1951-1952	Fulbright Scholar, University of Paris
1957-1958	Visiting Professor, University of Paris
Oct. 1964-Jan. 1965	Visiting Professor, University of Chicago
Spring 1965	Lecturer, Mathematical Society of Japan
Spring 1969	Visiting Professor, Tata Institute of Fundamental
Oct. 1981-Jan. 1982	Research Visiting Professor, ETH, Zurich
Sept. -Nov. 1983	Visiting Professor, Nanjing University, People's Republic of China
Nov. -Dec. 1983	Visiting Professor, Taiwan National University, Republic of China
Feb. -March 1984	Visitor, Center for Advanced Studies, University of Virginia
Sept. -Oct. 1985	Visiting Professor, Pennsylvania State University
April 1988	John Hasbrouck Van Vleck Distinguished Visiting Professor, Wesleyan University

Apart from his presence at these institutions he has also taught as visiting professor at various universities and research institutes. And he has also visited Japan several times. According to his autobiography sent to me (author), he spent the longest period of his stay in Japan from 3/16 to 6/6/1965 (Invitation of Mathematical Society of Japan invited by Yukiyosi Kawada (1916-1993)). In Tokyo, he stayed at Yamanoue Hotel for about 1 month ($10 per night), and gave special lectures starting from the University of Tokyo, (the lectures of Cayley plane in Okayama and Sendai) in Japan.

The topic of his lectures at Nagoya University, Kyoto University, Osaka University, Hiroshima University, Kyushu University, Hokkaido University, etc. were mainly on Jordan algebra and it is unlikely that there were too many lectures on Lie algebra(It seems that he only provided topics of relevance). Also, as his stay for Japan in 1965 coincided with the time he was writing a book on Jordan algebra, so he must have given many lectures on this subject (Jordan algebra). At the end of this chapter, according to his autobiography, he entered the University of Alabama at the age of 16, graduated at the age of 20, and when he was still in the University, he had the choice of majoring in law or pursuing a career in mathematics. He then went on to graduate school at Princeton University, where he wrote his thesis under J. H. Wedderburn (1882-1946) at the age of 24 and received Ph. D degree. It is thought that he studied very seriously the lectures of H. Weyl on continuous groups during his graduate school years. This experience was the start of his long years of research. In his later years he served as editor of Journal of Algebra for many years. I had the privilege of publishing in J. Alg. a paper communicated by N. Jacobson.

3. PUBLICATIONS of N. Jacobson (mainly about books)

The Theory of rings: Mathematical Surveys, No.11, Amer. Math. Soc., 1943(Russian Translation, 1947).
Lectures in Abstract Algebra: Vol.1, Basic Concepts, D. Van Nostrand Co. Inc., 1941 (Springer-Verlag reprint, 1975; Chinese translation, 1966).
Lecture in Abstract Algebra: Vol.2, Linear Algebra, D. Van Nostrand Co. Inc., 1953 (Springer-Verlag reprint, 1975; Chinese translation, 1960).
Lecture in Abstract Algebra: Vol.3, Theory of Fields and Galois Theory, D. Van Nos- trand Co. Inc., 1964 (Springer-Verlag reprint, 1975).
Structure of Rings: Amer. Math. Soc. Colloquium Publications, Vol.37, 1956, 1964 (Russian translation, 1961).
Lie Algebras: Interscience Publishers (John Wiley and Sons), 1962 Interscience Tracts in Pure and Applied Mathematics, No.10 (Dover reprint, 1979; Russian translation, 1964; Chinese translation, 1964).
Structure and Representations of Jordan Algebras: Amer. Math. Soc. Colloquium Publications, Vol.39, 1968.
Lectures on Quadratic Jordan Algebras: Tata Institue of Fundamental Research, Bombay, 1969.
Exceptional Lie Algebras: Lecture Notes in Pure and Applied Mathematics, Marcel Dekker Inc., New York, 1971.
Basic Algebra I: W. H. Freeman and Co., New York, 1974; second edition, 1985.
Pi-Algebras: An Introduction, Springer Verlag, 1975.Basic Algebra II: W. H. Freeman and Co., New York, 1980; second edition, 1989.
Structure Theory of Jordan Algebras: University of Arkansas Lecture Notes in Mathematics, 1981.
Finite Dimensional Division Algebras over fields: Springer-Verlag Grundlehre Series, 1996.
Apart from the publications listed above there are close to 100 papers published continuously between 1934 to 1980. Judging from these publications it can be said that he discusses Jordan algebra and Lie algebra as equal theme of his research .

4. LIST of Doctoral Students of N. Jacobson

I am listing the students who obtained their doctoral degree under N. Jacobson
University of North Carolina

Charles L. Carroll, Jr.: Normal simple Lie algebras of type D and order 28 over a field of characteristic zero (1945).

Yale University
Eugene Schenkman: A theory of subinvariant Lie algebras(1950).
Charles W. Curtis: Additive ideal theory in general rings (1951).
William G. Lister: A structure theory of Lie triple systems (1951).
Henry G. Jacob: A theorem on Kronecker products (1953).
George B. Seligman: Lie algebras of prime characteristic (1954).
Morris Weisfeld: Derivations in division rings (1954).
Bruno Harris: Galois theory of Jordan algebras (1956).
Earl J. Taft: Invariant Wedderburn factors (1956).
Dallas W. Sasser: On Jordan matrix algebras (1957).
Maria J. Woneburger: On the group of similitudes and its projective group (1957).
Tae-II Suh: On isomorphisms of little projective groups of Cayley planes (1961).
Herber F. Kreimer, Jr.: Differential,difference, and related operational rings (1962)
Charles M. Glennie: Identities in Jordan algebras (1963).
David A. Smith: On Chevalley's method in the theory of Lie algebras and linear groups of Prime characteristic (1963).
Dominic C. Soda: Groups of type D_4 defined by Jordan algebras (1964).
Harry P. Allen: Jordan algebras and Lie algebras of type D_4 (1965).
Eugene A. Klotz: Isomorphisms of simple Lie rings (1965).
Kevin M. McCrimmon: Norms and noncommutative Jordan algebras (1965).
Joseph C. Ferrar: On Lie algebras of type E_6 (1966).
Daya-Nand Verma: Structure of certain induced representations of complex semi-simple Lie algebras (1966).
Lynn Barnes Small: Mapping theorems in simple rings with involution (1967).
John R. Faulkner: Octonian planes defined by quadratic Jordan algebras (1969).
Samuel R. Gordon: On the automorphism group of a semi-simple Jordan algebras of characteristic zero (1969).
Michel Racine: The Arithmetics of quadratic Jordan algebras (1971).
Jerome M. Katz: Automorphisms of the lattice of inner ideals of certain quadratic Jordan algebras (1972).
Ronald Infante: Strongly normal difference extensions (1973).
Louis H. Rowen: On algebras with polynomial identity (1973).
Georgia M. Benkart: Inner ideals and the structure of Lie algebras (1974).
David J. Saltman: Azumaya algebras over rings of characteristic p (1976).
Robert A. Bix: Separable Jordan algebras over commutative rings (1977).
Leslie Hogben: Radical classes of Jordan algebras (1978).
Craig L. Huneke: Deteminantal ideals and questions related to factoriality (1978).
Among the theses of his doctoral students there are many suggestion that they are of the field of Jordan algebra.
The first three chapters in this note are more like chronicles but they serve to introduce Jacosons's work, biography, publications and the titles of the theses of his disciples.
On the other hand, E. Zelmanov (recipient of 1994 Fields Medal Award) researcher of Jordan superalgebra, was one of the mathematicians that was invited to the United States form Novosibirk in the 1980s by N. Jacobson and his students. I have an experience of giving an invitation lecture at an international conference organized by Zelmanov. H. Freudenthal (1905-1990) in University of Utrecht, who lived in the same era as N. Jacobson also took an interest in the geometric side view associated with Jordan algebra such as the concept of 56 dimensional meta-symplectic geometry. He was one of the people that had interaction with N. Jacobson and his students in research work.
I would like to, at some point in the future, write about the history, excluding Japan, in line of the works of
H. Weyl→ H. Freudenthal→ disciples of N. Jacobson→ E. Zelmanov
(more widely considering the 20^{th} century history of non-associative algebra that includes Tits, Springer and others). In particular because I have met N. Jacobson and one-third of his students at least more than once. I would also be interested in writing a story which include my exchanges with them in future.
NOTE. The chronology, publications, and the list of students have been quoted from Birkhäuser's "Collected Mathematical Papers of N. Jacobson (published in 1989).

5. Math. Review classification

The non-associative algebraic system of the Mathematical Review Classification (AMS) corresponds to 17. I have quoted from 17 and it is classified as follows:
17 Nonassociative algebras
17 A general nonassociative rings

17 Bxx Lie algebras and Lie superalgebras
17 Cxx Jordan algebras (algebras, triples and pairs)
17 Dxx other nonassociative rings and algebras

Example (Example of a more detailed classification)
17 C05 Identities and free Jordan structures
17 C 10 Structure theory
17 C 17 Radicals
17 C 20 Simple, semisimple algebras
17 C 90 Applications to Physics
17 D 05 Alternative rings
17 D 10 Malcev Rings
17 D 25 Lie admissible algebras
:
:
:
17D 92 genetic algebra

From this classification, I think it is not only I (writer) who feel that Lie algebras, Jordan algebras and other nonassociative algebras (for example alternative algebra, octonion, etc.) are treated equally in these study. To describe this historical subject I would like to introduce the Math. Review briefly as above. It is also true that there are not so many Japanese researchers who are classified into these categories in the primary, except for Lie algebra. In particular, I am understanding that there have been almost no papers Japanese dealing with structural theories such as alternative algebra and Jordan algebra (including books) for 70 years after the end of World War II. Thus I think that it is possible to collect and explore the concept of Japanese papers mainly engaged in the field of Math. Review classification 17 C (Jordan algebras, triple systems). I recognize that there are studies on the aspects of analytical geometric applications (homogenous bounded domains, symmetric space etc.) using Jordan algebra, but for example, algebraic structure theory for a field of the characteristic p has not been discussed much in Japan. I hope that the history and the study of mathematics in this field will develop in the future.

6. DISCUSSION

As you can see from the list of books by N. Jacobson and of his students, it seems that his field of study is as follows:

1) Noncommutative ring theory
2) Lie algebra
3) Jordan algebra (nonassociative algebraic system)

They can be roughly classified into these 3 fields. Furthermore, as we can be seen from the list of his doctoral students, it seems that he was interested in algebra (Including ring theory) systems in general, excluding group theory, and there is no one in Japan who has studied algebras under N. Jacbson, including Lie algebra, who does not know the books of N. Jacobson or the research field that are related to those of his doctoral students. He was born in 1910 and died in 1999. As a representative algebra scholar of the 20th century, I think he is a person who should be long cherished and remembered. With him as a clue, I would like to untie the string of things and then to put them together again. (Broadly speaking, the history of algebra of the 20th century summarized and handed down to the 21st century.). The time has come when we, in the 21st century, discuss about the history of algebras of the 20th century.

I would like to return to N. Jacobson. As we can be seen in the summary of his biography, he was the president of the Mathematical Society of America (1971 -1973). He trained many doctoral students. He was an invaluable person with a balanced triple contribution in the area of education, research and social activities (academic societies) for over 40 years in the field of algebra. In the human society, it seems that this triality (=triple contributions) is important (in my opinion). I have decided to write not about the personality nor achievements of N. Jacobson but to find some clues through him, as to why there are but few scholars of Jordan algebra in Japan. Of course, there is no conclusion to this question.

I believe that it is important that a common space of conceptualization of sharing of emotion (consciousness) is transmitted from teachers to students, because, again, one of the important elements is to pass down this conceptualization from teachers or students. I repeat that one of the important elements is this transmission of historical conceptualization from teachers or from those who came before us.

Few Japanese mathematicians know the terms and definitions of Jordan algebra although they might know the word and definition of Lie Algebra (I think some physicists know it in terms of quantum mechanics.). The 1934 papers of Jordan, Wiener, and Neumann are especially well-known. Also, Jordan algebra is related to Jordan triple system known as the fundamental formula of physics (called the Nambu identity)

$$\{ab\,\{cde\}\} = \{\{abc\}\,de\} - \{c\,\{bad\}\,e\} + \{cd\,\{abe\}\}$$ (definition of generalized Jordan triple system)

and is useful for the construction of Lie Algebras and Lie superalgebras in connection with the definition of the Jordan ternary system. Although there have been recent studies on these constructions by the author and D. Mondoc (cf.doi:10.1142/SO 219498820502230), for earlier references of the constructions, see the reference of this article, however the constructions are far from the subject of mathematical history, so I will talk about them on another occasion.

By the way from a viewpoint of history, even though the quaternion number is well known, there are few people who know that a Cayley number is an alternative algebra, and that the early publications (paper) of E. Artin (1898 -1962) who was famous for algebraic number theory are in this subject. Hence I will give propositions as a reference and then I will present the several definitions and historical mathematics results in nonassociative algebras.

Proposition ([E. Artin]): The subalgebra generated by any two elements of an alternative algebra is associative.
We define a commutative Jordan algebra over a field to be a commutative algebra in which the Jordan identity

$$(xy)x^2=x(yx^2). \text{ (Jordan identity)}$$

An alternative algebra is defined by the identities

$$x^2y=x(xy) \text{ and } yx^2=(yx)x. \text{ (alternative law)}$$

A Jordan triple system endowed with a ternary product {xyz} is defined by the identities

$$\{xy\{abc\}\}=\{\{xya\}bc\}-\{a\{yxb\}c\}+\{ab\{xyc\}\}. \text{ (fundamental formula)} \quad \textbf{(1)}$$

and

$$\{abc\}=\{cba\}. \text{ (commutative formula).} \quad \textbf{(2)}$$

Remark: The Jordan algebra is induced from the alternative algebra with respect to the new product $x\cdot y=\frac{1}{2}(x\,y + y\,x)$, where the right hand product is the alternative product.

Remark: By means of the Jordan algebra (or the Jordan triple system), we can construct simple Lie algebras (called a TKK construction).

Proposition ([O. Loos]): Let J be a Jordan triple system, which satisfies the extra ansatz of an element e ∈J such that {exe}=x for any x ∈ J. Then the homotope algebra $J^{(e)}$ with the bilinear product defined by x·y={xey} is a Jordan algebra with e being the unit element of $J^{(e)}$. Conversely, if A is a unital commutative Jordan algebra, then the triple product {xyz} given by {xyz}=x(yz)-y(xz)+(yx)z defines a Jordan triple system, that is it satisfies the identities (1) and (2).

Examples: By $\{xyz\}=x^t y z+z^t y x$, for any x,y,z ∈ Mat (m,n;R), where ${}^t y$ denote the transpose matrix of y, this product is a Jordan triple product. Also, let V be a vector space with an inner product <x,y>, then by the ternary product {xyz}=<x,y>z+<y,z>x-<z,x>y, where <x,y> is a symmetric bilinear form, this product is a Jordan triple product. Thus V is a Jordan triple system.

In come back on history: Why are there but few researchers of Japan in the alternating algebra and Jordan algebra? I can think but that it is God's mischief (Rather exaggeratingly).

On the other hand, there is a German book entitled "Jordan algebren" written by H. Braun (1914 -1986) and M. Koecher (1924 -1990) , based on the early papers of E. Artin, who was born in Germany, and lived in the United States and returned to spend his last years in Hamburg. However, with respect to the book, it seems that there are only a few readers. (Because, more specifically in Japan). However, it is an interesting book for the general reader where Cayley number is used as the book "number" edited by M. Koecher and R. Hirzeburch (1927-2012) et.al. Personally, I have talked with H. Braun about E. Artin at the Oberwolbach Institute (1982 summer) where she shared the last years of E. Artin in Hamburg. Her collaborative research works with Carl L. Siegel during her younger times are archived on quadratic forms into sums of squares.

On the other hand, in Germany, M. Koecher had fostered many doctoral students in mathematics, such as W. Kaup, O. Loos, W. Hein, U. Hirzeburch (he is a brother of F. Hirzeburch), J. Dorfmeister, K. Meyberg, and E. Neher, just like N. Jacobson. For example, O. Loos is working in characterization of algebraic features of symmetric space, K. Meyberg, E. Neher, and I are close in this field of research. Therefore I would like to write about my personal friendship with Koecher's students and exchanges with them through international scientific conferences as a page in history sometime in the future.

In my opinion, the following scheme can be understood as an extended concept of numbers:

R (real number) → C (complex number) → H (quaternion) → O (octonion) →H_3 (O) (27 dimemsion of Jordan algebra) → M (H_3 (O)) (56 dimension) → E_8 (248 dimension of Lie algebra)

This approach can be found in the research works of Jacobson's students, associated with Jordan algebra (including 27-dimension exceptional type) appearing everywhere. Also Takuro Shintani (1943-1980) seemed to have been interested in this 27- dimensional algebra.

It is mentioned in the list of doctoral students of N. Jacobson that M. Racine, a quadric Jordan algebra researcher and currently at University of Ottawa in Canada told me at a private dinner during an international conference that he had advised under Tsuneo Tamagawa (1925 -2017) while at Yale. What I thought was that both Shintani and Tamagawa seemed to have been interested in Jordan algebra (in relation to a symmetric Riemann space or an automorphic form of the Jordan algebra constructed from 27-dimensions). Of course, Ichiro Satake (mentioned later) of the Satake diagram had dealt with extensively about this subject of the algebra.

If you go back a little (100 years ago), into history to the quaternion, you can see that Syunkiti Kimura (1866 -1938), son of Admiral Kaisyu Kimura of the Imperial Japanese navy during the end of the Edo period, this S. Kimura acquired a degree of Ph. D in 1896 at Yale University in the Meiji period, under J.W. Gibbs of Yale Univ., who introduced the symbol ×, • (outer product and dot product) in relation to electromagnetic science and S. Kimura had left many publications, lectures and books on quaternions.

Aside from recent books (21 century), there are many people who have written books on the Lie algebra, in Japan such as Mitsuo Sugiura, Ichiro Yokota (Lie group), Gaishi Takeuchi, Yozo Matsushima, Morikuni Goto, Shigeaki Togo, and Nagayoshi Iwahori, but few people in Japan have written books on Jordan algebra.
N. Jacobson told me that "I sent Iwahori many papers on Jordan algebra, but he wasn't interested, although you (author) are different...”

As for books by Japanese, starting from Ichiro Satake (1927 -2014) who wrote a series of articles on Jordan algebra that were published in the "Science", and there are also books on “Hermitian Jordan Triple System and symmetric bounded Domain” Princeton Univ. Press,1980, (English version), Lie Group and Lie Algebra (Japanese version). From a friend of I. Satake, I had heard I. Satake talk as follows; “The Jordan algebra is more easy and simple than the Lie algebra.”

On the other hand, there is a key person in mathematical physics. “Introduction to Octonion and other non-associative algebras in physics “Cambridge University Press, 1995, (This book is on Mathematical Physics related to octonions) written by Susumu Okubo (1930-2015) is important. He is a mathematical physicist and a recipient of Nishina Memorial Award, with whom I have carried out much joint research (triple systems and triality relations, etc.). There are a couple valuable books ‘Okubo’, Satake’s books in the area of non-associative algebra by Japanese in the end of 20th century. Next to readers of general elementary mathematics there is a book "Introduction to Super Complex Numbers" written by L. Kantor (1936–2006), a Russian-born mathematician (Lund University in Sweden since 1990s). The book is translated in Japanese by Hisahiro Kasahara under the supervision of Hiroshi Asano. The content of the book is centered on Hurwitz's theorem, which describes the features of a norm algebraic system that satisfies $||xy|| = || x || \cdot ||y||$ (with the property of a composition algebra). On the personal side I have also co-authored a paper with Kantor and I had invited him in Japan (2003, Sep.-Dec).

In this note, please forgive me if because of my shallow learning, if there are many points that have been omitted from my remarks, I would like to add them some day.

Moreover, the fact that there are hardly any Japanese researchers who have studied for a long period under N. Jacobson or who have obtained degrees under his doctoral students is also one of the reasons why this field, especially the Jordan algebra, has not been actively discussed in Japan. In other words, the transmission of the ardor of mathematics from teacher to students has not been established in this field especially in Japan. (This is my own perception from the knowledge I have, so please forgive me again if there is any oversight.).

The history of this field of mathematics might have been quite different if the son of Yoshishige Abe (1883-1966) which was a minister of Ministry of Education, Makoto Abe (1915-1945), who was born in the same period as N. Jacobson lived a little longer. I say this because a paper in the field of Lie algebra written during the World War II exists as his posthumous work. And so if he had lived to continue his work in this field a little more longer, he might have given a contribution to the research and development of this field in Japan. Furthermore had he nurtured his own doctoral students the situation might have changed in this filed.

Also Hidehiko Yamabe (1923-1960), who contributed to the solution of Hilbert’s fifth problem spent most of his research days in the U.S.A., is also one of the mathematicians who died young. I do not think he has left any doctoral students of his own in Japan.

Why are there few researchers of Jordan algebra (or non-associative algebra) in the Japanese mathematical world? This is a strange phenomenon, as this is a field that is studied world-wide, except Japan, for in the western countries, for example, as Germany (M. Koecher etc.) as typified by Zelmanov from Russia and University of Novorvilsk (the university from where Malcev’s doctoral students had graduated), and the Univ. had created nonassociative algebra’s mathematicians. If I may add, in the Lie algebra that V. G. Kac, famous for the Lie superalgebra and Kac-Moody algebra, was also born in Russia and is active in the U.S.A.

I think the aspect of history, including mathematics, changes depending on which field you discuss. This time, however, I would like to take a look at the people who played an active role mainly in the 20th century, from a certain perspective based on their positions in the field of study (non-associative algebraic system), especially from the 20th century algebra with respect to scholar N. Jacobson. And I (author) emphasize that the situation in Japan could only be said as a "God's mischief".

However I apologize for many fragmentary information and I would like to talk arbitrary expressions trying to describe the germinative aspects of this field in Japan, which conveys the history of mainly nonassociative algebras in the latter half of the 20th century. Therefore, I have included a few references in this note as I tried to make it as self-contained as possible, and therefore I have not cited any prior research or references.

Again, I would like to ask why there are so few researchers in this field (non-associative algebra, especially Jordan algebra) in Japan, and I hope that this will lead to a clue as to find the cause of this problem. I have provided a short history that includes a few, mathematical topics with originating from N. Jacobson and also personal thoughts. There might be some mathematical, historical errors and misunderstandings I would be delighted if this will be the first step for our future considerations.

To sum up, with a dream of writing the history of the certain field of algebra of the 20th century (non- associative algebras) I have tried to present this short paper (focusing mainly on books) by weaving N. Jacobson's work, especially Jordan algebra as the vertical thread and Japanese researchers as the horizontal thread, with the hope that it will be a help in germinating the seed of further discussion.

7. CONCLUSION

In final comments, we note that this paper is a mathematical history that contains a personal matter but of course that based on true subjects, and is a new innovation.
The end of this note, please reaffirm that the personal, fragmented association that float in my mind is far from the conclusion of why researchers are scarce in Japan, and that it manifests itself as the presentation of a means of such description with an aspect of personal history.

8. REFERENCES

The references are written in to this paper.

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