SCIENTIFIC SESSION ON THE OCCASION OF 150TH ANNIVERSARY OF AGRICULTURAL CHEMISTRY IN POLAND

In 1969 the 150th anniversary occurred of publishing in Wilno the first book by Michał Oczapowski *Principles of Agricultural Chemistry*. On this occasion, by the Committee on Soil Science and Agricultural Chemistry, Polish Academy of Sciences, the Scientific Session under the motto "Agricultural Chemistry and Fertilizer Industry in the Fight for Further Intensification of Agriculture in Poland" was organized on 20–21 May 1970.

The Session was devoted to the achievements of the Polish science in the domain of agricultural chemistry within the period 1819–1969. It was held in the Staszic Palace in Warsaw, comprising about 200 participants, under the chairmanship of Prof. Dr. Dr. h. c. Kazimierz Boratyński and Prof. Dr. Tadeusz Lityński.

On the third day of the Session its participants visited the Nitrogen Trust at Puławy (one of the greatest in the world) and the exposition organized by the Institute for Soil Science and Cultivation of Plants. The exposition presented the publications on agricultural chemistry and the development of fertilizer industry in the 25th anniversary of the Polish People's Republic.

In the present issue the reports delivered during the Session are published *in extenso*.

T. LITYŃSKI

150 YEARS OF AGRICULTURAL CHEMISTRY IN POLAND

Summary

The author presents the development of agricultural chemistry in Poland, since the appearance of the first manual of Michał Oczapowski, professor of the Department of Agriculture, University in Wilno, entitled *Principles of agricultural chemistry* in 1819, up to the present day. Te draws attention to the valuable work
of Emil Godlewski, "Description of my own experiments on absorption properties of arable soil and survey of works carried out in this scope", edited in 1879 by Gazeta Rolnicza (Agricultural Journal). This work initiated many investigations in the domain of agricultural chemistry, first at the Agricultural Academy at Dublany, then at the Agricultural Department of the Cracow Jegellonian University, and since 1906 at the Warsaw College of Agriculture. Particular services to the development of agricultural chemistry in Poland in the period up to World War I were rendered, besides Emil Godlewski, by Stefan Jentys, Józef Mikulowski-Pomorski, Bronisław Niklewski, Adam Prażmowski, Helena and Seweryn Krzemieniewski.

From 1918, the year of regaining independence by Poland, the second period of the development of agricultural chemistry in Poland begins with an enlargement of existing research centres and organization of new ones in Poznań and Wilno. Besides the works of former scientists, there appear the works of Jan Żółciński and Arkadiusz Musierowicz in Lwów, Władysław Vorbrodt in Kraków, Marian Górska in Warszawa, Feliks Terlikowski in Poznań, and others. In the interwar period 1918—1939 the organization of a national fertilizers industry begins.

In 1939—1945 not only a standstill in the normal activity of colleges and of the Agricultural Institute at Pulawy takes place, but also material and personal losses occur in consequence of the invasion of Nazi armies into Poland and subsequent persecutions and martyrology of the Polish scientists, including many agrochemists, after their imprisonment in concentration camps.

In the post-war period 1945—1970 there begins not only the recovery of the country, gravely destroyed during the war activities, but also a broad extension of the network of academic schools, particularly in the regained western and northern territories, in Wrocław, Szczecin and Olsztyn. The fertilizer industry regenerates; its dynamic development allows supplying agriculture with higher and higher amounts of mineral fertilizers, contributing to systematic yield increases. The provincial agrochemical stations prepare an inventory of soils of the whole country as far their reaction and abundance in nutrient elements are concerned, which makes possible a more reasonable fertilizer application. In the colleges of agriculture and at the Pulawy Institute research of a basic and scientifc-agrotechnical character is carried out in all branches of agricultural chemistry, constituting an important contribution of Polish science to the world scientific output. Much of this work is applicable in agricultural practice, which finds its expression not only in yield increases, but also in economic profits, in work organization, etc.

Rich post-war literature in the scope of agricultural chemistry, represented by various scientific publications of the Polish Academy of Science and by those printed in the Roczniki Gleboznawcze — the periodical of the Polish Pedological Society, allows to estimate positively the achievements of agricultural chemistry in the 25th anniversary of the Polish People’s Republic.

Besides the papers of a strictly scientific character, also pamphlets, leaflets, articles, etc. were published for possibly quick transmission into agricultural practice of new achievements in the scope of soil fertility and fertilization.

The achievements of agricultural chemistry in the post-war period are to be estimated the more positively, as they were obtained within a short time, with a relatively insufficient outfit of scientific laboratories and a small number of technical workers. A considerable increase in laboratory equipment, an improvement of the ratio between scientific and technical workers and a more collective than hitherto elaboration of selected research problems, will enable to raise the Polish agricultural chemistry to a still higher level.
**B. ŚWIĘTOCHOWSKI**

MICHAŁ OCZAPOWSKI AND HIS MERITS FOR DEVELOPMENT OF AGRICULTURAL SCIENCE

**Summary**

A prominent personage in the agricultural science in Poland was Michał Oczapowski (1784–1854). His influence on Polish agriculture covered the whole XIXth century. He was a pupil and follower of A. Thaer, particularly of his agronomic and economic views. Being a university professor, he published, nevertheless, his works with concern for practical agronomists, among whom he had very many followers.

At the end of his pedagogical activity, he published the work "Gospodarstwo wiejskie" (Husbandry), in which he presented contemporary views in the agricultural science as a whole. These views proved, that Oczapowski was a precursor of many later agronomic ideas, e.g. of shelterbelts, as well as such agricultural disciplines, as ecology, weed biology, crop rotations, etc.

In the article a broad presentation of scientific and didactic achievements of M. Oczapowski is given. It ends with the appeal to publish, on the occasion of the jubilee year of this scientist, his 16-volume work "Gospodarstwo wiejskie", while providing every volume with the commentary elaborated by the respective specialists.

**M. KOTER**

MICHAŁ OCZAPOWSKI AS A CREATOR OF AGRICULTURAL CHEMISTRY IN POLAND

**Summary**

In 1819 there appeared in Wilno the first manual on fertilization in the Polish language, written by Michał Oczapowski. It was the second manual in this domain in the world after the "Elements of Agricultural Chemistry" by H. Davy.

Its author was a prominent personage of those days, who exerted an economic influence on several generations of agronomists. His views Oczapowski proclaimed not only from the Chair of Agronomy, University in Wilno and upon its closing as the professor of the Agronomic Institute at Marymont near Warsaw, but also as an indefatigable popularizer of agricultural science among practical agronomists. His books and articles enjoyed a high recognition and some of his main views are actual up to now. Certain definitions introduced by this scientist are valid still nowadays.

Therefore, a demand has been put by the reporter to elaborate the scientific heritage of Oczapowski.
CONTRIBUTION OF POLISH PHYSIOLOGISTS TO STUDY ON PHYSIOLOGIC FUNCTIONS OF MACRO- AND MICROELEMENTS

Summary

The contribution of Polish physiologists to the study on physiologic functions of macro- (potassium, phosphorus, nitrogen) and microelements in higher plants is presented in the article. It has been stressed that the respective study was initiated in Poland (on the turn of XIX/XX century) by so-called Cracow school with Godlewski at the head. Consequently he must be regarded as a pioneer of the study in Poland on the role of the above nutrients in plants. Also the merits of Prażmowski (and of Krzemieniewskis) have been stressed in investigating the problem os symbiotic and asymbiotioc nitrogen fixation.

Also the contribution of Polish biologists to the general output of the investigations of microelements is discussed in short, at which it has been stated that the Polish achievements in this scope are rather scarce ones.

PHYSIOLOGIC INVESTIGATIONS IN POLAND ON IMPORTANCE OF HUMIC COMPOUNDS FOR PLANT ORGANISM

Summary

The works on physiologic effectiveness of humic compounds have been started in Poland by S. and H. Krzemieniewski at the beginning of the present century [36, 37, 38]. The investigations concerned importance of the above compounds in the \( \text{N}_2 \) fixation process by \textit{Azotobacter} (1908—1909). They were continued by Prażmowski [58], Kotkówna [34], Bassalik and Neugebauer [1, 2], Krzemieniewski and Kovacs [39, 35], Kostecka [33] and Duda [12].

The effect of humic compounds on yeasts was studied by Dzierzbicki [13], Gumiński and Gumińska [22], Badura [4, 5], Gumiński and Sulej [28].

The effectiveness of these compounds in relation to algae constituted the subject of investigations of Gumiński [19, 20] and Kyć [40].

Depending on concentration of humic compounds, either favourable or inhibiting effect on growth of the microorganisms investigated was found, at different susceptibility of particular species. It has been found that this effect consists principally in regulation of uptake of metallic cations by microorganisms.

Broad investigations on effect of humic compounds on higher plants was carried out by Niklewski with his co-workers and pupils in 1927—1948. Plant growth stimulation in water and sand cultures [48, 45, 49, 50, 52, 53], uptake intensification of mineral salts — Pastewski [56], Niklewski and Wojcie-
chowski [46, 53], Wojciechowski and Kuźdowicz [70], Duda [11], have been stated. Wojciechowski [69] proved that humic compounds as if substituted iron on chlorophyll forming process in leaves. Niklewski, Brodowska, Kahl and Dydo [47] as well as Niklewski and Wolnicka [54] observed a chemotropic action of these compounds on roots. Niklewski, Wojcikówna and Pestka [55] reported about a favourable ("euphietic") effect on growth of an isolated root.

Gumiński [20] investigated effect of plant substrate factors on biologic effectiveness of humic compounds. He has found that their favourable effect is visible only in non-aerated water cultures, while at aeration this effect disappears. This action is connected with physico-chemical properties of the above compounds and not with accessory substances [22, 23]. The effect consists mainly in regulation of iron uptake by roots [26, 9, 10]. Humic compounds prevent, blocking iron by bicarbonates [27, 7].

The effect of root respiration was investigated by Gumiński, Czerwiński, Unger and Bacowa [24] and that on seed respiration — by Gumińska [15] and Mielnik [44].

The effect on symbiosis of legumes with nodule bacteria was investigated by Brodowska-Dworakowska [8], the mechanism of this phenomenon — by Tatkowska [63].

The effectiveness of different fractions of humic compounds was studied by Trojanowski [67], Unger [68], Gumiński and Sulej [28].

On the whole, it has been proved that biological effectiveness of proper humic compounds is connected with their sorption capacity. Similar effectiveness has been proved in the experiments with brown coal by Lityński and Jurkowska [41, 42, 43] and Jurkowska [29, 30, 31], while Gumińska, Augustyn, Gracz and Sulej [17] have found an analogous biological effectiveness of humate obtained from brown coal as of that from compost and peat.

The results obtained were applied in the practice for improvement of hydroponic cultures [16, 17] and for Cyanophyceae algae control in aquaria [62].

Some biologically active substances, not closely recognized hitherto, have been found in peat extracts by Rafiński and Fojudzki [60] as well as by Tolpa and Czyżewski [65, 66]. In the former case bacteriological properties, in the latter one — those stimulating or strongly inhibiting plant growth, have been described.

K. WILK

MORE IMPORTANT STUDIES ON HUMUS IN POLAND

Summary

More important studies on humus of Polish soils are discussed. An attention is drawn to the necessity of working out an objective method of soil preparation for analysis, what is of particular importance for investigation humus dynamics.

In the light of works of the Polish authors, the C:N ratio is not a criterion of humus quality, nor any typologic index of soil; its value depends to a considerable degree on careful separation of plant parts from soil.
In the Polish agropedological laboratories different methods of determining particular humus fractions are applied, what makes that the results obtained cannot be comparable. In this connection an urgent need exists of developing one or at most two methods of humus content determination, ensuring comparability of the results.

Long-term fertilizing experiments carried out both in Poland and abroad, have shown that organic fertilization distinctly increases humus content in soil. Also mineral fertilization causes a slight humus content increase as compared with non-fertilized soil. The humus content increase in soil under influence of fertilization is not accompanied by adequate crop yield increments. Thus a need exists of developing new research thematics taking into account humus role in crop yield forming against the background of an intensive mineral fertilization.

Also an attention is drawn to purposefulness of using more exact nomenclature of humus compounds, as under the notion of humus not the same compounds are meant by particular authors, what leads often to misunderstandings.

L. KUSZELEWSKI

ROLE AND IMPORTANCE OF DUNG IN INTENSIFICATION OF AGRICULTURE

Summary

In conditions of chemization of agriculture there increases the amount of organic fertilizers and the role of organic matter contained in these fertilizers in improving soil conditions, i.e. bringing them to a favourable state for an intensive plant nutrition. Simultaneously, mechanization and specialization of agricultural production make necessary introducing the methods of modern management of organic fertilizers, particularly of dung. This management must take into account:

— simplified technology,
— facility of mechanization,
— full hygiene.

In the perspective of further fertilization development in this country, dung will continue to be a great source of various nutrients for plants as well as a main source of trace elements. It suggests a necessity and purposefulness of investigations on trace elements circulation in agriculture within the schema: livestock feeding — fertilization of crops and their balance agriculture.

There increases more and more the role and importance of dung in forming physical, chemical and biological properties of soil. Owing to a complex action of organic fertilizers, even in conditions of a high chemization in the domain of fertilization, the highest and the most stable yields can be obtained at parallel application of organic and mineral fertilizers. Hence a basic problem would be recognition of action and interaction of organic and mineral fertilizers in increasing yields. In particular, the point is to recognize the effect of organic matter of organic fertilizers on plant nutrition as well as on quantity and quality of yields, in conditions of already weak or even negative effect of high mineral fertilization rates.

Moreover, the advance and modernization of agriculture make necessary to simplify and mechanize the whole organic fertilizer management, and particularly
that of dung. In this scope, beside of a number of occasional methods, the highest effects would ensure a litterless cowshed and liquid dung production.

Z. GONDEK

FERTILIZER INDUSTRY DEVELOPMENT IN POLAND

Summary

Although the first fertilizer plants were created in Poland as early as at the end of the last century, the use of fertilizers in this country was low up to the world war II, and consequently the fertilizer industry development was slow as well.

In the post-war period a rapid recovery and enlargement of the fertilizer industry begins, basing on the technologies known in the interwar period. The ammonia production was based principally on coke, the main assortment of phosphorus fertilizers being simple superphosphates.

Only within the last decade an enlargement of fertilizer industry begins, on the basis of modern technologies. The ammonia production was developed basing on earth gas. A huge ammonia plant has been built at Puławy, with the production capacity of 3000 tons per day, the building of another plant at Włocławek with the capacity of 1500 tons per day is near completion.

The total ammonia production in 1970, including that of parallely enlarged old nitrogen plants at Kędzierzyn, Tarnów and Chorzów, reached the level of 5.3 thou tons per day, what means threefold increase within the last 5 years, with further increase up to 6.8 tons per day by 1973.

To increase the production of phosphorus fertilizers, two plants of triple superphosphate in Gdańsk and ammonia phosphate at Police have been built simultaneously. The production capacity of these plants, upon completion of the Police plant about 1973, will be approximately 600 thous. tons of P₂O₅. The total production of phosphorus fertilizers, including old simple superphosphate plants, will be over 1 million tons in 1974–1975.

In the fertilizer industry development within the last few years two basic trends can be observed:

— steady increase of production capacity of the aggregates,
— concentration increase of the produced fertilizers, at transition from single to complex fertilizers.

Thus, the first ammonia plants at Kędzierzyn created after the war, had the production capacity of 80 tons per day, while the actual capacity of the plant at Włocławek is 750 tons per day.

If still 10 years ago there prevailed in Poland the fertilizers with concentration of about 20% of pure element, so at present mainly 34%/N-saltpeter, 48% P₂O₅-triple superphosphate, ammonia phosphate with 64%/content of pure fertilizer elements, are being produced.

The fertilizer industry development ensures to a full extent the Polish agriculture requirements of nitrogen and phosphorus fertilizers. Potassium fertilizers are fully imported, as there is a lack in Poland of own potassium salt deposits suitable for industrial exploitation.
The application of mineral fertilizers is increasing systematically, reaching the following values in kilograms of pure element per 1 hectare of agricultural lands:

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>7</td>
<td>13</td>
<td>13</td>
<td>27</td>
</tr>
<tr>
<td>1960</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>37</td>
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<tr>
<td>1965</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>58</td>
</tr>
<tr>
<td>1970</td>
<td>46</td>
<td>59</td>
<td>59</td>
<td>141</td>
</tr>
<tr>
<td>1975</td>
<td>67</td>
<td>79</td>
<td>79</td>
<td>200</td>
</tr>
</tbody>
</table>

Irrespective of covering home requirements considerable quantities of nitrogen fertilizers are being exported.

In 1972—1973 the broad program of fertilizer industry development will be completed. It should ensure the level of crop yields satisfying to a full extent the home requirements. Further development of this industry branch will run more moderately. The industry will be concentrated upon constant improvement of the assortment — principally by production of complex fertilizers.

J. GÓRALSKI

NITROGEN AND NITROGENIC FERTILIZATION-RESEARCH

Summary

The theses on mineral nutrition of plants, proclaimed by Liebig, had found a quick response in the Polish science. As early as in 1848 Michał Oczapowski declared himself as a Liebig’s opponent, nevertheless he related to his theses with a great deal of objectivism and expressed the opinion that, if the theses of Liebig proved to be a correct ones, a radical change not only in agriculture, but also in social relations would take place.

The experimental works according to Liebig on mineral nutrition of plants started in Poland as early as in 1846/1847, and the results of field experiments were published in the volume XVIII of the Rocznik Gospodarstwa Krajowego (National Economy Annual) in 1851. In this experiment winter wheat sown in rows, fertilized with the rates of 300 and 600 tons of farmyard manure per hectare, was compared with wheat fertilized with ash from the same farmyard manure rates. It has been found by the author that the wheat sown on the incinerated farmyard manure in vicinity of the plots fertilized with farmyard manure made use of nitrogen of the non-incinerated dung.

In 1859 the Committee of Agricultural Society had organized a laboratory, the task of which consisted in carrying out chemical analyses of soils and fertilizers.

In 1863, after suppression of the Polish insurrection in the Russian occupation zone the activity of Agricultural Society including that of the mentioned laboratory was stopped by the tsarist authorities.

In 1890 the Agricultural Study of the Cracow University was allowed an area for an experimental field near the Cracow city. In 1894 a permanent fertilizing experiment was established in 4 replications within the scheme: CaNPK, unfertilized,
NPK — N in the form of ammonia sulphate, CaNK — N in form of Chile saltpeter as well as CaNK — N in form of ammonia sulphate. The rates per hectare amounted to 90 kg N, 50 kg P₂O₅, and 52 kg K₂O. The experimental plants constituted in the consecutive years: wheat, rye, potatoes, barley, wheat, sugar beets. In the view of wheat lodging in the first year, nitrogen was applied at the rate of 35 kg per hectare in the subsequent years.

In 1895 began the activity of the Station of Agricultural Chemistry at Dublany near Lwów, where fertilizing experiments and fertilizer analyses were carried out. For cereals the rate of 25 kg N per hectare were applied.

Also in the German occupation zone fertilizing experiments were carried out, but without any participation of Polish scientists.

In the interwar period in two chemical plants in Poland nitrogen fertilizers were produced, their peak consumption amounting in 1928/1929 to 2.8 kg N per hectare. The world-wide crisis checked, and even lowered the consumption of mineral fertilizers. A certain improvement of the situation took place close before the world war II. After the war, in view of enormous destructions in the fertilizer industry, the Polish agriculture was supplied in the first years only with the amounts of slightly more than 30 000 tons of nitrogen. At the same time also ammonia aqua as a nitrogen fertilizer began to be introduced. A gradual reconstruction of the former plants and building of new objects, like the plants in Kędzierzyn and Puławy, has brought about that the Polish agriculture is being supplied from year to year with increased nitrogen amounts. In 1969/1970 the consumption per hectare was somewhat more than 40 kg N, while for 1985 the consumption of about 90 kg N is envisaged. Poland, as the first among the European countries, has started the fertilizer urea production, being further on the greatest producer of this nitrogen form in Europe.

A. WONDRAUSCH

STUDIES ON PHOSPHORUS AND PHOSPHATE FERTILIZERS IN POLAND

Summary

In the paper a review of studies on phosphorus and phosphate fertilizers carried out in Poland is given. This review concerns all studies on fertilization, physiology of plant nutrition, soil science and determination methods of phosphorus.

Besides few papers published by the end of the 19th century, this review comprises those papers published between the two World Wars and after the last war up to 1968 including.

M. KOTER

POTASSIUM FERTILIZERS

Summary

The discovery in the first decade of the XIXth century of potassium salt deposits in the Podkarpacie region did not evoke any greater interest of the Austrian authorities ruling this territory after the Poland's partition. The Austro-Hungarian

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M. KOTER

POTASSIUM FERTILIZERS

Summary

The discovery in the first decade of the XIXth century of potassium salt deposits in the Podkarpacie region did not evoke any greater interest of the Austrian authorities ruling this territory after the Poland's partition. The Austro-Hungarian
monarchy, besides, retarded quite intentionally the industry development in the whole Galicia. This state was also influenced by the German "Kalis syndikat" not wanting any new rival in Europe. Therefore, the first attempts of creating an enterprise for potassium salt deposit exploitation failed, and only in 1913 the Polish specialists succeeded in establishing a joint stock company in Lwów, which took over exploitation of the deposits Kalusz from ephemeral companies.

The activity and development of this joint stock company were checked to a considerable degree by the world war I. The restituted Polish state transformed this company in 1920 into the Potassium Salt Exploitation Co., called in abbreviation TESP. The task of this new enterprise was, first of all, to supply Polish agriculture in potassium fertilizers. The production of these fertilizers was closely connected with the general economic situation of the country. In 1928, in the period of prosperity, 42,513 tons and in 1932, during the world crisis — 14,754 tons of K₂O were produced by the TESP.

In the group of chlorine fertilizers 10—14% kainites and 20—40% potassium salts were produced. Some parties of these fertilizers applied for sugar beets were enriched in boron (by addition of 1—2% borax).

Among sulphate fertilizers so-called kalimag — 12% K₂O and 18% MgO, and kalimagnesium — 26% K₂O and 55% MgSO₄, were produced.

A part of the above fertilizers was exported, particularly after proving by the scientists' team that they are of equal effectiveness and often even better that the fertilizers of the "Kalis syndikat".

After the world war II the Podkarpacie region with the potassium salt deposits lies outside the Poland's frontiers. Therefore, immediately after liberation intensive geological explorations began, which proved the occurrence of potassium salt deposits in several regions of the country. Among the exploration results obtained the karnalite deposits at Kłodawa deserve attention, the common salt and kiserite layers. However, the salts from these deposits contain only 7—9% K₂O and are very hygroscopic, and for this reason are not suitable in raw state for fertilization purposes. They can, of course, be processed into more concentrated products.

Also near the Baltic coast, in the vicinity of Puck, several polyhalite nests have been discovered. They contain 12—15% of K₂O. Fertilizing value of the salts gained from these sources is fairly high, the more that they contain also magnesium and sulphur.

On the whole, it can be stated that eventual exploitation of the above potassium deposits will be too expensive.

Besides of geological sources, in supplying agriculture with home potassium, industrial wastes might play a certain role, particularly volatile dusts of quickly developing cement industry.

Intensive searches after home potassium sources are continued. For the time being, however, agriculture supply with potassium is based mainly upon export from the USSR and GDR.

The first Polish works on potassium importance in agriculture appeared in the second half of the XIXth century. Among few publications of this period, attention deserves the work of E. Godlewski, the prominent Polish plant physiologist, concerning potassium sorption by different soils and its importance for growth of plants [29]. The proper development of investigations in this domain started only after regaining Poland's independence, i.e. after the world war I. The number of works dealing with potassium problems considerably increased in 1930's, i.e. in the period of development of home potassium industry. Main subject of the respective ex-
The experiments consisted in determination of value of the produced potassium fertilizers and of their suitability for particular crops. An important role in this scope played the research centres under the guidance of Prof. Dr. M. Górski in Warsaw and Prof. Dr. F. Terlikowski in Poznań.

The experiments carried out have proved a high value of the Polish potassium fertilizers, what was an important argument in their propagation among the Polish farmers. The published works cleared for the Polish potassium industry the path for export, what was of great importance in conditions of those days. Many valuable indications were given concerning application of different fertilizer kinds for particular crops. Under influence of demands put up by the scientists the industry started to produce borated potassium fertilizers suitable for sugar beets as well as fertilizers with almost full lack of chlorine (kalimag) for such crops, as tobacco and hop.

Distinctly better action of raw potassium fertilizers than of concentrates has been found, what resulted in paying attention to the compounds accompanying potassium salts in mines. Also several works connected with potassium role in the life of plants have been published.

After the world war II a lack of own potassium industry compelled to more economic use of potassium fertilizers and to searches after new sources of this element. In this connection the investigations on fertilizing value of potassium salt deposits discovered after the war were carried out. Also the possibility of utilizing industrial wastes for fertilization purposes is studied. For this purpose a number of experiments on fertilizing value of volatile dusts of the cement industry were carried out. In this scope important services were rendered by the Cracow research centre under guidance of Prof. Dr. T. Lityński.

A separate group of investigations constitute the works aiming at determination of potassium content in Polish soils. An introduction to these works constituted methodical studies on developing the most suitable methods of available potassium determination in soil. The investigations on potassium content in soils have proved that the great majority if our soils require potassium fertilization, since only 7% of the soils are abundant in potassium. At attempts to raise crop yields the demand has been put up of increasing agriculture supply with potassium fertilizers, the deliveries of which are based almost solely on import.

Beside of academic centres, an important role in the respective works play provincial agrochemistry stations. Also physiological investigations on potassium role in sugar accumulation by sugar beets, potassium effect on nitrogen compounds of maize, transpiration of plants, accumulation of nitrates, etc., are continued (IUNG w Puławach).

While summarizing the scientific achievements in this domain within the last 25 years, the author stresses very strongly the need of creating home potassium industry.
1 — period up to the end of the world war I;
2 — interwar period;
3 — period after the world war II. In the first period the knowledge of principles and effectiveness of liming was based mainly on observations of particular farmers. Only at the end of this period experimental investigations were undertaken concerning effect of liming and influence of lime on phosphorus mobilization.

In the second period the works on liming were supplemented with basic investigations on soil acidity problems, which were facilitated very much by application of potentiometric acidity determination. Terlikowski had worked out the first soil acidity maps. Also the first numerous series of field experiments on demand and effects of liming were carried out. Suitability of furnace slag for liming was investigated, too.

In the third period, in connection with expansion of the research centres, establishment of provincial agrochemistry stations and organization of a network of field experiments, the investigations on soil acidity and liming underwent a significant widening. There have been worked out and modified the methods of investigation of potential acidity and reaction of soil, of lime fertilizer activity estimation, of determining calcium and magnesium content. The relationship between hydrolytic acidity on the one hand and reaction and mechanical composition of soil on the other has been determined. The influence of such factors on demand and effectiveness of liming, as mobile aluminium content, decalcification depth, intensity and kind of mineral fertilization was investigated.

The limestone and dolomite deposits as well as a number of industrial wastes were investigated from the viewpoint of their suitability for production of lime fertilizers.

By the provincial agrochemistry stations pH of soil of all agricultural lands and in a part of samples also hydrolytic and exchangeable acidity, were determined. The determination results have proved that about 70% of agricultural lands require liming.

About 2000 field experiments on liming effectiveness and values of particular lime fertilizers have been carried out. On this basis mean liming effectiveness in the first year and the subsequent years has been determined. At the experimental stations long-term experiments have been established, the results of which will constitute a base for working out a reasonable liming system.

The above investigations were used for setting up state plans of liming by 1970 and 1975, taking into account quantity and assortment of lime for particular provinces as well as organization of liming. The lime consumption by the Polish agriculture increased in the post-war period from 100 thousand tons up to 2 million tons, and in the next few years a further increase up to 3 million tons is foreseen.

L. TUchołKA

THE POLISH WORKS ON MAGNESIUM AND MAGNESIUM FERTILIZERS

Summary

The interest of Polish agricultural chemists magnesium arose mainly owing to investigations carried out after World War I on the value of low-percentual po-
tassium salts from the mines at Kalusz and Stebnik. These salts contained considerable amounts of magnesium and other by-components. In the latter ones the cause of better effect on plants of raw low-percentual minerals than that of concentrated salts was sought after. Among plants being investigated at that time only horse beans showed a positive response to magnesium, what lowered considerably the scientists' interest in this question.

However, in later years, close before World War II positive results in the scope were obtained with magnesium fertilization of sugar beets.

After World War II, in the 1950s, a considerable interest in magnesium took place. Numerous works carried out since that time till the present day can be divided as follows:

— works aiming to establish the methods on available magnesium determination in soils;
— works on abundance of Polish soils in magnesium;
— experiments with magnesium fertilization in different conditions;
— works on value of particular magnesium fertilizers originating from home sources.

Among the investigated methods, the most popular in Poland is the chemical method of Schachtschabel. This method is widely applied in stations of agricultural chemistry. However, there is questioned the boundary value of 5 mg Mg per 100 g of soil, assumed by Schachtschabel for light soils. This value, in opinion of many Polish scientists, would be too high.

The investigations on the abundance of Polish soils in magnesium have been carried out on a broad scale under participation of many research centres. The stations of agricultural chemistry, basing on the analyses of 300 thousand samples taken from an area of 2.7 million hectares, have found that 31% of soils are insufficiently provided with magnesium. In some provinces 50% of the investigated soils suffered from magnesium deficiencies.

In experiments carried out on soils poor in magnesium, yield increments have been found in most cases. For example, in rye an average grain yield increase resulting from magnesium sulphate application, amounted to 1.6 q/ha, at simultaneous liming — to 1.4 q/ha and at dolomite application, as compared with agricultural lime — to 0.82 q/ha. Moreover, the magnesium effect in these experiments fluctuates within a very wide range, viz. from a yield increase by 13.7 q/ha to a yield drop by 2 q/ha. It suggests that the magnesium fertilization should be considered in a complex way, against the background of some properties of soils used for the experiments, and the kinds of other fertilizers applied.

An attention deserve also the investigations on influences extracted by nitrogenic fertilizer kinds on requirements of plants with respect to magnesium. It has been found that these requirements are growing disproportionally to the ammonia and urea rates.

Thus the experiments being carried out in Poland on magnesium fertilization of crops show that, under certain conditions, it can result in considerable yield increments. Therefore, an exact inventory of the home sources of magnesium fertilizers has been carried out, including dolomites occurring on wide areas in Poland. Also dolomite offals of the metallurgical industry are taken into account. Concerning fertilization of non-acid soils, the utilization possibility of serpentinites or magnesites, occurring abundantly in Poland, is being considered.

Finally, it is to be noted that in investigation of fodder crops sometimes a magnesium excess occurs in meadow hay, as compared with the standard for good
hay. It is also an indication that the magnesium fertilization grows more and more important in Poland.

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TRACE ELEMENTS — DEVELOPMENT OF RESEARCHES AND PRESENT STATE IN POLAND

Summary

The first field experiments on magnese fertilization were carried out in Poland in 1910—1913. After the world war I few investigators of trace elements confined themselves to mainly magnese and copper applied for fodder, field and horticultural crops on peat.

In 1930-ies there appeared several works on boron in connection with comprehensive elaboration of the Polish potassium fertilizers.

Simultaneously a publication appeared on titanium content in some crops.

After the world war II, the trace elements were of only slight interest in Poland. The respective investigations were few and concentrated themselves upon boron, manganese and copper.

A broader interest in trace elements arose under the influence of Prof. Dr. A. Maksimov's publications, and particularly a detailed monography "Trace elements and their role in the life of organisms", published in 1954. In this period the investigations comprised, beside boron, manganese and copper, also zinc, molybdenum and cobalt as well as other trace elements. In the period 1951—1960 the total number of works on this subject amounted, to 114 and by 1968 increased by more then 200 items. The investigations having been carried out comprised: physiologic role of trace elements, their content in plants, experiments on trace elements as fertilizer components, as well as works listing these elements in soils.

Taking into account a considerable growth in use of mineral fertilizers in Poland, more frequent deficiencies of trace elements in plants and animals should be expected. Therefore, a need arises of research intensification in this domain. Particular attention ought to be paid to unification of the research methods, particularly on determination of the trace elements, to ensure comparability of the investigations.

In the scope of fertilization with trace elements particularly urgent are the investigations concerning meadows and pastures in view of the reported cases of animal diseases.

The investigations on soil abundance in trace elements are being carried out at the stations of agricultural chemistry, disposing of sufficient personnel and equipment. Therefore, it would be expected that the maps of content of at least certain trace elements in the Polish soils will be elaborated within the next few years.