

of accommodation and plus 1.16 (4.35 - 3.19) to replace the 4th dioptré of accommodation.

To bring out the points presented more fully the distance between the second principal point of the lens and the first principal point of the eye was taken as 20 mm. instead of the usual 15 mm. This somewhat exaggerates the findings.

OPHTHALMIC PROBLEMS AND VISUAL STANDARDS IN INDUSTRY*†

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WITH the expansion of the Industrial Medical Services has come the realization that the industry presents many visual problems which have to be faced and eventually solved. So far, although this country has made no unified attempt to deal with the vision of employees, individual firms have done so. In 1938 the Industrial Welfare Society sent out a questionnaire to its 750 member firms in order to find out whether applicants for employment had to pass eyesight tests and what minimum visual standards were considered necessary. From the replies received from 398 firms, employing about 1,000,000 workers, it was found that most firms do not insist on eyesight tests; and that the many firms who are vision conscious vary in their approach to the problem. Thus while many small firms do not require employees to pass eyesight tests, others representing the same branch of industry insist on them. A large number of firms, having instituted eyesight tests demand a visual standard of 6/6 or 6/9 in each eye, while other firms are satisfied with 6/12 in each eye.

In this paper an attempt is made to elucidate some of the principles which may guide industrial medical officers in the selection of employees for various jobs in industry. There is no doubt that greater efficiency will be achieved in industry if we place the workers in the jobs for which they are best physically fitted. This would eventually be followed by a larger output in production and would in addition ensure the safety of the workers in many branches of industry. However, under present conditions of employment a country wide compulsory medical examination could not be instituted for all workers. Should such an examination be

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carried out a huge pool of physically unfit would be created whose members would have to be re-trained and then placed in suitable employment. This is a big problem which it is hoped will be tackled in the future. A number of private firms have already adopted the principle of a compulsory medical examination of employees and the direction of workers into jobs for which they are best physically suited. This policy which is ideal if carried out in combination with the training of the physically handicapped must be put on a sound medical basis.

Ophthalmic work of the examining factory surgeon

The Factories Act of 1937 provides that juveniles (14-16) should be examined by the examining surgeon and an eyesight test be carried out. The general examination of the workers must be thorough; the examining surgeon should be able to refer cases to consultants for special examination. At present the examining surgeon is given no instructions as to the visual standards required in the various branches of industry and in most cases he has no facilities for the efficient examination of the vision of the juveniles. It is essential that the examining surgeon and the industrial medical officer should use a Snellens type at 20 feet when the worker's vision is tested, and should the vision of the applicant for employment be less than 6/12 in each eye he should be referred to an ophthalmic surgeon. The Medical Boards examining all men for War Service refer those whose vision is less than 6/12 in each eye to an ophthalmic surgeon for an opinion. The same procedure might well be followed by the examining surgeon and the industrial medical officer. The ophthalmic surgeon would then report on the vision of the individual as corrected with glasses. The visual standards laid down by the Army, Navy, and Air Force are based on the vision of the individual corrected with glasses. In special jobs in the Navy and for Air Crews in the Air Force as well as in the case of drivers of public vehicles (trains, buses, and trams) high visual standards without glasses are demanded. For all workers in industry the use of glasses presents no handicap and the efficiency of the worker is in no way diminished by their use. On the other hand investigations in the various branches of industry have shown that workers whose vision has been satisfactorily corrected with glasses have suffered from fewer symptoms of eyestrain when engaged at work than the workers who have not had an ophthalmic examination.

Suggested visual groups in industry

Modern industry is capable of employing men and women with all grades of vision—from Grade 1, with the highest vision, to the partially and even totally blind. The standards of vision required

in industry need not be rigid, but should vary according to the jobs assigned to the workpeople in the factory. For purposes of classification all occupations can be divided into four groups. In the first group are the occupations which require especially good eyesight, such as the very close work necessary in the manufacture of silk yarns, silk hose, inspection and manufacture of electric light bulbs and radio valves, watch making, invisible mending, jewel work, etc. In the second group are the industrial occupations and distributive trades which require normal eyesight. In the third group are those occupations suitable for those with weak eyesight, such as cookery, soapmaking, gardening, billposting, etc. In the fourth group are the trades in which blind people are employed, brush making, basket work, piano tuning, massage, physiotherapy, and many others. A more detailed classification of the visual standards required in industry is given below. The following grades of vision are suggested in allocating applicants for employment, whether juveniles or not, to various occupations.

Grade I vision.—To this group belong all those possessing 6/6 or 6/9 vision in each eye and also those having 6/6 in one eye and not less than 6/36 in the other eye. Individuals in this group are fit for all occupations.

Grade II vision.—Individuals having not less than 6/12 in each eye and also those having 6/12 in one eye and not less than 6/36 in the other eye. Workpeople with Grade II vision are fit for all industrial occupations except for the very close work essential in the manufacture and inspection of radio valves, electric lamps, certain silk yarn trades and a few others. Grade II vision is sufficient for all clerical work, the engineering industry, and the driving of vehicles.

Grade III vision.—In this group are all the one-eyed people who have 6/6, 6/9, or 6/12 in the good eye, and less than 6/36 in the other eye, or who have one blind eye. The one-eyed with 6/6 in the good eye are fit for all occupations even for those which require fine close work. The one-eyed who have 6/9 or 6/12 vision can be engaged in most trades and industries. Certain occupations such as coalmining, and certain operations in the engineering trades such as hammering, chipping, turning, milling, etc. present a greater danger of injury to the eyes. It is therefore suggested that one-eyed workers should not be engaged in coalmining or any of the above mentioned engineering operations.

Grade IV vision.—To this group belong the workpeople who have 6/24 vision in each eye, or 6/24 in one eye and 6/36 in the other eye. People with grade IV vision can be employed in all outdoor occupations, building trades, carpentry, dock labour, portering, and many other like trades.

Grade V vision.—To this group belong the blind and partially blind and can include all individuals with less than 6/36 vision in either eye.

The National Institute for the Blind has issued several pamphlets dealing with the employment of the blind. They show how since the beginning of the war the blind and partially blind have been employed in hundreds of industrial occupations. (1) Assembling of petrol tanks, crash helmets, ball bearings, etc.; (2) Bakery work; (3) Boot repairing; (4) Catering; (5) Clerical work; (6) Engineering work, and (7) Machine operating, and several others.

This subdivision of workpeople into 5 groups is meant to be a guide only, for the industrial medical officer will often come across workmen with 6/24 vision in each eye doing excellent work in the engineering trades where a higher vision should be required. Vision is only one of the factors necessary in the make up of the skilled worker. High intelligence and experience often counter-balance the handicaps which arise from a poor visual acuity. Such people should not be turned away from their jobs for in the selection of the right man for each job the total mental and physical make up of the individual should be the guide.

Close Work.—Fine work at close range presents a special problem in industry. The radio valve manufacture, electric lamp inspection and manufacture, fine weaving and silk hose manufacture necessitate working at ten inches or even less from the job. This requires a constant accommodation effort and convergence to a greater degree than does ordinary clerical work. In the selection of workers for these jobs greater attention should be paid to a full investigation of vision. The visual acuity required is 6/6 or 6/9 in each eye. The muscle balance and binocular vision should also be investigated. A Maddox wing can be used for measuring the muscle balance of the eyes for near vision and a Worth's amblyoscope is a very convenient instrument for estimating the degree of binocular vision (fusion, stereopsis, and convergence). Both instruments are small and cheap. Industrial Medical Officers are not usually fully acquainted with the details and interpretation of muscular imbalance. It would therefore be advisable that an investigation by an ophthalmic surgeon be carried out on all individuals engaged or likely to be engaged on such work. Young men and women with a high error of refraction (latent hypermetropia) will often have 6/6 vision but will suffer from headaches when engaged at close work. In all such cases a routine examination by an ophthalmic surgeon would lead to a correction of refractive errors and of muscle imbalance and thus would prevent headaches and eyestrain from which workers often suffer. As a general rule one can state that individuals with

refractive errors, if properly corrected with glasses, suffer no discomfort when engaged at close work. Older workers wearing glasses to correct their presbyopia are just as efficient as younger workers. Investigations of the Industrial Fatigue Research Board in 1927 and 1928 (Weston and Adams) have shown that persons engaged in very fine close work suffer from eyestrain which is in many cases relieved by the wearing of spectacles provided with strong prisms (base in) to relieve the excessive convergence. These investigations have been confirmed and in some factories these spectacles, which are also provided with a magnifying lens are issued to the workers, but of course they are not always worn. Dr. L. B. Bourne recently reported on the procedure in careful selection of workers employed in radio valve manufacture which involves close work on very fine parts. Employees are graded according to their distance and near vision, and on the degree of muscle balance of the eyes. Employees who have phorias (exo or esophorias) greater than five prism dioptres are not put on fine close work. The adoption of this procedure has been followed by very satisfactory results. Only a very small number of workers, about 2 per cent., have complained and asked to be transferred to another section of the factory where such fine close work is not necessary.

Recent research in binocular vision has shown that not only phorias but also poor stereoscopic vision may often be responsible for symptoms of eyestrain. The conclusions reached in "A Study of a Selected Group of Women Employed on Extremely Fine Work" (Ida Mann and Dorothy Archibald) are that to be able to continue fine close work without fatigue one should have a well developed stereoscopic sense and good muscle balance for the near point. As a general guide one could recommend that employees engaged in very fine close work should not have hyperphoria. The exophoria or esophoria must not be greater than five prism dioptres. They should have good stereoscopic vision in addition to a corrected visual acuity of 6/6 or 6/9 in each eye. It is interesting to note that one-eyed workers with 6/6 vision in the good eye can continue working comfortably in occupations involving fine close work. Such careful selection of workers for fine close work should be done in factories, training and rehabilitation centres, by ophthalmic surgeons who should have the assistance of an orthoptist who might carry out treatment of individuals with small degrees of muscle imbalance and poor stereoscopic vision but who are otherwise fit and willing to do such work.

Myopia.—The ophthalmic surgeon is often asked by myopes and parents of short-sighted adolescents whether it is safe for them to carry on with clerical work or any other type of close work.

There is no evidence that close work has any effect on the progress of myopia. In the past ophthalmologists held the view that close work caused a deterioration of the sight of myopes (a progression of myopia). Recent investigations have not confirmed this opinion. Myopes whose vision with glasses is 6/6 or 6/9 each eye can carry on comfortably with fine close work (needlework, weaving, etc.). Myopes with 6/12 vision in each eye are fit for all types of clerical work. Adolescents suffering from myopia, whose corrected vision is less than 6/9 in each eye at the age of 16, should be advised against taking up close work, as with the natural progress of myopia between the ages of 16 and 25 there is a likelihood of their vision further deteriorating. At the age of 21 they might have 6/18 vision only and find themselves unable to carry on with clerical work or any other type of close work with comfort. The selection of a suitable job by a high myope in adolescence will obviate many years of wasted training.

Latent hypermetropia.—The Railway companies insist that employees who are training as firemen and later as engine drivers, should have, on entering their service, 6/6 vision in each eye without glasses. Many young men with a latent hypermetropia of 2 or 3 dioptres have 6/6 vision each eye without glasses and pass the necessary eyesight tests required by the Railway companies. At the age of 40 their latent hypermetropia becomes manifest and their vision without glasses drops to 6/18. When re-examined at this age their vision is below the required standards without glasses, although their vision with glasses is 6/6 in each eye.

These men are refused promotion from firemen to acting drivers and are given lower grade jobs with loss of wages. The same applies to drivers of public vehicles who are not allowed to go on driving. They have wasted many valuable years in training for a high grade job and at middle age are refused promotion. This could have been prevented had an ophthalmologist examined their eyes before they had taken up employment. The railways and other public transport companies should not employ men who are to be trained as drivers if their latent hypermetropia is 2 dioptres or over.

The selection of workers for suitable jobs is one of the great problems to be solved after this war. With the co-operation of the industrial medical officers, ophthalmologists, psychologists, and safety officers a great deal may be accomplished.

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ANNOTATIONS

An Error in Diagnosis

Border-line cases between two special departments in surgery are often intriguing. Some forty years ago, when the writer was house surgeon to the ophthalmic department, an elderly man was admitted for marked ectropion of the left upper lid. The lid was completely turned back upon itself and kept in this position by a tense band of tissue leading towards the inner end of the eyebrow where was a puckered scar attached to bone. The man said he had had abscesses in the forehead for years and had been treated in out-patients. His out-patient book was found, from which it appeared that twenty or more years previously he had been under treatment by one of the surgeons and the diagnosis made at the time was gumma of the skull. Much iodide of potash had run down his throat since. The ophthalmic surgeon incised the puckered scar, freed the lid which resumed its proper place, and the man was discharged soon after. Some months later, when we were house surgeon to the hospital, this man was re-admitted with ectropion as before. He was referred to our surgeon who was inclined to consider the primary cause as a gumma of the skull. We had no idea what made us offer an opinion unless it was that the surgeon asked what we thought; but, looking at the site of the puckered scar it occurred to us that his trouble might all the time have been in the frontal sinus and we suggested a reference to the nose and throat surgeon. This was done and old standing disease was found in the sinus. The man was treated surgically and some saving in the expenditure of iodide of potash was made. It seems odd that such a prolonged history of chronic disease should have persisted without a proper nasal examination. But the error of repeating a medicine, which may do good and cannot do much harm, is an easy one to fall into in out-patient practice. Also the house surgeon must know his chief and his foibles pretty well before he