become ambulant after a pure conus or cauda equina injury, and yet be able to go about much as he desires when he has learned the precautions necessary to his state.

Treatment

The immediate treatment of all cases will be decided upon after a survey of the neurological signs, and of lateral radiographs of the spine. In cervical injuries good pictures of the lower end of the region are not easy to obtain, especially when there is a complete and high cord injury, because the shoulders are commonly elevated abnormally by the unopposed action of the trapezius and levator scapulae muscles. This can be overcome by the taking of stereoscopic oblique views of the thoracic inlet. Without exact information of the injury it is impossible to proceed. In general it is, of course, proper to reduce the dislocation, if one is present, but it must be observed that crush fractures without notable displacement sometimes occur in the cervical region as well as lower down, and call for nothing more than immobilization followed by plaster. As for the dislocation, some have been reduced by manipulation under anaesthesia, others by slow traction. I have not been favourably impressed by the method of reduction described by Taylor¹⁰ of New York, although he got good results himself, in which great tractive power is developed by means of pulleys. I have reduced one case by this means, completely failed with another after two attempts, and in a third I believe the cord injury was made worse.

The difficulty in any method is to get the traction in precisely the right plane, without at the same time risking forward tilting of the upper fragment. The neck is so mobile at the point of dislocation, below the level as well as above it, that the lower fragment tends to be uncontrollable. Plain backward extension is equally not without danger. I feel sure that the safest plan is to try for slow reduction by fixing the head to the top of the bed and using the inclined body weight as the reduction force. I have no experience of the ice-tongs method advised by Coleman and by Mackenzie, applied after making small superficial burr holes in the skull. Whether this is less irksome than the collar encircling below the chin and occiput is debatable, but intrinsically it is a sound method. It is certain that complete reduction is not easily achieved, or once achieved is not readily maintained. Most of my own cases and those of others that I have seen have been imperfect, though perfect examples have been obtained.

I shall leave the discussion of the treatment of the thoracic and lumbar injuries in other hands. There is no doubt that the Watson Jones' method is admirable in its results on the vertebral injury. So much must at once be admitted. The point that we have to discuss is whether it is an equally good method when there is neural damage. Its advantages are that it will reduce the bony displacement provided that that is not of too extravagant a kind, and that it will be likely to relieve the cord of pressure. But no method, however skilfully applied or resolutely carried out, will restore function to a severely injured cord—which means to a patient with a densely anaesthetic body. The advantages of reduction are that if the patient recovers he will be freed from the painful back which so often disables the workman. Against reduction are two points: (1) the fear of pressure sores in anaesthetic areas, and (2) the plaster case compels catheterization whether we like it or not. The best plan, in my view, is the making of a plaster bed for the severer cases, to be followed in a week or two by a plaster case if the improvement warrants it. This obviates the dangers of immediately enclosing a paralysed and anaesthetic patient, and so preventing any variation in treatment or observation of alteration in sensory levels.

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PULMONARY TUBERCULOSIS IN YOUNG ADULTS*

SIGNIFICANCE OF CONTACT HISTORY

BY

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AND

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The serious nature of pulmonary tuberculosis developing in young adult life was clearly shown by A. S. MacNalty in 1932 in his report on tuberculosis,¹ in which he stated that "towards the end of childhood and in young adult life . . . approximately one-third of the deaths from all causes in males, and almost one-half of the deaths from all causes among females, are due to tuberculosis, chiefly of the pulmonary form." The problem of young adult tuberculosis has been and is being attacked from many angles, and we, in our present investigation, have attempted to ascertain the significance of certain of the aetiological factors, with special reference to the history of contact with persons known to be suffering from pulmonary tuberculosis.

The histories of 1,000 patients between the ages of 15 and 25 years in whom a diagnosis of pulmonary tuberculosis had been made have been carefully examined. In the case of those with a history of contact with any person suffering from definite pulmonary tuberculosis we have noted whether this person was: (a) one of the family—parent, brother, or sister—or other relative; (b) a friend in the same household or not; and (c) a fellow-worker with whom there had been close association. So far as was possible information has been obtained of the details of the length and degree of exposure to the infection, the age of the patient when thus exposed, and the early symptoms which led to the diagnosis of the disease. Other points of possible aetiological significance have been noted—namely, type of occupation, hours of work, and mode of travel to work.

Of our series of 1,000 patients suffering from pulmonary tuberculosis 663 had tubercle bacilli in the sputum and the remainder had definite clinical and radiological evidence of the disease; no patients with a doubtful diagnosis or with pleurisy alone were included in the series. Apart from this there was no selection of material.

We found, in recording the family histories, that a number of patients were ignorant of the cause of death of even their near relatives, or else were content with such terms as "asthma," "bronchitis," "pleurisy," or "congestion of the lungs." Although some of the diagnoses were suggestive of pulmonary tuberculosis, we have included these patients in the "non-contact" group, and have also put in this group those (twenty-six) cases with a family history of meningitis or surgical tuberculosis only. In all those who were exposed to infection outside the household contact had been definite and repeated. The contact group, therefore, includes only those patients with

* The expenses of this investigation were defrayed by a grant from the Halley Stewart Trust.

an unmistakable history of contact with a definite case of pulmonary tuberculosis.*

The series consists of 634 females and 366 males, and the majority of cases in both sexes were diagnosed between the ages of 18 and 23 years.

Results

The results of the first part of the investigation, as seen in Table I, show that 396—that is, roughly, 40 per cent.—of the patients gave a history of contact with a case

TABLE I

	Contact	Non-contact	Total
Males ...	131 (36 %)	235 (64 %)	366
Females ...	265 (42 %)	369 (58 %)	634
Total ...	396 (3.96 %)	604 (60.4 %)	1,000

of definite pulmonary tuberculosis previous to the onset of their disease. In similar investigations by other workers the percentage of patients having a history of contact in the family or household was 41 of 3,000 patients at Hauteville Sanatorium² (Stephani-Cherbuliez), and 36 of 500 dispensary patients at Leeds³ (Tattersall).

Unfortunately we do not know of any published figures for the contact history in the 15 to 25 age group of the general population for comparison with our figures, and any attempt at comparison with histories of patients with diseases other than tuberculosis attending the Brompton Hospital would give an erroneous conclusion, since many of these sought advice on account of a family history of tuberculosis. However, since about forty out of every 100 cases of young adults with pulmonary tuberculosis were known to have been exposed to infection, we consider that a history of contact with the disease is of definite aetiological importance and justifies a more detailed study.

Details of Contact History

History of a known case of phthisis in the household was found in 82 per cent. of all the contact cases, and outside the household in 18 per cent. of the cases.

In Tables II and III the different relationships of the household contacts are shown. From these it is evident

TABLE II

Source of Infection	Number of Cases	Per 100 Contacts	Per 100 Total P.T. Cases
Household	Mother ...	66	—
	Father ...	119	—
	Total parents ...	185	46.7
	Brother or Sister:		
	Same sex ...	71	—
	Opposite sex ...	56	—
	Total same generation	127	32
	Friends or other relations	14	3.6
Total in household ...	326	82.3	32.6
Ex-Household	Friend, fellow worker, or other relation	70	17.7
		396	100
			39.6

that contact with tuberculous brothers and sisters occurred in 32 per cent. of the contact cases, and contact with tuberculous parents in 46.7 per cent. Therefore the

* Those accepted as definite cases of pulmonary tuberculosis were persons who either had died of the disease or had had treatment in a sanatorium.

older generation was by no means responsible for all the known tuberculous infection in the family, but infection was apparently introduced in many cases by a brother or sister from a source outside the home. These figures may be misleading because undetected lesions in the parents may exist, but, for practical purposes, the history of contact in the same generation is an important factor, especially if we consider that there were, in our series, 60 per cent. of patients with no history of contact who definitely did thus introduce new sources of infection into their families. Contact with tuberculous brothers and sisters was also found frequently by Tattersall; in his series of 181 young adults with pulmonary tuberculosis with a history of contact in the family seventy-eight were known to have tuberculous brothers or sisters, thirty-five to have tuberculous parents, and thirty-two to have tuberculous parents and brother or sister.³

Another point of interest brought out in Table III is that, taking the parental contact group as a whole, exposure to tuberculous fathers was almost twice as frequent as exposure to tuberculous mothers, although this difference was less marked among the young adults who developed the disease between the ages of 16 and 20 years. Tattersall's figures again support our findings, as in his series the number of young adults with tuberculous fathers was twenty-seven, and with tuberculous

TABLE III

Age at Onset	Household					Ex-household	Total
	Mother	Father	Brother or Sister	Friend or Relative	Total	Friend, Fellow-worker, or Relative	
16-20 yrs.	41 (21 %)	57 (29 %)	60 (31 %)	7 (3 %)	165 (84 %)	32 (16 %)	197
21-25 yrs.	22 (12 %)	56 (31 %)	61 (33 %)	7 (4 %)	146 (80 %)	37 (20 %)	183
15 yrs. ...	3	6	6	0	15	1	16
	66	119	127	14	326	70	396

mothers seventeen. The importance of exposure to tuberculous fathers was suggested in a previous investigation carried out at the Brompton Hospital⁴ in which it was found that the incidence of tuberculous infection was slightly higher in children with tuberculous fathers than in children with tuberculous mothers. In contrast to this, the mortality rate from tuberculosis in young children is higher among those with tuberculous mothers than among those with tuberculous fathers.¹ The significance of these facts is difficult to assess, since many aetiological factors are involved, but the problem might with advantage be further investigated.

Interval between Contact and Onset of Disease

Although the duration of exposure to tuberculous infection is no doubt of importance, we could not feel sufficiently confident of the accuracy of the alleged date of onset of the disease in the person presumed to be the source of infection to draw any conclusions from this part of the investigation. On the other hand, the period between the last known exposure to infection and the onset of disease in the patient could be ascertained in all but three of the 396 cases. The remaining 393 fall into two groups: (1) those who were exposed to infection at the onset or within one year of the onset of disease; and (2) those who were no longer exposed because the individual who was the source of infection had been removed from the patient's environment or had died, or (in sixteen cases only) had become free from symptoms and was considered to be cured. Of the 393 cases 174 (44 per cent.) were known to have been exposed to infection

within one year of the onset of the disease, the remaining 219 (56 per cent.) being free from contact with known infection for over one year.

TABLE IV

Interval between Last Known Infection and Onset of Disease	No. of Cases	Per 100 Contacts
Under 1 year... ..	174	44.2
1-5 years	139	35.4
Over 5 years	80	20.4

In Table IV the cases are divided, according to the period of freedom from infection, into three groups: (1) those known to have been exposed within one year of the onset of the disease; (2) those known to have been exposed within one to five years of the onset of disease; and (3) those who were free from known infection for over five years. It is seen that the first two groups contain the majority of the cases—namely, 313, or 79.6 per cent. In other words, in four out of every five of the contact cases the onset of the disease occurred either during exposure to infection or within five years of the last known exposure to infection.

Early Symptoms

Interrogation of the patients concerning the symptoms at the onset of the disease has shown such variations in the degree of apparent illness that an attempt has been made to separate the 1,000 cases into two groups, according to their early symptoms. In one group, which we have called the "non-toxaemic," are included those with a history of haemoptysis or chronic cough but with no malaise, night sweats, or wasting, and also those persons without symptoms in whom definite radiological evidence of disease was found on routine examination. In the other group are included the "toxaemic" cases—that is, those with constitutional disturbances such as malaise, lassitude, night sweats, fever, and wasting, and those whose first symptom was either so-called influenza or an acute attack of pleurisy.

Among the non-contact cases (see Table V) there is a definite preponderance of toxaemic over non-toxaemic

TABLE V

Interval between last known Infection and Onset of Disease		Type of Onset				Total
		Non-toxaemic	Toxaemic	Pregnancy	No History Obtained	
Contact	5 years and under	108 (34.5%)	194 (62%)	5 (1.7%)	6 (1.8%)	313
	Over 5 years	40 (50%)	32 (40%)	3 (4%)	5 (6%)	80
	Total...	148 (37.7%)	226 (57.5%)	8 (2%)	11 (2.8%)	393
Non-Contact	{	171 (28%)	421 (70%)	10 (1.6%)	2 (0.4%)	604

(70 per cent. toxaemic and 28 per cent. non-toxaemic), and the contact cases, taken as a whole, show roughly an equal number of each type. However, on dividing the contact cases according to the length of interval between the last known exposure to infection and the onset of the disease, we find that in Group 1, in which this interval was five years and under, there is a preponderance of toxaemic cases (62 per cent. toxaemic and 34 per cent. non-toxaemic), and in Group 2, with a period of freedom from known infection of over five years, there is a slight excess of non-toxaemic cases

(50 per cent. non-toxaemic and 40 per cent. toxaemic). Although this division of the patients according to the history of their symptoms can at best be only a rough guide, yet these figures seem to suggest that the type of tuberculosis with toxaemic symptoms at the onset is the predominating one among the non-contact group of our cases; whereas among those who have not developed clinical tuberculosis until at least five years after the last known contact there is a relative increase in the number who develop the type of disease in which the onset is less acute. In a small way these differing reactions are a reflection of what appears in the history of certain races. Lyle Cummins has shown that South African natives, to whom tuberculosis is a comparatively new disease, develop an acute toxaemic form of tuberculosis.⁵ In China the opposite condition is found, for there tuberculous infection has been known to exist for centuries, and the disease develops insidiously and often without any evidence of toxaemia.⁶

In the toxaemic group, in 35 per cent. of the cases, the first symptom was so-called influenza (19 per cent.) or pleurisy (16 per cent.). According to the last report from the Research Department of the Brompton Hospital,⁷ early lesions were demonstrated in 0.5 to 1 per cent. of the adolescent population who had no more suggestive symptoms than these. Is it not worth while subjecting young people who suffer from these ailments to an examination more searching than is usual, to exclude the possibility of pulmonary tuberculosis?

Occupation

The occupation of the young adults in our series was another aetiological factor investigated. Of the 1,000 young adults with pulmonary tuberculosis 3 per cent. had no occupation, 7 per cent. were married women, and the remainder were employed at the onset or within a few months of the onset of illness. Most of them were working in offices or factories and workshops, these employments being responsible for 44 per cent. of the total.

A comparison between the occupations of the 1,000 tuberculous patients and 400 patients with no evidence of tuberculosis showed that there were 12 per cent. more office workers in the tuberculous group than in the non-tuberculous group. Although this is not a striking difference it is appreciable compared with the other occupations, whose incidence was remarkably similar in the two groups, except, perhaps, in the case of domestic servants, who were found less frequently among those with pulmonary tuberculosis (Table VI).

It was not possible to make any statistical estimation of the conditions of travelling, but our impression was that on the whole these were distinctly worse for the clerical workers than for the factory hands. There was a tendency

TABLE VI

Occupation	Per cent. P.T. Cases	Per cent. N. n-tuberculous Cases
Office	23.8 (238)	11.5 (46)
Domestic service	5.7 (57)	11.0 (44)
Factory or work-shop	20.0 (200)	19.5 (78)
Retail shop	10.1 (101)	13.5 (54)
Dressmaking, millinery or tailoring	7.4 (74)	8.0 (32)
School or university	3.3 (33)	4.9 (19)
Hospital nursing	3.2 (32)	2.7 (11)
Other occupations... ..	16.1 (161)	18.2 (73)
No occupation	3.2 (32)	4.8 (19)
Married women	7.0 (70)	6.0 (24)

for the latter to find employment near home, many of them walking or bicycling to work and returning home to their midday meal. Many of the office workers, on the other hand, had long journeys at the rush hours in conditions which must tend both to lower resistance and to facilitate the spread of any infection. An interesting statement concerning this subject was published in a recent report of the Industrial Health Research Board:² in clerical trades and light industries it was found that the factory worker had a lower rate of sickness than the clerical worker.

Conclusions

1. Contact with pulmonary tuberculosis is an important factor in the aetiology of pulmonary tuberculosis in young adults, and therefore it should be possible to detect the disease in its early stage in many instances by examination of all those with a history of such contact.

2. About four out of every five of young adults suffering from pulmonary tuberculosis who have been in contact with a known case of infection develop the disease within five years of exposure to the last known contact with infection—a fact which stresses the value of continuing the observation of contacts for at least five years after they were known to be last exposed to infection.

3. There is a history of household infection in 82 per cent. of the contact cases.

4. History of exposure to tuberculous fathers is almost twice as frequent as history of exposure to tuberculous mothers.

5. In about half of the contact cases spread of infection is not obviously due to transmission of the disease from parent to offspring, but in many cases infection is apparently introduced into the household by a brother or sister.

6. It is important to realize that 60 per cent. of the young adults who develop pulmonary tuberculosis are unaware of any contact with the infection.

7. In non-contact cases the toxæmic type of onset is more common than the non-toxæmic (70 per cent. versus 28 per cent.). If all classes of contact cases are taken together the toxæmic and non-toxæmic types of onset occur in about equal proportions. It appears, however, that if there is an interval of over five years between the last known exposure to infection and the onset of the disease the onset is more likely to be of the non-toxæmic type.

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R. Liberti (*Il Policlinico*, Sez. Med., August 1st, 1936, p. 400) states that the mortality among 143 cases of tetanus admitted to the Clinic for Infectious Diseases of the University of Rome from 1922 to 1935 inclusive ranged annually from 22 to 83 per cent., the average being 51 per cent. All the cases were treated by anti-tetanic serum administered by various routes, combined with bromide and chloral or morphine. Dufour's method of deep anaesthesia by ether or chloroform for at least half an hour, and repeated, was used in twenty-eight cases with a mortality of 50 per cent., which was higher than that of cases not so treated, while 35.6 per cent. died of bronchopneumonia as compared with only 1.8 per cent. of those not so treated. In conclusion, Liberti states that Cole's method of continuous avertin anaesthesia for several days deserves consideration.

RECENT OBSERVATIONS ON THE BIOCHEMISTRY OF THE LENS*

BY

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For this paper I have reviewed the work of the past three years in order to give an account of the more important observations on the biochemistry of the lens. Recently the search for the cause of cataract has been in three main directions:

1. The discovery of new methods of producing experimental cataract.
2. The investigation of general metabolic changes which may be associated with cataract.
3. The identification of new substances in the lens.

The results of these biochemical experiments are more closely related to clinical facts than they have been heretofore. For instance, among the new methods employed for producing experimental cataract are:

1. A disturbance of carbohydrate metabolism.
2. A deficiency of vitamins.
3. Investigation of hereditary cataract in animals.
4. The administration of toxic substances.

The first of these—that is, a disturbance of carbohydrate metabolism—is directly related to the clinical problem of diabetic cataract. The rapid changes in refraction which can accompany a rise or fall of blood sugar in the diabetic patient are well known, and it is generally accepted that the development of cataract in a young diabetic is a bad prognostic sign. It is interesting to note that Chaikoff and Lachmann (1933) found lens changes in eight out of ten dogs which had been made diabetic by the removal of the pancreas, and had been kept in good health for periods up to two years by the administration of insulin. The lens opacities varied from peripheral striations to diffuse irregular opacities resembling early senile cataract. The development of cataract bore no relation to the duration of the diabetes nor to the age of the dog. The animals were receiving a full protein and vitamin diet.

Carbohydrates and Cataract

Mitchell and Dodge (1935) accidentally observed mature cataract in three rats which were on a diet containing 70 per cent. lactose, and proceeded to a full investigation of the effects of a high carbohydrate intake. All of the rats given this diet showed lens changes, which in about half of them developed into mature cataract in some ten weeks. The addition of calcium gluconate had no appreciable effect. With lower percentages of lactose the cataract developed more slowly and fewer became mature. Rats subjected to the diet at an early age—that is, under 30 days old, were more susceptible than older rats. Diets containing 70 per cent. of starch, dextrin, or maltose, or 50 per cent. of sucrose or maltose, had no effect on the lens. The lens opacities appeared either as a zone of defraction round the nucleus, followed by nuclear opacity, or began as flake-like opacities in the anterior cortex. It is interesting to find that there was an increase of calcium content in the eyes which developed cataract, but no corresponding changes in the calcium content of the blood or bones.

Lactose has some association with calcium metabolism, and it is said to aid the absorption of calcium from the intestine (Bergeim, 1926) and to have a favourable effect on the calcification of rachitic bones, so that it is quite possible that this sugar has some effect on the permeability

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