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EDITORS

DAVID L. EDSALL, M.D., S.D., United States

A. F. STANLEY KENT, A.M., D.Sc., Great Britain

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CHRONIC BENZOL POISONING *

THOMAS M. LEGGE, M.D., D.P.H.

HC Majesty's Medical Inspector of Factories and Workshops, Great Britain

IN January, 1918, two cases of purpura hemorrhagica were brought to the notice of the Factory Department by Dr. Veitch of Edinburgh. The illness affected two men employed in a large rubber works as rubber spreaders; one case was reported as already having proved fatal; the other, as being seriously ill in hospital. These are the first cases of chronic benzol poisoning known to have occurred in this country.

Cases of chronic benzol poisoning have been reported from time to time from other countries. In 1911 two fatal cases in rubber works (characterised by purpura hemorrhagica) were reported from Austria (1). Santesson (2) reported in 1897 four fatal cases occurring among nine women engaged in a tire factory in Sweden. The prominent symptoms of these cases were purpuric spots (*i. e.* hemorrhages into the skin) and hemorrhage from the nose and mouth. Three similar cases were also reported by Selling (3) in 1910 in an American cannery among girls employed using a solution of rubber and benzol for sealing tins. In all the cases in which blood counts were made a great diminution was observed in the number of red blood cells which, in one case, fell to 640,000 per c. mm., together with marked leucopenia (diminution in the number of white blood corpuscles), the loss chiefly affecting the polymorphonuclears (special form of white blood cells).

Investigation by Dr. Bridge of the cases reported by Dr. Veitch showed that the two men were employed in rubber works spreading balloon fabric. In September, 1917, they had been transferred to a new spreading room accommodating twenty spreading machines. Three machines were used for spreading the balloon fabric, the rubber for this being dissolved in benzene (crystallisable benzol); the solvent previously used having been coal tar naphtha. The two men concerned were working on two of the three machines. The first man left work on Dec. 11, 1917, and died on the

18th. the second gave up work on Dec. 13, 1917, and died on Jan. 9, 1918. Approximately, therefore, three months elapsed between the commencement of intoxication and the onset of acute symptoms. The ages of the two men were 30 and 29 years and both were apparently healthy young men. As Dr. Veitch stated "both were young men, both were changed from one room to another, both were changed from one drug to another, and both developed the same symptoms at the same time." The history of these cases was practically identical, commencing with malaise and anemia which was followed by subcutaneous and submucous hemorrhages, and both were eventually admitted to hospital suffering from bleeding from the nose, gums and bowels. The blood count of the first case, under the care of Professor Gulland of Edinburgh, was as follows: — Red blood cells, 2,800,000 per c.mm.; white cells, 2,000 per c.mm.; hemoglobin, 35; color index, 0.6.

The chief characteristic of the post-mortem examination in both cases was numerous submucous hemorrhages throughout the intestinal tract and under the endothelium of the heart. In the second case, where a more detailed examination was available, characteristic changes were observed in the bone marrow of the long bones. The conditions observed in life and after death were those seen in cases of aplastic anemia and are identical with those which have been noted in twelve cases (all fatal) arising from poisoning by T.N.T.

A third case was reported in July, 1918, and also proved fatal: the patient was one of three men employed in coating metal rims with rubber solution in the manufacture of pneumatic tires. The use of benzene as a solvent commenced in January, 1918, and a description of the working conditions found is worth stating as it shows the adverse effect produced by accidentally diminishing ventilation where fumes from benzene or other similar bodies are given off during work. The workroom

* Reprinted from the Annual Report of the Chief Inspector of Factories and Workshops, Great Britain, for the Year 1918.

was the corner of a large spreading room partitioned off partly with glass and partly with wood. The dimensions were: — 12 feet long, 12 feet wide, and 11 feet high; there were six windows made to open, four being placed on one side and two at one end. The area of each when fully open was 28 by 36 inches.

At the beginning of May, 1918, structural alterations were commenced on the floor above and, in order to support the framework of the windows, wooden uprights were inserted in the window-frames. This prevented four of the windows opening beyond a few inches, so that from May onwards ventilation was only provided by means of two windows. The man who died was one of three men employed in this room; he was 33 years of age, and presented the same symptoms as those recorded above.

Although in both instances medical examination was immediately made of all the other workers exposed to benzol, no other worker showed any signs of poisoning.

The firm's chemist made determinations of the amount of benzol in parts per 10,000 of air at different places in the spreading room.

Sample From	No. of Machines Spreading when Sample Was Taken	Benzene in Parts per 10,000 of Air
Middle of corridor opposite a machine	7	e.1
In front of a fan and at back of machine, machines on both sides, both spreading	8	10.5
Between two adjoining machines, both spreading, 1 ft. from floor	6	3.7
Between two adjoining machines, both spreading, close to ceiling	6	4.6
1 ft. from gauge of a machine at level of spreader's face	5	2.5
1 ft. from gauge of a machine where boy takes up cloth	10	2.5
During spreading of varnish coat	8	8
During spreading of varnish coat	5	7
During spreading of body gum	3	4
Dough mills at height of worker's face	—	6

From these data Mr. Stevenson Taylor calculated that in a spreading room with a capacity of 55,000 cubic feet and containing 10 spreading tables for proofing balloon fabric, 15.33 cubic feet of benzol vapor will be produced per minute. Hence, with 30 changes of air per hour, assuming uniform diffusion of the vapor, the atmosphere in the room would contain .055 per cent. (i. e.,

5.5 parts in 10,000) by volume of the vapor. This amount is well below the lower explosive limit for mixtures of benzol vapor and air, which is 3 parts of benzol vapor and 97 parts of air, the upper explosive limit being 6 parts of benzol vapor and 94 parts of air. If the same room were unventilated, at the end of an hour the atmosphere in it would contain 1.68 per cent. (i. e., 168 parts in 10,000).

In view of the dangers disclosed, the alternatives were either to stop the use of benzol or to increase the ventilation of the rooms in which it was to be used so as to reduce the percentage of benzol in the air below a toxic limit. The experience gained in the ventilation of dope rooms encouraged belief that the same method of dealing with rooms in which benzol was being used would prove effective, and it was on these lines the Factory Department proceeded. The ventilation in the spreading room where the two fatal cases occurred was immediately taken in hand and was improved so that the number of changes of air per hour was increased from sixteen to fifty-seven. Immediate steps were taken to protect the workers on tire manufacture and the work was transferred to a room efficiently ventilated. Subsequently in the pneumatic tire room, a fan displacing 4,370 cubic feet of air per minute was installed, and a sample of air tested with the windows open but with the fan stopped showed 28 parts of benzol per 10,000 of air while, with the fan running, a sample taken as near as 18 inches from the work performed showed only 8 parts. The result in both cases was satisfactory in that no further cases occurred.

Medical supervision of the workers was also immediately instituted and all firms likely to be engaged on this class of work were visited and instructed as to the precautions they should take in the event of benzol being used.

Dr. J. Burnet, the Certifying Surgeon for Edinburgh East, who carried out the periodic medical examinations of these workers, regards hemorrhages from the mucous membrane of the gums and nose as an early symptom and one that can be safely used as a guide for the purpose of exclusion from work (4).

Alternatives to benzol were also considered. Inquiry was kindly undertaken on this point by Dr. H. H. Dale, F.R.S., and Miss F. M. Durham of the Medical

Research Committee into the toxicity of a mixture known technically as "Xylol compound," which was capable of being supplied in large quantities by the Asiatic Petroleum Company. The point referred to was whether it could be used safely as a

rubber solvent. Dr. Dale reported that "from the practical point of view, it seems that the Xylol compound could be used as a rubber solvent with, at any rate, very much less danger of causing aplastic anemia and purpura than benzene."

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NOTE ON ANTHRAX IN KASHMIR

R. PROSSER WHITE, M.D.

ANTHRAX is one of the dangerous occupational diseases to which man is liable. Sporadic cases will assuredly crop up in different countries of the world unless it is stamped out at its original sources.

Ernest F. Neve in an article on *Cutaneous Anthrax* (British Medical Journal, 1919, Vol. II, page 559) says, "it is extremely common in animals in Kashmir. Every few years an epidemic sweeps through the valley carrying off thousands." Since 1900, seventy-five men have been treated by him at the Kashmir Mission Hospital for cutaneous anthrax, and he finds the disease is becoming more frequent. So far as Neve knows, the hides of animals are exported without warning or precautions. Of his cases, 40 per cent. were affected in

the upper extremities, 32 per cent. in the head and neck, and 12 per cent. in the back. In the hide and skin industry, out of 923 cases investigated by W. Koch, the head and face were primarily affected in 48 per cent., and the upper extremities in 40 per cent. Legge finds, in the heavy woolen industry, the incidence to be head and face 45 per cent., neck 41 per cent., and upper extremity 12 per cent. Neve, in his article, utters the serious plaint "that the prophylactic serum which is procurable at the Imperial Bacteriological Laboratory, Muktesar, has not yet been brought into use." Only seven died out of his series of seventy-five cases. His only treatment was a very thorough cauterization with a red-hot button cautery.