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ON THE HAZARDS OF UPPER EXTREMITIES CAUSED BY PORTABLE PNEUMATIC TOOLS — ESPECIALLY ON X-RAY FINDINGS OF WORKERS' ELBOWS.

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Concerning symptoms of the arms resulting from the use of pneumatic tools, many reports have already been published. The results of our investigation as to the physical troubles of both right and left arms of rivetters and holders in a dock-yard in Kobe, Japan, will be reported hereupon.

38 rivetting workers in all (22 rivetters and 16 holders) were queried orally, and both elbow joints of 14 workers of them (7 rivetters and 7 holders) were examined roentgenologically.

The following table shows distribution of workers according to age and work experience.

Age Years of experience	20-24	25-29	30-34	35-39	40-44	45-49	Total
1-4	(1)						(1)
5-9		1 (2)	3 (1)	1 (1)	(2)	(1)	5 (7)
10-14		1	3 (1)	(1)	(2)	(1)	4 (5)
15-19			2 (2)	1	1	1	5 (2)
20-24					4 (1)	4	8 (1)
Total	(1)	2 (2)	8 (4)	2 (2)	5 (5)	5 (2)	22 (16)

Figure in brackets shows the number of holders.

The rivetting conditions of our investigation were 840 c. p. m. with the amplitude of 3.6 mm. in case of rivetting of one and one eighth inch rivets and 860 c. p. m. with the amplitude of 2.5 mm. in case of rivetting of seven eighth inch rivets. The rivetting tool in each case weighed 12 kg.

Results.

More rivetters than holders complained of numbness, pain and blanching of fin-

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gers as shown in the Table 1 and 2. No difference of symptoms between the whip hand and the other hand was found.

Table 1. Numbness and Pain in Fingers.

	Whip hand	Other hand	Both hands	Total	No symptom	Grand total
Rivetter	6	5	8	19	3	22
Holder.	4	2	5	11	5	16
Total	10	7	13	30	8	38

Table 2. Blanching of Fingers.

	Whip hand	Other hand	Both hands	Total	No symptom	Grand total
Rivetter	1	1	5	7	15	22
Holder	1	1	2	4	12	16
Total	2	2	7	11	27	38

Table 3. Difficulty in Bending of Joints.

		Finger	Wrist	Elbow	Total	No symptom
Rivetter	Whip side	1	0	0	1	15
	Other side	0	1	1	2	
	Both side	3	2	1	6	
	Total	4	3	2	9	15
Holder	Whip side	2	1	0	3	8
	Other side	2	1	1	4	
	Both side	2	0	1	3	
	Total	6	2	2	10	8

Table 4. Arthralgia.

		Wrist	Elbow	Total	No symptom
Rivetter	Whip arm	0	0	0	12
	Other arm	2	1	3	
	Both arms	6	4	10	
	Total	8	5	13	12
Holder	Whip arm	4	2	6	4
	Other arm	5	1	6	
	Both arms	1	1	2	
	Total	10	4	14	4

More workers than expected complained of troubles in joint bending or pains at the joints. No difference in incidence was found between the rivetter and holder. As to the degree of severeness, rivetters exceeded holders. More frequent and severer cases were found in the arm opposite to the whip hand. (See Table 3 and 4.)

Table 5. Incidence of Pain in Seasons.

	Spring	Summer	Autumn	Winter	No pain
Rivetter	2	4	2	13	8
Holder	2	3	2	6	9
Total	4	7	4	19	17

Table 6. Time of Occurrence of Symptoms.

	On way to work shop	During work	After work	After return- ing home	During bed time	After leav- ing bed
Rivetter	2	7	8	3	13	7
Holder	0	3	2	2	4	4
Total	2	10	10	5	17	11

As to the relations of frequency of cases to the season the largest percentage of cases was occupied by the sufferers in winter, followed by those in summer, spring and autumn. Blanching and pains of fingers were found most frequently during winter and quite a number of workers complained of arthralgia even during summer. (See Table 5.)

As for the hours of their complaints, complaints during bed time were the most, followed by those during working hours and after their daily work as shown in the Table 6.

Such symptoms as mentioned above are complained by workers, especially when large rivets are handled.

Roentgenological findings:—

Elbow of seven rivetters and seven holders were examined roentgenologically at the conditions of 44 K. V. P., 80 mA. of current, 80 cm. in distance and 0.5 sec. of time. The deformation at the head of radius, trochlea of humerus and olecranon of ulna were described in the Table 7.

According to the degree, the deformation of elbow joint bones is classified into A, A', B, B', C and C', where A indicates normal and C the roentgenologically discernible abnormality.

As shown in the Table 7, changes in elbow joints were generally noticeable roentgenologically though they were slight in degree. These changes were mostly "Osteo-hyperplasy" of the head of radius. The changes at the trochlea of humerus and

Table 7. Roentgenological Findings of Elbow Joint.

	No.	Age	Work experience	Right elbow joint			Left elbow joint		
				Head of radius	Trochlea of humerus	Olecranon of ulna	Head of radius	Trochlea of humerus	Olecranon of ulna
Rivetter	1	24	11	A	A		A	A	
	2	30	8	A'	A		A	A	
	3	39	20	A	A	Spine formation	A	A	Spine formation
	4	41	19	A'	A		A	A	
	5	31	15	B	A		A'	A	
	6	37	16	A'	A		B	A	
	7	43	17	A'	A'	Spine formation	B	A'	Spine formation
Total				A 2, A' 4, B 1	A 6, A' 1		A 4, A' 1, B 2	A 6, A' 1	
Holder	1	42	14	A'	A	Tendency of spine formation	A'	A	
	2	31	15	A'	A		A'	A	
	3	39	6	A'	A		A	A	
	4	27	11	A	A		A	A	
	5	30	6	A	A		A	A	
	6	33	14	A	A	Tendency of spine formation	A'	A	
	7	38	13	A	A	Spine formation	A	A	Spine formation
Total				A 4, A' 3	A 7		A 4, A' 3	A 7	

Such signs were observed on three workers with 15 or more years of experience to the medium extent. Other cases were of slight degree. Changes in case of holders were found to be generally slight.

However, the roentgenological examination could not detect any change which would have been caused by the use of pneumatic tool.

Summary

Summing up the above mentioned symptoms and signs among rivetting workers of shipbuilding industry, the following will be concluded:

1) More workers than generally expected complained of the symptoms on their arms, although they were not so serious as to require medical treatment. Of the sufferers of arthralgia, many complained of the pains in wrist joints.

2) Although not much difference between rivetters and holders as to the incidence of such symptoms was found, rivetters complained of stronger symptoms than holders.

3) Less difference in the symptoms between the whip hand and the opposite arm was observed in case of holders, while much difference in case of rivetters.

4) The changes in the elbow joints as seen on roentgenograms were of slight degree contrary to a general supposition, but medium degree in some cases of rivetters.

In other words, the symptoms and signs of the arms of shipbuilding rivetters are of so slight in nature on the whole that continuation of their work is possible if proper control of work and rest are provided to them.

However, in large shipbuilding yards there is the growing tendency of constructing larger vessels which results in employing of larger rivetting machines and larger rivets. Furthermore, with the progress in welding technique, rivetting shops and workers have decreased in number and consequently the rivetters are liable to be subjected to overwork. Naturally there is a possibility of increase of sufferers from diseases concerned. As a result of the adoption of the block construction system in shipbuilding the working method of rivetters, especially their rivetting postures, has undergone changes, so in further investigations on hazards of the rivetter these matters should be taken into consideration.

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Before concluding, it is our pleasurable duty to express our sincere thanks to Prof. Shuzo Matsushima and Prof. Takeo Yamori, to whom we owe much advices during the preparation of this paper.

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