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REPORT ON THE INTER-REGIONAL TRAVELLING SEMINAR ON THE PURIFICATION AND DISINFECTION OF DRINKING-WATER

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CWS/71.1

REPORT ON THE PROCEEDINGS

The Travelling Seminar was held in Moscow, Kiev and Leningrad from 6-28 May 1971, attended by 13 participants. In addition, over 40 doctors, engineers and scientists from the USSR assisted the Seminar by presenting papers, giving lectures, and explaining various plants visited during the Seminar.

The co-directors of the Seminar were Professor N. N. Trahtman, Doctor of Medical Sciences of the Central Institute for the Further Training of Physicians and Mr W. R. W. Ferguson, World Health Organization Consultant. The co-directors presided over the meeting on alternate days.

The Seminar was officially opened on 6 May by Dr A. V. Pavlov, Chief, Central Board of Sanitation and Epidemiology, Ministry of Health of the USSR, and closed by Dr Loransky, Deputy Chief Physician of the Central Board of Sanitation and Epidemiology of the Ministry of Health of the USSR.

As the title indicates, the purpose of the Seminar was to provide the participants with as much information as possible on the purification and disinfection of drinking-water with the ultimate object of making use of this information when they returned to their own countries. The information naturally emphasized the work done on this subject in the USSR. However, the participants themselves presented papers concerning the water supplies in their own countries so that there was a mutual exchange of information.

The subject was a very broad one and the various papers presented covered every aspect of drinking-water purification and disinfection, and also included such matters as water softening and fluoridation. In addition the question of purification and disinfection of waste water was also covered and visits were made to waste water purification plants.

Altogether, 24 papers were presented and 11 visits to works or laboratories were made. The papers not only dealt with the conventional methods of water treatment, such as coagulation, flocculation, sedimentation, filtration and chlorination, but also with methods used less frequently such as contact clarification and chlorination using sodium hypochlorite made by electrolysis on the site. Certain of the laboratory projects shown were still in the experimental stage and were not yet operating on a large scale, but were nevertheless of great interest.

The papers and visits evoked a large number of questions from the participants and these, in every case, were answered by the authors even when, as happened occasionally, the questions were outside the scope of the subject matter of the particular paper. In a number of cases charts were used to explain various systems; as these were in Russian, the participants asked for translations which were provided.

As the participants nearly all came from developing countries, the problems they have in their own countries were not always identical with those encountered in the USSR. For example, shortage of competent professional and sub-professional staff is one of the greatest problems in most of the developing countries, whilst this is not a difficulty in the USSR. Shortage of finance is another problem in all the developing countries and so the participants realized that the knowledge gained at this Seminar can only be partly applied in their own countries. The question of standards was raised early in the Seminar and the majority of the participants stated that, at present, their countries could not expect to be able to comply with either WHO or USSR drinking-water quality standards, although they might wish to attain them in the future. Nevertheless, they realized that the new knowledge they have gained can do much to help them to improve the drinking-water situation in their own countries.

It is not proposed in this part of the report to go into details of the individual papers and visits as summaries of them and the resulting discussions are attached.

Acknowledgement

Thanks are due to all those people within the USSR Government, the Ukrainian Federal Government and the Russian Federal Government and others who contributed so much to the smooth and efficient running of the Seminar which gave so much of interest and enjoyment to the participants. The hospitality extended to them was greatly appreciated, not only during the working periods. Their comfort was never neglected; transport and administrative arrangements were faultless and participants, whilst seeing many things of great interest to them professionally, visited places of historical and social importance, and were able to absorb much of the culture of the USSR.

LIST OF PARTICIPANTS AND SUPPORTING STAFF

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PROGRAMME OF THE SEMINAR

In Moscow

Thursday, 6 May	Opening of the Seminar by Dr A. V. Pavlov, Chief of the Central Board of Sanitation and Epidemiology, Ministry of Health of the USSR.
	"The Organization of the Sanitary Service in the USSR and the Tasks of the Sanitary Authorities in Sanitary Inspection of Water Sources and Water Supply" by Dr A. V. Pavlov.
Friday, 7 May	"Disinfection of Water by an Electrolytic Process" by G. L. Medrish, Candidate of Technical Sciences, Academy of Municipal Services.
	"Hygienic Aspects of the Disinfection of Water" by Professor N. N. Trahtman, Doctor of Medical Sciences, Central Institute for the Further Training of Physicians.
	"Desalination of Water" by V. A. Kljačko, Doctor of Technical Sciences, All-Union Institute for Research on Water Supply and Sewerage Systems, Hydraulic Engineering Installations and Applied Hydrogeology (VODGEO).
Saturday, 8 May	"Training of Sanitary Engineers and Waterworks Staff" by A. V. D'jackov, Chief Engineer of the Moscow Water Supply Installation.
	"Hygienic Aspects of Water Supplies for Centres of Population" by Professor S. N. Čerkinskij, Corresponding Member of the Academy of Medical Sciences of the USSR, Professor, First Moscow Medical Institute.
Monday, 10 May	"Coagulation and Flocculation, New Coagulants and Flocculants for Water Treatment" by Dr L. N. Paskutskaya, Candidate of Technical Sciences, Academy of Municipal Services.
	"Selecting Technological Projects for Treatment of Surface Water" by S. A. Shubert, Candidate of Technical Sciences, Academy of Municipal Services.
	"Treatment of Subterranean Water (removal of iron)" by Miss A. M. Perlina, Candidate of Technical Sciences, Academy of Municipal Services.
Tuesday, 11 May	Visit to the Eastern Waterworks, Moscow.
Wednesday, 12 May	"Certain Aspects of Waterworks Design" by V. I. Filippov, Chief Engineer, State Institute for the Design of Water Supply and Sewerage Systems.
	Visit to the Academy of Municipal Services.
	"New Trends in Perfection in the Process of Water Filtration" by Dr D. N. Mintz, Doctor of Technical Sciences, AMS.
Thursday, 13 May	"The Problem of Purification and Disinfection of Rural Water Supplies in Developing Countries and a Brief Review of Assistance given by the World Health Organization" by W. R. W. Ferguson, WHO Consultant.

"The Organization of Sanitary Inspection in the Protected Zones of the Moscow Water Supply Installation" by M. B. Trahtman, Sanitary Engineer of the Moscow City Sanitation and Epidemiology Centre.

"Improvement of Water Quality in Rural Areas" by E. A. Silin, Candidate of Technical Sciences.

Friday, 14 May

"Organization and Improvement of Water Supply Services in Rural Areas (using the Moscow Oblast as an example)" by P. M. Vindukov, Deputy Chief Medical Officer, Oblast SEC.

Visit to the Kuryanovskaya sewage purification plant. Description given by Mr Elya, Chief Engineer of the plant.

Saturday, 15 May

Visit to a rural water supply installation in the rayon of Odintsovo.

In Kiev

Monday, 17 May

Opening of the Seminar sessions in Kiev by Mr Ovshanikov. Description of work carried out at the Kiev Research Institute for General and Communal Hygiene by Professor Shandala.

"Hygienic Characteristics of Drinking-water Sources in the Ukrainian SSR and Requirements in Regard to Water Treatment" by Professor N. N. Kvitnitskaya, Doctor of Medical Sciences and Deputy Director of the Institute.

"Experience in using various Methods of Treating Drinking-water at Waterworks in the Ukrainian SSR" by Dr V. V. Tsapko, Candidate of Medical Sciences, Kiev Research Institute for General and Communal Hygiene.

Tuesday, 18 May

"The Theory and Practice of Water Fluoridation and Defluoridation in the Ukrainian SSR" by Professor R. D. Gabovitch, Kiev Medical Institute.

"Experience in Softening and Freshening Drinking-water at Waterworks in the Ukrainian SSR" by N. I. Omel'janec, Candidate of Medical Sciences, Kiev Research Institute for General and Communal Hygiene.

Wednesday, 19 May

"New Trends in the Technology of Treatment and Disinfection of Drinking-water" by Professor L. A. Kul'skij, Order of Technical Merit of the Ukrainian SSR, Member of the Academy of Sciences of the Ukrainian SSR.

"Sanitary protection of groundwater against Pollution with Waste Water" by Professor E. I. Goncharuk.

Country Reports:

"Water Supply Practices in Mexico" by Mr. E. Urróz J., Director, Water Pollution Prevention, Ministry of Water Resources, Mexico City.

"Thailand's Rural Community Water Supply Programme" by Mr P. Chulavachana, Sanitary Engineering Division, Department of Health Bangkok, Thailand.

Thursday, 20 May — Visit to the Research Institute of Colloidal Chemistry and Water Chemistry. Explanations given by Professor L. A. Kul'skij and Mr Rudenko, Candidate of Technical Sciences.

Friday, 21 May — Visit to the village of Tsybli, Kiev Oblast.

Saturday, 22 May — Professor Kvitnitskaya gave a brief explanation of the irrigation systems seen en route to Tsybli, followed by Professor Neinstein on work in the CWS and waste water fields in the Research Institute.

Country Reports:

"Water Supply Systems in Argentina" by Mr J. Savinic, Civil Engineer, Obras Sanitarias de la Nacion, Buenos Aires, Argentina.

"Water Supplies in Western Samoa" by Dr S. Ieremia, Chief, Division of Public Health, Apia, Western Samoa.

"Community Water Supplies in Malaysia" by Mr A. Sekarajasekaran, Senior Public Health Engineer, Ministry of Health, Kuala Lumpur, Western Malaysia.

"Water Supplies in Turkey" by Mr T. Kayserilioglu, Ministry of Health and Social Welfare, Ankara, Turkey.

"Water Supply Programme in Nepal" by Mr R. M. Shrestha, Divisional Engineer, Irrigation and Water Works Department, Kathmandu, Nepal.

"Water Supply in the Libyan Arab Republic" by Mr K. S. S. Ftis, Ministry of Interior and Local Government, Tripoli, Libya.

"Water Supplies in Iraq" by Mr A. R. Khayatt, Director of Sanitary Engineering, Baghdad, Iraq.

"Status of Water Supplies in India" by J. M. Dave, Adviser, Environmental Health Engineering, Government of India, New Delhi, India.

"Water Supply Situation in Fiji" by Dr E. M. Salato, Medical Department, Suva, Fiji.

Closing of the Seminar sessions in Kiev by Professor Shandala.

In Leningrad

Monday, 24 May — "The System of Water Supply in the City of Leningrad" by P. V. Novikov, Head of the Water Board of the Leningrad City Executive Committee.

"The Organization of Sanitary Inspection of Water Supplies in Leningrad" by Dr A. Y. Dudarev, Chief Sanitarian of the City of Leningrad.

Tuesday, 25 May — Contact Clarification and Fluoridation of Water at the Main Water Supply Installation in the City of Leningrad. Explanations given by P. V. Novikov.

Visit to the Research Laboratories of the Leningrad affiliated branch of the Academy of Municipal Services. Explanations given by Mrs Osipova and Mr Losovsky.

Wednesday, 26 May — Visit to Solnecnic Diene and Zelanagorsk water purification plants. Explanations were given by P. V. Novikov and Mr Losovsky.

In Moscow

Friday, 28 May — Concluding discussion and closure of the Seminar by Professor Loransky.

"Water Supply in the Yemem Arab Republic" by Mr M. N. Ghalib, Engineer, Ministry of Public Work, Sana'a, Yemen Arab Republic.

REPORTS OF DISCUSSIONS

Thursday, 6 May

Opening of the Seminar.

Paper: "The Organization of the Sanitary Service in the USSR and the Tasks of the Sanitary Authorities in Sanitary Inspection of Water Sources and Water Supply" by Dr A. V. Pavlov, Chief of the Central Board of Sanitation and Epidemiology, Ministry of Health of the USSR.

The Seminar was officially opened by Dr A. V. Pavlov, Chief of the Central Board of Sanitation and Epidemiology of the Ministry of Health of the USSR. Dr Pavlov presented a paper on the organization of the sanitary services of the USSR. He gave a number of examples of the duties carried out by the sanitary inspection services aimed at eradicating and preventing pollution of the water supplies and discussed the Government and State laws and statutes which have been passed to guide the service. He drew particular attention to the duties of the inspectorate service in regard to the preservation of hygienic conditions in reservoirs and instanced work he had carried out in the Dnieper area of the Ukraine. Their inspection of reservoirs and consequent advice resulted in a great improvement of the biohydrological regime and prevented pollution.

Another interesting feature mentioned concerned the rural water supply inspection services and the utilization of volunteers who were given the responsibility for sanitary inspections of smaller supplies in places where the organization had insufficient staff. Their primary task was to send back information to the sanitary and epidemiology section so that corrective measures could be taken.

In the ensuing discussion the system of organization of sanitary inspection and epidemiology was considered to be of great interest and might well be emulated in other countries. In many of the developing countries ministries are still fluid and only a few health ministries are responsible for operating and running community water supplies. Nevertheless, whichever organization was responsible for running water supplies, it was agreed that the inspection and control of drinking-water quality should be the responsibility of health ministries.

In response to questions regarding the laws in connexion with drinking-water, it was pointed out that they were similar in all the Republics, but in the case of well waters for rural supplies it was realized that the same high quality laid down for urban supplies could not always be adhered to.

It was further explained that the technical planning, design and construction of water supplies is the function of the Ministry of Communal Service but that the Ministry of Health plays an important part in supporting the former ministry in obtaining necessary funds for water supply construction.

Friday, 7 May

Papers: "Disinfection of Water by an Electrolytic Process" by G. L. Medrish, Candidate of Technical Sciences, Academy of Municipal Services.

"Hygienic Aspects of the Disinfection of Water" by Professor N. N. Trahtman, Doctor of Medical Sciences, Central Institute for the Further Training of Physicians.

"Desalination of Water" by V. A. Kljačko, Doctor of Technical Sciences, All-Union Institute for Research on Water Supply and Sewerage Systems, Hydraulic Engineering Installations and Applied Hydrogeology (VODGEO).

In the paper dealing with disinfection by electrolysis, pertinent points such as the cost compared with that using liquid chlorine, power requirements and the limitations of the process, were brought out by the author. The discussion covered many aspects of the process, including voltage requirements, size of units, life of the electrodes, problems of conversion from AC to DC power, use of portable generators, etc. The possible interference by other dissolved salts and the possibility of using this system directly in wells were also raised. It was explained that the latter was not thought to be a practicable proposition.

In the second paper, Professor Trahtman highlighted the main points of disinfection of water. It was emphasized that the residual chlorine concentrations normally used in USSR (0.3-0.5 ppm mg/l) had proved entirely satisfactory. Even viruses of polio, Coxakii, etc. are absent with a residual Cl_2 concentration of 0.3-0.5 ppm, if the preliminary treatment of the water is very good.

It was pointed out that laboratory studies showed that 100 ppm concentration of chlorine given to animals produced no adverse effects, i.e. change in growth rate, lifespan, breeding, blood, internal organs or tumour growths. Such experiments had been carried out over a period of nine years for seven generations.

The Seminar was informed that electrolytic chlorine (NaOCl) is equally as good as free chlorine for disinfection, but that chloramines are 50 times less effective for virus. With a residual count of three coliform/litre in disinfected water, as per the USSR standards, no other pathogens are detected. Coliform count has also been found to be an equally reliable index when either ozone or ultraviolet disinfection is used. Therefore it can be taken as reliable index for all disinfection processes.

The discussion of the paper concerned the difference in the coliform index number used in USSR and the number used in other countries; on the methods used for bacterial determination tests and on the mechanism of the effect of chlorine and bacteria. The question of residual chlorine in the distribution system and home tap was also raised. In USSR residual chlorine determinations are made only at the plant outlet.

In the third paper on the topic of desalination the author, Mr Kljačko, described the various processes being used in USSR, their principal features and the cost analysis of each was highlighted.

The discussion concerned corrosion due to salt water and desalinised water on the plant, its stabilization, difference in the cost of plants made by various countries, the economics of transporting water over long distances, and the possibility of small portable plants for small islands was also raised. There was considerable discussion on costs, particularly concerning the USSR system of writing off the whole capital cost in eight years as compared with other systems elsewhere.

Saturday, 8 May

Papers: "Training of Sanitary Engineers and Waterworks Staff" by A. V. D'jackov, Chief Engineer of the Moscow Water Supply Installation.

"Hygienic Aspects of Water Supplies for Centres of Population" by Professor S. N. Čerkinskij, Corresponding Member of the Academy of Medical Sciences of the USSR, Professor of the First Moscow Medical Institute.

Mr A. V. D'jackov, Chief Engineer of the Moscow Water Supply Installation, outlined briefly the sources from which Moscow city draws its water supply, namely, the Rivers Moscow and Volga. These sources provide Moscow with over 4 000 000 m^3/day.

He stressed the importance of providing a safe water supply for which it is necessary to have sufficient and efficiently trained staff to carry out this work. This training fell into three categories: training staff for newly-built water supply installations; training of people for old supply systems; training of management staff and leading specialists for newly established waterworks. They depend on the colleges to supply qualified staff.

Refresher training of personnel from time to time is necessary to allow them to keep up-to-date with new types of equipment to enable them to carry out their duties efficiently. To boost the morale of the workers, certain incentives are provided, e.g. housing, canteens, medical facilities and recreation facilities. Attractive bonuses of up to 20 per cent. of basic salaries are paid according to the type of work.

Questions from the participants concerned various aspects of the training programme.

Professor S. N. Čerkinskij, who is both a qualified doctor and engineer, presented the next paper on the Hygienic Aspects of Water Supplies for Centres of Population. He reiterated the statement of previous speakers that a good and safe water supply is the most important preventive system in reducing disease, both in urban and rural communities. Today, the countries of the world are encountering problems of overcrowding in cities, increasing industrialization and water supplies are having difficulty in coping with this increasing urbanization. He stressed that successful development of water supplies in the USSR resulted in the problem of water-borne diseases being eradicated, and emphasized that in the planning of water supply systems, it is essential to bear in mind the necessary control measures to protect the population from the scourge of water-borne diseases.

The other important feature is to meet the demand of the population, not only to satisfy the cultural and health requirements, but also to meet the agricultural needs and industrial requirements of the country.

Centralized water supply systems in the USSR have proved effective in meeting these requirements. However, he also mentioned the importance of small simple forms of water supplies for rural areas as outlined in the WHO publication by Wagner & Lanoix (1963), and emphasized that the role of construction of small rural water supply systems should not be under-estimated.

He spoke briefly on the standard for the quality of drinking-water in the USSR (GOST-2874) as well as the choice of the source of water supply (GOST-2761) which is valid for all centralized water supplies, and again placed great importance of vigilance to prevent violation of the sanitary standards which might endanger the safe quality of drinking water. He also considered it necessary to undertake periodic re-examinations of the existing drinking-water quality standards. He warmly supported international contacts to enable the exchanging of experiences with other nations.

In conclusion, he illustrated his lecture by showing various slides depicting tables showing established standards in the USSR.

Monday, 10 May

Papers: "Coagulation and Flocculation, New Coagulants and Flocculants for Water Treatment" by Dr L. N. Paskutskaya, Candidate of Technical Sciences, Academy of Municipal Services.

"Selecting Technological Projects for Treatment of Surface Water" by S. A. Shubert, Candidate of Technical Sciences, Academy of Municipal Services.

"Treatment of Subterranean Water (removal of iron)" by Miss A. M. Perlina, Candidate of Technical Sciences, Academy of Municipal Services.

Miss L. N. Paskutskaya dealt mainly with the aspect of coagulant aids in water treatment with special reference to practices in the USSR. In stressing the importance in the choice of reagents and the mode of application, it was pointed out that the widely used coagulant - aluminium sulphate - was not very satisfactory in the poor stability of floc and the slow rate of hydrolysis and the crystallization of the solid phase under low temperature of water. It also reduces the water pH radically. These drawbacks have led to the development of a synthetic organic flocculant aid, polyacrylamide, which has proved satisfactory in pilot plant studies. Other action flocculants have been synthesized and studied and one such flocculant which has also proved very satisfactory is VA-2.

She emphasized that all new flocculants before use had to satisfy the chemists, technologists and the hygienist of their suitability of application and from the point of view of health and toxicological properties.

In the discussion that followed, it was further pointed out that temporary conditions should be taken into account when normal coagulants were used in conjunction with polyacrylamides as the flocculant must be produced after the hydrolysis has been completed. The case of boiling or the rising of settled flocs taking place during the hot part of the day, especially in the tropical countries, was due to ununiform local changes of temperature in sedimentation tanks. The formation of heavy flocs should reduce this. Substances similar to polyacrylamide reduce colour formed by humic substances. These are less stable in acidic media.

Mr. S. A. Shubert gave a brief resumé of waterworks projects in the USSR and went on to describe the present trends in the design of water treatment plants. One aspect of water treatment design of particular interest was the different types of filter design. In the past, when the quality of water in the rivers and lakes was good, the two-stage treatment of water was sufficient. Presently with the industrialization and the demand of water for agriculture, etc., the flow of water in the rivers has to be regulated by the building of dams. This has somewhat drastically changed the quality of water for treatment purposes. Water use during the whole year has now increased drawdown.

The two-step design was no longer good enough for such waters and a rather more complicated process was needed, particularly when water temperatures were low. Therefore flocculants were used to improve flocculation and sedimentation and more acceptable flow sheets were developed to treat such waters. One aspect of water treatment design was the development of the contact coagulation installations and these were called contact clarifiers. The new technique uses the one-step principle in its physical and chemical essence. The principle is the reduction of charge of the particle, formation of microstructures, for these particles to adhere to the surface of the grains of the filter and the whole process goes on in one filter apparatus. This process ensures more reliable treatment and more stable condition of water clarification and is being used widely in the USSR. In the choice of design of filters for the two-step treatment of water, the old concept that the filtration occurs on the surface of the filter has recently been given up. The new idea that filtration occurs inside the thickness of the filter bed was substituted and thoroughly proved.

In the discussion that followed, the details of the workings of the KO-1 filter were explained, and it was necessary to use microscreens for pre-purification so as not to overload the filters.

Miss Perlina dealt with the advantages of using subterranean water as a source in preference to surface water. However, the chemical composition of the water is extremely diversified, depending upon the ground conditions. There is one common factor in most underground waters, that being its iron content. There are various methods of iron removal in practice, but the selection of method depends on the chemical properties of the water and the chemical form in which it is present. The method of iron removal that has recently been practised in the USSR after extensive research is known as the filtering method. This method depends upon the ability of water which contains salts of bivalent iron to form a film on the surface of the grains of the filtering material in the presence of dissolved oxygen. Advantages of this method are the stability of the process throughout the filtering cycle and the fact that it does not call for preliminary oxidation of iron and there is no need in the intensive aeration of water to remove carbon dioxide and increase the pH at special plants for aeration.

It was mentioned that in Nigeria and other parts of the world, pressure filters were used for the removal of iron, but that the filter media was a proprietary product and was provided by the manufacturers to the filter plant. It was also mentioned that magnatite was used in other countries for the same purpose.

Tuesday, 11 May

Visit: The Eastern Water Works of Moscow City.

Before visiting the purification plant at the Eastern Water Works of Moscow City, the Chief Engineer gave some details of the scope of water supplies in Moscow.

The principal features of the operation are as follows:

Raw water quality

1.	Maximum turbidity	20 mg/l
2.	Colour	40 to 70 units
3.	NH_3	0.5 to 1 mg/l
4.	BOD	2 to 3 mg/l
5.	Dissolved oxygen	7 to 8 mg/l

The treatment plant has a capacity of 1 000 000 m^3/day. Before settling, the raw water passes through automatic micromesh (100 to 144 mesh/cm^2) strainers. From there it flows into a P-shaped channel with a capacity of six hours supply. It is then pumped through 1400 mm diameter pipes to the chemical dosing house where alum, lime and activated carbon are applied. The alum dose was 60 ppm, controlled automatically and fed every alternate hour, i.e. average dose of 30 ppm using a 14 per cent. solution. The lime dose was three to five ppm and was automatically adjusted with the variations of pH. The water flows through the mixing and flocculating channels for nine minutes before reaching the sedimentation units which are of the horizontal flow type.

After settling the water flows to the filters. These are rapid gravity filters but have two layers, one of sand and one of anthracite. There are 46 each 120 n^2 in area. The anthracite layer (2 mm) is 400 mm thick. Below it the sand layer (0.5 mm to 1.2 mm) is 700 mm deep. A conventional gravel and underdrain system is used. Filtration speed is three to six m/hr. Backwash rate is 14 l/m^2/sec, i.e. 50 m/hr - approximately 10 times the flow rate. Filter runs are about 24 to 30 hours.

The plant also included eight "bi-flow" filters and two contact clarifiers.

Primary disinfection was with chlorine at a rate of 7.2 ppm. There were six chlorine contact tanks which allowed 30 minutes detention.

The water was pumped to the city by high-lift pumps with 30 000 m^3 per second capacity, and a head of 56 metres of water. Residual pressure in the city was about four atmospheres (i.e. 60 l/in^2 or 150 ft wt column). Pumping is direct into the distribution mains without elevated reservoirs, except in high buildings which have their own boosters.

Water quality was tested regularly, both chemically and bacteriologically, the latter using millipore filters. Trace elements such as fluorine, lead, zinc, copper were checked once a month and bacteriological analysis was made daily.

In response to questions, it was stated that the area around the canal and the Uchinska reservoir are well policed by guards to prevent pollution. Points were also raised regarding the use of dilution techniques for bacterial counts, the methods used for identifying faecal coliforms, and sampling procedures. The reason given for dosing of alum only on alternate hours was said to be that it gave better flocculation.

Wednesday, 12 May

Papers: "Certain Aspects of Waterworks Design" by V. I. Filippov, Chief Engineer, State Institute for the Design of Water Supply and Sewerage Systems.

"New Trends in Perfection in the Process of Water Filtration" by Dr D. N. Mintz, Doctor of Technical Sciences, Academy of Municipal Services.

Visit: Academy of Municipal Services.

Mr Filippov pointed out that the factors to be taken into account in the design and operation of water supply systems must include: water quality standards and the most efficient and economical way of providing the right quantity of water. This can be attained by using the latest technique and by the rational use of personnel. About 90 per cent. of water supplies in USSR conform to standard designs and any which cannot do this need special approval. It was said that such a procedure cuts design costs to one-fifth and the use of standardized units and equipment saves both time and money.

In answer to questions it was stated that there were a number of different sized standard designs, inlet and outlet pipes and structures which allowed for future expansion. Elevated tanks were not normally used for cities and high buildings and had their own booster pumps. Most structures are prefabricated and the parts of which are made in factories in the main cities. Water to combat fires was allowed for in proportion to the size of the towns. Considerable work has been carried out in the construction of joint community water supplies, particularly where ground water is not available. Industries inside cities use the municipal supplies and where possible recirculate to save water, but those outside may have their own water systems.

By way of introduction, Dr Mintz stated that most of the engineering design, water supply and sewage systems are done in this Academy as well as some research. At present there is some research work being done on the development of simulation techniques for the optimization of water sand filtration. These mathematical models are based on theoretical and experimental formulas. Three parameters are being used: rate of filtration; depth of filtering media; size of sand grains. The objective variables are the time lag between the start of filtration and the permissible head loss, and the quality of filtered water. Dr Mintz stated that all these variables and parameters may vary according to quality of raw water itself and the season of the year. The importance of this investigation is based on the fact that 30-40 per cent. of the total cost of a water treatment plant is taken up by the filtration system.

The pilot plant size is about 1/20 of the actual plant size. According to preliminary results he said that the rate of filtration can be increased to 5-6.5 m^3 per m^2 per day before reaching a head loss of 2.02 m, which is the limit of filtration losses before backwashing.

Normally for a given size of sand bed and quality of raw water the time of filtration is decreased as the time of filtration is increased.

Dr Mintz also mentioned that investigations on the use of different materials for the filtration media is an important aspect, and among these materials they are studying calcinated clay, volcanic ash, etc.

Questions were asked upon the results of the relative importance of the parameters and variables used for which Dr Mintz stated that it would not be possible to determine precisely the most sensitive parameter, but it was a combination of all of them.

It is important to mention that diatomized earth material has not been used in this country. The research conducted in this laboratory was not only limited to water purification, but to the treatment of waste waters, and most of their attention was being paid to the removal of organic and inorganic materials such as nitrogen and phosphorus, as well as the use of polyelectrolytes for the coagulation of waste water.

In the computer room, Dr Mintz described the work being done by the analogue computer on working out water supply distribution systems. He pointed out that a digital computer had a much broader application than an analogue computer, but the latter was much more efficient for the specialized activity of working out water supply distribution systems. He then described the use of apparatus for electrolytic production of chlorine and showed the party one using magnatite. Part of the magnatite was in fact soldered to the stainless steel top and bottom of the vessel. Another system described used graphite electrodes.

Thursday, 13 May

Papers: "The Problem of Purification and Disinfection of Rural Water Supplies in Developing Countries and a Brief Review of Assistance given by the World Health Organization" by W. R. W. Ferguson, WHO Consultant.

"The Organization of Sanitary Inspection in the Protected Zones of the Moscow Water Supply Installation" by M. B. Trahtman, Sanitary Engineer of the Moscow City Sanitation and Epidemiology Centre.

"Improvement of Water Quality in Rural Areas" by E. A. Silin, Candidate of Technical Sciences.

Mr Ferguson dealt with the practices of rural community water supply and presented some of the problems facing the developing countries. He emphasized that the design of treatment plants should be as simple as possible and automation should be avoided as most of the countries faced a great shortage of technical personnel.

Mr Ferguson mentioned the assistance given by WHO and other United Nations agencies in the field of community water supply. In the discussion that followed, the problems facing the developing countries, it was pointed out, were not only technical but also socio-economic and the cultural pattern of the society was important. Although emphasis on the quality and convenience of providing water was important, the quantity of water should always be considered to be of paramount importance.

Mr M. B. Trahtman dealt with the legislation that exists in the USSR on sanitary protection zones. These were divided into two belts, each with different boundaries and regimes. It was also pointed out that with the experience already accumulated in this field over the years, the necessity of changes had been felt and the revision of the legislation was in fact progressing.

In the discussion that followed, it was pointed out that proper legislation on protection zones could ensure satisfactory raw water qualities at the point of the intake. Various ideas were expressed by the participants on the use of pesticides. It was felt, for example, that the use of DDT in countries which suffer from malaria on a large scale cannot be avoided for the present in spite of its toxic effect. However, it was mentioned that use of DDT in the USSR was being stopped from 1975, the target set being dictated by the necessity of exhausting the present stockpile. Less stable chemicals with low toxicity values were being increasingly used in its place as pesticides.

Mr E. A. Silin brought to light some new ideas on the treatment of water for smaller units of the rural community. In this connexion a slow sand filter designed to combine a horizontal sump and the filter itself was said to be of advantage in saving the cost of construction and space. Further, the control of the work of the sump and the filter being concentrated at one point proved an advantage in operation. Another point made was the automatic washing of sand in the filter itself as opposed to scraping of the upper layer in conventional slow sand filters.

The working of an electro-coagulator for the removal of colour, odour and similar undesirable elements was also explained. It was also stated that bio-absorbers were one of the simplest and most effective methods for the removal of algal growth. New developments for disinfection of water by ultraviolet rays were also explained.

In the discussion that followed, it was pointed out that practically all the rural communities in the USSR enjoyed the benefit of electrification and hence the various units of water treatment described in the paper could be installed with great advantage.

Friday, 14 May

Paper: "Organization and Improvement of Water Supply Services in Rural Areas (using the Moscow Oblast as an example)" by P. M. Vindukov, Deputy Chief Medical Officer, Oblast SEC.

Visit: Kuryanovskaya sewage purification plant.

Dr Vindukov gave some pertinent information concerning the Moscow Oblast (administrative area).

In the old system 50 per cent of communities had wells and the rest took their water from the ponds and brooks. Therefore an organization was formed which has completed 58 000 wells and boreholes. Seventy-five to 78 per cent. of the community are now served in this way and the cost averages about 7500 roubles. The increased use of groundwater may deplete the level of the water table and there are chances of pollution entering the aquifers. Control measures planned are: better sewage disposal facilities consequent on new developments in rural areas, such as new modern houses in central units of state farms where 60 to 80 houses are built. Though the quantity of water used is greater, there is better waste disposal; the selective use of seven acquifers.

New dangers of pollution may occur due to activities such as sand and gravel pit excavation, exploratory drillings and building large underground storage for natural gas, oil, etc. A reappraisal of the entire groundwater management technique is under consideration by the government and regulations to control these activities may be drawn up in future.

Questions were raised concerning the average depth of the wells, and we were informed that they are 66 to 260 m deep and are assumed to have a cone of depression of 500 m and a discharge capacity of five to 250 m^3/h. The minimum safe distance from houses was considered to be 25 m for bore-holes and 100 m for dug wells. It was stated that it is not practicable to check all wells for sanitary quality regularly. The village latrines are pit types for small isolated ones and concrete tanks for larger houses. All schools, central offices, etc. and public buildings use mechanical clarification and sand filters.

A visit was paid to the Kuryanovskaya sewage purification plant.

Mr Elya, Chief Engineer of the plant, gave a brief description. The plant is a conventional activated sludge type, and has a capacity of one million m^3 per day, but is at present being overloaded by 25 per cent. It is being expanded by an extra one million m^3/day in 1971 and will be further extended to give a capacity of three million m^3/day in 1972. The process used is mechanically cleaned screens, primary settling, aeration, final settling, after which the effluent is discharged into the Moscow river. Primary settling is one-and-a-half hours, aeration five hours in four m deep tanks. Air diffusers with a rate of 1.5 gm/l of sewage per hour, five m^3 of air is used per kilogram of BOD removed. Thirty-five per cent. of the sludge is recirculated; solid concentration is maintained at 1500 to 2000 mg/l with a 75 per cent. volatile fraction. Final settling is two-and-a-half to three hours. There is no disinfection of the final effluent at present but there will be disinfection with electrolytic chlorine in the new plant.

The sewage is 40 per cent. industrial waste and 60 per cent. domestic waste; the BOD_5 value is 200 mg/l. Suspended solids are 230 mg/l. The final effluent has a BOD of 15 to 20 mg/l and ammonia concentration of 35 to 40 mg/l.

During discussion it was brought out that sludge is digested for seven days at 52°C. The plant is affected by excess industrial effluent discharge and takes from a few days to a week to restore the activated sludge.

Saturday, 15 May

Visit: A rural water supply installation in the rayon of Odintsovo.

The purpose of this visit was to observe a rural water supply system in the rayon of Odintsovo. The visit to this installation was limited to the well and elevated tank area of the town. According to the quality of water standards, all wells should be fenced 20 m around.

This particular tank was of 25 m^3 for the supply of a population of 400 people. The characteristics of the well were as follows: it was 90 m deep with a pumping rate of 25 m^3/h and a water table of a depth of eight to 10 m. It is important to mention that the sanitary supervision is done once every three months and there is a constant maintenance done by a full-time mechanical worker. It is desirable to install elevated tanks for small communities in order to keep the specified pressure and uniform supply of water.

Monday, 17 May

Opening session in Kiev.

Papers: "Hygienic Characteristics of Drinking-water Sources in the Ukrainian SSR and Requirements in Regard to Water Treatment" by Professor N. N. Kvitnitskaya, Doctor of Medical Sciences and Deputy Director of the Kiev Research Institute for General and Communal Hygiene.

"Experience in using various Methods of Treating Drinking-water at Waterworks in the Ukrainian SSR" by Dr V. V. Tsapko, Candidate of Medical Sciences, Kiev Research Institute for General and Communal Hygiene.

Mr Ovshanikov and Professor Shandala welcomed the participants to Kiev. The latter dealt with the different aspects of work that were being carried out at the Institute. One of particular interest was the involvement of the Institute in preparing the master plan for water resources in the Republic. It had, by its collection of data, been able to fix the state of water supplies and how effective sanitary measures could be carried out to combat pollution. Another interesting feature was the development of hygiene in town planning, hygiene in homes and apartments and the containment of industries so as not to be a hazard to health.

Dr Kvitnitskaya dealt with the task of producing drinking-water for people and the difficulties encountered in finding good surface sources, as 75 per cent. of the drinking-water came from such sources. Because of increased demand, water has to be regulated by construction of dams. This has drastically changed the characteristics of the water quality and extensive research had to be carried out in dealing with this complex problem. One aspect of this also deals with the siting of industries and of limiting the size of industries into small and medium sized towns so that the river can be used in future for drinking-water purposes. In some cases the groundwater had to be mixed with surface water so as to increase the quantity. No unified method of treatment of water is possible.

A committee on environmental pollution had to be set up to prevent pollution of water resources. Industries have changed the processes to re-cycle used waters and in other cases reclamation of substances from waste waters have been economical. This has reduced the waste load on the rivers as final effluents discharged by industries have to meet prescribed standards.

In the discussion that followed, it was pointed out that it was necessary to reduce toxic waste, chemicals and other substances from industrial waste before discharging into water bodies.

Presently, the agriculture and livestock farms are becoming larger and the waste water from these sources is getting more complicated, treatment problems are arising and every attempt is being made to develop the balance between water resources and various industries.

Thermal changes in surface waters are presenting algae problems and biological processes are being developed to combat flowering.

It was further explained that water distributed through canals was studied with respect to evaporation losses, infiltration losses, vegetation growth, pollution prevention, etc. and appropriate measures were taken when constructing these canals.

Dr Tsapko dealt with the different sources of drinking-water the various stages of treatment necessary, depending on their composition, the problems encountered and advice on solutions of these problems.

Seventy-five per cent. of the drinking-water was from surface sources needing two-stage treatment, while most underground waters do not need filtration and disinfection.

The difficulties encountered in the use of the AKX filters in the smaller treatment plants and their subsequent conversion to dual media filters were of particular interest. The speaker felt that the AKX filters could be successfully used in the larger treatment works where more skilled and experienced labour was available.

The removal of colour, odour and ferrous salts were successful in the filtration plants using suitable media. Disinfection was largely carried out by chlorination. Although ozonization of water was done in some water works, the results were not satisfactory and additional chlorination had to be carried out to counteract secondary contamination.

A new development in recent years was the high-speed contact filter - KF-5 - used for reagent treatment of fresh surface water and which also shows promise of removing ferrous salts from subsoil waters.

In the discussion that followed, it was said that slow sand filters were used for the smaller communities of up to 2500 people, when no suitable underground water was available. When the suspended particles exceeded 40 to 50 mg/l, pre-filters were used to cut out the sediment load on the slow sand filters.

In lakes nature had created ecological balance, but in the construction of artificial lakes or reservoirs care was also taken to try and obtain this balance. There were often difficulties sometimes when laboratory experiments showed promise of obtaining this balance, it was not possible to attain in practice. It was mentioned that the control of algae is carried out in some countries by the use of copper sulfate, but studies are being carried out in the USSR to combat flowering of algae by biological methods.

Although synthetic substances are used in the treatment of drinking-water, they had to satisfy the sanitary authorities with respect to hygiene standards so as not to worsen the character of the water.

Tuesday, 18 May

Papers: "The Theory and Practice of Water Fluoridation and Defluoridation in the Ukrainian SSR" by Professor R. D. Gabovitch, Kiev Medical Institute.

"Experience in Softening and Freshening Drinking-water at Waterworks in the Ukrainian SSR" by N. I. Omel'janec, Candidate of Medical Sciences, Kiev Research Institute for General and Communal Hygiene.

The main points raised by Professor Gabovitch dealt with data obtained in the USSR on the effects of fluoride on health. These included better teeth, quicker healing of bone fractures, lower cardiovascular disease rate and lower kidney infection. Laboratory animals, when given 0.2 to 1.0 mg/l of fluoridated water had a higher life-span than others. Similarly the study of communities with naturally fluoridated waters showed no effect even when concentration was 2.5 mg/l. The claims of damage due to fluoridation when given in the correct concentrations are unfounded. Two systems of fluoridation are practised in the USSR: a constant dose of 1.0 to 1.5 mg/l throughout the year; doses of 1.0 to 1.5 mg/l in winter and 0.7 to 0.9 mg/l in summer. The latter is preferable as it gives better protection.

Fluoridation is already practised in many USSR cities and many more will be covered in the next five-year plan. Chemicals used are Na_2F_3, Na_2SiF_2 $(NHa)2SiF_6$. The last named is more soluble and more suitable for large plants as it saves space. The dosage must be accurately controlled. Automatic equipment proportional to flow and concentration is preferable and such a dosage should not have an error of more than 0.05 mg/l. It can also be added with the coagulant. A slightly larger dose may be needed but special equipment is eliminated.

In the discussion it was asked if fluoridation caused osteosclerosis. The author said no such effect was noticed when the correct dosage was carried out. Loss of fluoride in pipelines is negligible. Methods of supplying fluorides in the form of tablets, food, toothpaste are not as good as fluoridation of water. The presence of natural fluoride in food was raised and it was agreed that certain foods such as tea contained a high fluoride rate and natural fluoride in food should be taken into account when fluoridation of water was being considered.

Dr Omel'janec said that world water resources were greatly limited, only one per cent. of the total is available as fresh water. Much of the groundwater in Ukraine is too hard or mineralized. The surface flow is likely to become insufficient and softening or demineralization will have to be resorted to if the Ukraine is to have good supplies of water. The institute in which Dr Omel'janec works is engaged in solving this problem, both from technological and hygienic points of view. The technology will deal with various processes, its mechanics and cost. The hygienic aspects will deal with effects of the process on the water produced and its chemical quality to ensure the health of the people. This institute checks various residual substances from resins, metals, etc.

The discussion was mostly limited to the practicable use of the various systems described and their cost. Points were also raised about drinking-water standards for such plants and the need to add salts such as Ca, Mg, to make water potable. The author pointed out that this was usually done by adding a certain amount of saline water to the desalinated water, but the former may first need to be disinfected.

Wednesday, 19 May

Papers: "New Trends in the Technology of Treatment and Disinfection of Drinking-water by Professor L. A. Kul'skij, Order of Technical Merit of the Ukrainian SSR, Member of the Academy of Sciences of the Ukrainian SSR.

"Sanitary Protection of Groundwater against Pollution with Waste Water" by Professor E. I. Goncharuk.

Country reports: "Water Supply Practices in Mexico" by Mr E. Urroz J., Director, Water Pollution Prevention, Ministry of Water Resources, Mexico.

"Thailand's Rural Community Water Supply Programme" by Mr P. Chulavachana, Sanitary Engineering Division, Department of Health, Bangkok, Thailand.

Professor Kul'skij pointed out that mankind should not only worry about the quality of water but also the quantity. This is becoming a world-wide matter for concern. The present trends of water technology are made much more complicated by the fact that, although 10 000 pollutants are already known, many more are being discovered. On the other hand the discovery of new drugs and new chemical compounds have encouraged scientists to carry out further research into the discovery of new methodology to get rid of the existing pollutants. Such research is being carried out in the research institute laboratory of which he is the Head, in which practical and theoretical aspects of water treatment are being undertaken.

Professor Kul'skij outlined the two main trends of the work being carried out at present: colloidal chemistry; and the chemistry of water. Work on the former started in 1967, but the work on the latter had commenced about 40 years ago. The main aim was, of course, to improve the quality of the drinking-water. This requires a complete study and understanding of the process of disinfection and purification. He stated that despite the efforts put into this kind of research, no-one can fully understand these processes yet.

Several questions were asked by the participants concerning the efficacy of the methods used for the purification of water in the USSR.

Finally the participants were shown models exhibited in the hall of the Academy of Sciences Pavilion in the Park of Economic Achievements, of the various types of automatic apparatus.

Professor Goncharuk stated that subsoil waters are being used in USSR and other parts of the world to supply the need of rural communities as it is the simplest method of providing water and often does not need purification or disinfection. However, he stressed that without sanitary protection of the groundwater, there is always the danger of subsoil waters being polluted with liquid waste discharged from domestic and industrial wastes. A series of investigations have been carried out to find the most effective methods of sanitary protection of underground water. As a result, the institute has established hygienic standards which are being observed and successfully carried out.

Finally, he stated that it has been proven possible to purify the sewage washes from infectious hospitals by employing subsoil filtering units. In addition, investigations carried out under field conditions on experimental subsoil filtering installations have made it possible to establish a number of general biological rules for purifying sewage in the filtering layer of the subsoil, taking into account, for instance, the influence of temperature, quality of the sewage and the composition of the soil.

Thursday, 20 May

Visit: Research Institute of Colloidal Chemistry and Water Chemistry.

Professor L. A. Kul'skij dealt with the theoretical and practical aspects of the work done at the Institute of Colloidal Chemistry and Water Chemistry and the main trends of the work in which they were presently engaged. He mentioned that there are two main departments: (a) colloidal chemistry department; (b) department of water chemistry and technology. Under these departments there are six structural divisions and many other smaller laboratories with a total staff of about 200 engaged in research activities. The central department co-ordinates the work carried out by the different sections. The six main divisions are: (1) control of drinking-water quality. The work carried out by this section was the use of oxidation and other reagents in water and the compounds formed in water as a result of adding these substances. Studies are also being conducted on the deodorization of water and determining methods of control in these processes; (2) demineralization of water. The work of this section is to determine various demineralization processes to remove minerals in industrialized waters; (3) physical and chemical properties of industrial water. The work carried out by this section was on the major emphasis on industrial effluents polluting water courses and removal of such substances so that the effluents can be discharged into water courses. Research is also being carried out into pseudofluoridized beds; (4) biological method of purifying industrial effluents. The work of this section includes the culture of certain bacteria that will render these toxic substances harmless in water; (5) the physical and chemical control of water quality and automation in the water industry. The methods of water quality are based on qualitative and quantitative analysis and the inventions by this department in the automation of water treatment plants are being widely used in the USSR and many other countries; (6) processes and methods of water treatment in simulation, technical aspects and theoretical prospects of water treatment. The main work done by this section is the removal of blue/green algae in water and the control of this with silver ions and other metals. The other small laboratories are also carrying out research on different aspects of water quality and one is engaged in work on the removal of heavy metals from water and is trying to develop techniques and equipment.

Mr Rudenko, in his talk about the water treatment in Kiev, said that there were three sources from which the town of Kiev was supplied with drinking-water. The total consumption was 900 000 m^3, of which 300 000 m^3 was obtained from the River Dnieper; 400 000 from the River Disnar; and another 200 000 m^3 from artesian wells. The water from the River Disnar and the artesian wells was of good quality and did not present any problems, but the water from the River Dnieper was highly polluted, very highly coloured and with phytoplankton. During the winter there was much manganese and iron. The quality of this water has deteriorated since the artificial lake was created. He then described the first and second stage treatment processes and also the pilot plant studies carried out. These studies revealed that the water had to be treated by different methods during the four seasons of the year.

During the discussion that followed, it was mentioned that if the intake had been constructed somewhat higher, the quality of water could have been a little better. It was further mentioned that plans for the future included the sinking of wells in the river bed for extraction of better quality water, but that from investigations carried out there was as much as 6 mg/l of iron and therefore mixing of the water from underground sources with that from the River Dnieper would be necessary. The colour of the water was mainly due to humic and organic substances present in the water. With regard to the water from artesian wells, 95 per cent. of it was very good natural water, but about five per cent presented some problems in that iron bacteria were present.

Friday, 21 May

Visit: Village of Tsybli, Kiev Oblast.

A visit was paid to the village of Tsybli, which is located 100 km south-east of the city of Kiev. Mr Golovko, the deputy chairman of the Regional Executive Committee explained that the new village of Tsybli was being constructed to rehabilitate people from four villages which will be submerged by a new reservoir being constructed for a hydro-electric project.

The village will have a complete water and sewerage system. At present only 140 of 300 homes are connected to a piped water supply. The sources for water supply are three tube wells 260 m deep. For sewage disposal there will be three lift stations, which will pump sewage four kilometres away where it will be treated in the purification plant. At present it discharges into sewage fields, alternating every month. Later on, treated sewage purified by filtration will be used to irrigate crops.

In the discussion, questions were asked about water charges and responsibilities for maintenance. It was explained that there is a charge for water of one-and-a-half to two roubles per family per month. The system is paid for by the State but will be maintained by the co-operative farm which owns the village. It will also have a special maintenance organization for both water and sewerage systems. The water supply to 160 unconnected houses is through 130 water hydrants whose maximum distance is 150 m. The water system has an elevated tank of 150 m^3 capacity. The supply to families includes quantities for other purposes such as animals, gardening, etc. Water quality is inspected by district sanitarians. Chlorination is not done regularly but there is provision for feeding calcium hypochlorite solution in the system by the help of injector pumps.

Saturday, 22 May

Country reports: "Water Supply Systems in Argentina" by Mr J. Savinic, Civil Engineer, Obras Sanitarias de la Nacion, Buenos Aires, Argentina.

"Water Supplies in Western Samoa" by Dr S. Ieremia, Chief, Division of Public Health, Apia, Western Samoa.

"Community Water Supplies in Malaysia" by Mr A. Sekarajasenkaran, Senior Public Health Engineer, Ministry of Health, Kuala Lumpur, Western Malaysia.

"Water Supplies in Turkey" by Mr T. Kayserilioglu, Ministry of Health and Social Welfare, Ankara, Turkey.

"Water Supply Programme in Nepal" by Mr R. M. Shrestha, Divisional Engineer, Irrigation and Water Works Department, Kathmandu, Nepal.

"Water Supply in the Libyan Arab Republic" by Mr K. S. S. Fits, Ministry of Interior and Local Government, Tripoli, Libya.

"Water Supplies in Iraq" by Mr A. R. Khayatt, Director of Sanitary Engineering, Baghdad, Iraq.

"Status of Water Supplies in India" by J. M. Dave, Adviser, Environmental Health Engineering, Government of India, New Delhi, India.

"Water Supply Situation in Fiji" by Dr E. M. Salato, Medical Department, Suva, Fiji.

Closing of the Seminar sessions in Kiev.

As this was the last day in Kiev, no formal lectures were scheduled as this day was allocated for the presentation of participants' reports on the water supplies of their own countries.

However, before these presentations, Professor Kvitnitskaya gave a short explanation of certain irrigation systems which the party had seen on their previous day's visit. This was followed by a short talk by Professor Neinstein on research work done by the Institute at Kiev, particularly in connexion with industrial waste.

The participants' presentations then followed, with the exception of that of the participant from Yemem, who made his presentation on the last day of the Seminar (28 May). After the participants' presentations the meeting was finally addressed by Dr Shandala.

Monday, 24 May

Opening session in Leningrad.

Papers: "The System of Water Supply in the City of Leningrad" by P. V. Novikov, Head of the Water Board of the Leningrad City Executive Committee.

"The Organization of Sanitary Inspection of Water Supplies in Leningrad" by Dr A. Y. Dudarev, Chief Sanitarian of the City of Leningrad.

Mr Novikov described the Leningrad water supply system and gave a short history of the supply from the time the first plant was built in 1863. At the time of the Revolution in 1917, the water requirements were only 360 000 m^3/day, whereas in 1970 they were over two million m^3/day.

The water supply of the city is drawn from five intakes from the River Neva. Of the total water consumed 43 per cent. is for domestic use, 15 per cent. by offices, 38 per cent. by industry and four per cent. for miscellaneous purposes - washing of streets, construction, etc. The average per capita consumption has risen from 1301 per capita per day in 1917 to 5251 per capita per day in 1970.

Industry has been encouraged to take water from their own sources wherever possible, and uses approximately 1 000 000 m^3/day. The charges levied on industrial water are much higher than for domestic water which is four k/m^3 and is six k/m^3 with a charge for excess water. The average daily flow of the River Neva is 2550 m^3/sec, whereas abstraction by the five treatment plants amounts to 24 m^3/sec. The quality of the water is comparatively good with approximately 100 mg/l of suspended solids, even during the flood period.

The treatment plant equipment consists of the water intakes, first stage pumps, purification plant, purified water reservoirs and second stage pumps. The average water requirements in the first three months of 1971 were 2 058 000 m^3/day, which is approximately 6.7 per cent. increase over the 1970 water supply requirements. The treatment plants have been able to take this extra load and still meet the required standards.

Since 1961 single stage treatment by the use of contact filtration has been adopted in two of the treatment plants. Due to low alkalinity, low temperature the flocs will be small and reaction not intensive and this is why contact clarification is an important feature in the treatment of the water from the River Neva. Almost half the total water treated is through contact filtration as no sedimentation tanks are necessary in this type of treatment, as the coagulation takes place in the contact filters which is an upward flow filter. The chemical treatment of water is the same in all treatment plants. First ammonia is added to water before treatment with the object of binding the chlorine to form suitable chloramines. Although this means the use of large doses of chlorine, the results have been useful. The coagulation is obtained by the use of liquid alum supplied in special rubber-lined tankers from the manufacturers and has an active alum concentration of 77.5 per cent.

In the Southern Station, polyacrylamide and soda ash are used in addition to alum. Since 1967 the water in the main station has been fluoridated with the addition of sodium silico-fluoride with the object of obtaining one to 1.1 mg/l of fluoride ions. The amount of fluoride dose varies from 0.6 to 1 mg/l. The service reservoir capacity is 500 000 m^3, which is 25 per cent. of the water needed in one day. In addition to the second stage lift pumps, there are eight smaller booster stations for maintaining pressure in parts of the reticulation. The addition of coagulants, filtration and pumping is fully automated. A new intake station is now being constructed 60 km upstream and when this is completed all of the five present water treatment plants will be stopped, although the five intakes will remain as emergency standbys.

In the discussion that followed it was mentioned that their intake wells were located 100 metres from the river banks and that the raw water was fed by gravity to the first stage pumps for lifting water to the treatment plant. Water loss through leakage was approximately 10 per cent.

Dr Dudarev divided his lecture into two parts. The first part dealt with the structure and responsibilities of the Sanitary-Epidemiology Service (San-Epid) and the second the Leningrad San-Epid's work in connexion with the water supplies. The San-Epid Service is responsible for all sanitary hygiene in the city and rayons and although the department was more involved with preventive work, it also co-ordinated the activities of the corrective section. It also included the following: control and prevention of environmental pollution, air, water and soil; control of observance of hygiene legislation and enforcement; study of extraneous factors on working conditions of workers; constant control on the hygiene of the city and its environs; control of the sanitary conditions of all projects and all other matters to combat disease.

In their work the San-Epids are in close contact with the research institutions and institutions of higher learning, the Society of Hygienists and the Red Cross Society. An important function of the Department is the control of city development.

In the second part of the lecture, the speaker dealt in detail with the work carried out by the San-Epids in preserving the quality of drinking-water. There were special State standards for the control of water quality and all drinking-water had to meet these standards. Underground water sources usually needed no purification, but sometimes the underground sources could not meet the requirements and treatment was necessary.

The San-Epid Station had a big say in the location of water supply sources, intakes and the sanitary protection zones. It also checked that all water supply treatment processes were constantly controlled. The San-Epids were officially responsible for the efficacy of purification after repairs and in emergencies. There was also laboratory control and routine checks carried out in the water purification system prior to commissioning a water supply. Seventy bacteriological and chemical tests were carried out at fixed points on the distribution system every day in order to maintain the quality of the water. The residual chlorine and the level of fluorine was also tested and any deviation of the quality of the water in the River Neva was transmitted to a control centre which investigated the problems and took adequate measures. There was a rigid control on industrial projects for those using waters

from undesirable sources and great pains were taken to avoid cross-connexions. Water re-circulation in industrial projects was encouraged. The inspection and control of drinking-water supply is provided in the water legislation laws of the USSR and the subsequent rules for sanitary control of drinking water rules for protection of surface water from pollution, State water quality standards are also embodied in the legislation.

In the discussion that followed it was suggested that there was duplication of work between the San-Epid Station and the work carried out by the laboratories in the water treatment plant. It was agreed that this was so, but the sampling, etc. made by the San-Epid Station was considered necessary as a check.

Tuesday, 25 May

Visits: The Main Water Supply Installation in the City of Leningrad.

Research Laboratories of the Leningrad affiliated branch of the Academy of Municipal Services.

The city of Leningrad has five water treatment plants. The total capacity of all the plants is 2 002 000 m^3/day and a visit was paid to the largest plant. At present it has a designed capacity of 610 000 m^3/day but is operated to give 700 000 m^3/day. Like all other plants it draws its water from the River Neva. The raw water flows to the intake sump by gravity and is then pumped to the purification plant. This consists of three different types of unit: conventional horizontal sedimentation tanks and rapid sand filters; upflow sludge blanket clarifiers with rapid sand filters; contact clarifier units.

The contact clarifiers have a capacity of 240 000 m^3/day. Water is first screened and any sand is allowed to settle for six minutes, after which it passes through the contact clarifier unit. Details of the above are as follows:

1. Screens

Two self-cleaning screens moving on drums. The screen mesh is 5 mm and flow-through rate of each is 10 m^3.

2. Pre-filters

Ten concrete units, 3 m deep chambers of concrete with a gravel bed 50 cm deep. The gravel size is 32-34 mm. The area of each unit is 13 m^2 and the filtration rate is about 8 m/h. Units are backwashed every 12 hours using the gravel filtered water.

The pre-filtered water is passed through a de-aeration tank three-and-a-half metres deep and detained for six minutes. Water flows upwards from the bottom, which is sloping, where sand, etc. which settles down is removed.

Alum is prepared in agitated tanks in a strength of 8-12 per cent. Two tanks are used, one at a time, one for feeding and the other for solution preparation. The solution of alum is pumped from the tank and is fed to the pre-filtered water before the venturi meter, where it becomes thoroughly mixed.

3. Contact filters

There are 28 units each 80 m^2 in area. They are 10 x 8 m and are 4-1/2 m deep. The bottom has distribution pipes with holes along the under side. These pipes are covered with a 50 cm deep bed of 16-32 mm diameter gravel. On top of the gravel is a 200 cm deep bed of .5-2 mm sand. The water flows up from the bottom pipe through the gravel and the sand bed at a rate of 5-5.5 m^3/h. The filters are backwashed every 24 hours. Backwash rate is at 15 l/sec/m^2, i.e. 50 m^3/h approximately and is for five minutes. The sufficiency of backwash

is checked visually by the wash water appearance. The backwash water used is six per cent. of the throughput of the unit. The observed flow rate in the meters was 2.8-5 m^3/h. The loss of head through the contact filters is 3 m.

4. Fluoridation units

Two units, one a pilot plant and the other a second regular unit, were shown. The first has a variable dry feed of fluoride (Na_2SiF_6) powder into a constant feed solution tank. Two conductivity probes in the treated and untreated water measures the difference in conductivity 9f the water and automatically controls the fluoridation dose through a solenoid valve. The special safety precautions taken when handling the silico-fluoride were also explained.

During the discussion it was stated that the raw water has a turbidity of 2 ppm, a colour of 35 to 40 degrees and a hardness of four degrees. The total head loss through the plant is 16 m Na_2 Co_3 is used to correct pH and a dose of 10 to 12 ppm is given after the alum is fed to the water. Final pH is 6.6 to 6.8 for the water treated in the plant.

In answer to questions, it was explained that the gravel pre-filters are occasionally washed with steam to remove oil. The fluoridation cost would go up by 1.5 to two times if fluoridation was done before treatment. The comparison of the conventional and the new contact clarifiers showed that the new units give better performance in colour removal (2-3 against 7-8) and turbidity (.5-.7 against .9-1.1 ppm) and need a lower alum dose.

A visit was also paid to the research laboratory. Various experiments on filtration, sedimentation and contact clarifiers were shown with full detailed explanations by Mrs Osipova and Mr Losovsky.

Wednesday, 26 May

Visit: Selnecnic Diene and Zelanagorsk water purification plants.

On this last working day of the Seminar, the party visited Solnecnic Diene and Zelanagorsk, some 60 km north of Leningrad.

Mr Novikov narrated the history of the water supply in Leningrad city. At Solnecnic Diene, water is derived from three boreholes which supply 11-12 000 m^3/day. Purification of the water using electrolysis began here in the year 1969. Liquid chlorine was not used for fear of injuring the health of the children. The disadvantage of using liquid chlorine is that it is a toxic substance requiring special safety measures, particularly for transportation, storage and dosing. Also the cost of delivering chlorine over long distances sometimes increases expenditure six to eight times. Therefore the Institute was requested to investigate and produce a better method. They produced the present method which has provided safe water, i.e. the employment of electrolysis to make sodium hypochlorite. This system has been operating successfully during the last two years. The hypochlorite is produced from NaCl which is diluted in a tank to a concentration of 120 g/l. The solution is then further diluted to a concentration of 60-70 mg/l, after which it is electrolysed to sodium hypochlorite of 8-10 mg/l of active chlorine using graphite electrodes.

The water in many of the underground sources such as Zelanagorsk, which was next visited, contains from 6-8 mg/l of iron and the system now used to get rid of the iron is much more efficient than the conventional system used previously. This involves pre-chlorination followed by only slight aeration after which the water passes through a filter, and does away with sedimentation before filtering. At Zelanagorsk, one of the old sedimentation tanks had been converted to a rapid filter. This had proved most successful and a very good quality water had been produced.

Explanations of the plant were given by Mr Novikov and Mr Losovsky.