the *in vivo* and *in vitro* experiments, in the light of the theory of Woods and Fildes unless one assumes that this organism produces *para*-aminobenzoic acid in excess *in vivo*, while it is not able to do so *in vitro*. It is doubtful whether this is the case and further experiments are in progress to examine this question.

Till now, the action of the sulphanilamides have not been tested in experimental vaccinia virus infections but there are a few instances on record (McCammon, 1939; King and de Rozario, 1938) of the beneficial effects of prontosil and sulphanilamide in smallpox. The results recorded in table IV indicate that the drugs do not possess any specific therapeutic effect against this virus and obviously the above-mentioned favourable clinical results are due to the prevention of the secondary streptococcal infection of the lesions by these drugs. The sulphanilamide derivatives may thus be of use in smallpox, if at all, only in this direction.

The action of sulphanilamide and some of its derivatives in experimental rabies infections have previously been reported. Kirk (1939) has found 'prontosil' to have no effect on rabies of rabbits. McCrea (1939) has reported that sodium sulphanilyl-sulphanilate prevented the development of rabies in one-third of the number of rabbits; this result does not appear to be very definite. Gross, Cooper and Lewis (1939) have found only a very slight prolongation in life of rats infected with the virus when treated with sulphanilamide or sodium sulphanilyl-sulphanilate. Powell and Chen (*loc. cit.*) have declared sulphanilamide and sulphapyridine to be of no value in rabies in mice. Our results show that sulphapyridine and sulphathiazole also are of very little value in rabies of mice.

Summary

1. The therapeutic value of sulphathiazole in experimental *Bact. typhosum, V. choleræ* and fixed rabies virus infection in mice and vaccinia virus infection in rabbits has been investigated.

2. Experimental results show that the drug has appreciable therapeutic effect in experimental *Bact. typhosum* infection in mice and is of no therapeutic value in experimental *V. choleræ* and fixed rabies virus infection in mice and vaccinia virus infection in rabbits.

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AGES OF EPIPHYSIAL UNION AT ELBOW AND WRIST JOINTS AMONGST 238 CHILDREN IN NORTH WEST FRONTIER PROVINCE

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VERY frequently doctors are called upon to give an opinion as to the age of a person, either for medico-legal purposes, for entry to government service, or to enable a candidate to sit for university examinations, etc.

The registration of births is still extremely incomplete in India, even in municipal areas.

In January 1939, Colonel R. S. Townsend, gave us a copy of a paper written by himself and Rai Bahadur Dr. Raghunandan Lall, M.B., B.S., on age determination of Indian girls in the United Provinces by *x*-ray demonstration of epiphysial union.

His paper was published in the *Indian Medical Gazette*, October 1939.

The present paper is a continuation of his work. He obtained from the Provincial Government a grant of Rs. 200 for this purpose and this investigation owes its inception to his enthusiasm and interest.

The requisite number of boys and girls could not have been obtained without the support of Miss Littlewood, inspectress of girls' schools, N. W. F. P., and the hearty co-operation of the head-mistresses and head-masters of schools in Peshawar, to all of whom we acknowledge our debt of gratitude.

The first problem was to collect an adequate number of scholars whose ages could be proved to be between 13 and 20.

(*Continued from previous column*)

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We appealed to all the schools in Peshawar and found that there were 788 boys and 200 girls on their registers whose official ages were recorded as between 15 and 19.

The school medical officers, Dr. Mohamad Shah, Dr. Shuaib, and Dr. (Miss) Mubarak Jan, carried out a long and conscientious investigation into the proof of age of all these children.

After consulting birth registers, municipal records, horoscopes, and so on, we were finally left with 189 boys and 49 girls whose ages were proved.

Out of nearly 1,000 scholars, only 238 could really prove their age.

The procedure was as follows :—

We decided to limit our investigation to the epiphyses around elbow and wrist joints for the following reasons :—

(*a*) To keep the cost within the available grant.

(*b*) To avoid difficulty which would have arisen if we had tried to undress the girls for *x*-ray of hip and knee. Even strictly purdah girls raised no objection to exhibiting an arm from under the *burqa*.

We used Agfa *x*-ray sensitive paper 15 inches × 12 inches as cheaper than film, and not so much affected by the hot weather. Each sheet was large enough to radiograph the elbows and wrists of four subjects.

Six dozen papers sufficed for the 238 children.

The details of each child were entered on an index card which was numbered and the same number radiographed on to the sensitive paper. A specimen of the card used is in the protocol (p. 84). Great care was taken to centre the central ray in every case.

Very early we learnt that it was impossible to get an accurate antero-posterior view of the epiphyses at the upper end of the ulna as it was hidden by the lower end of the humerus and the *x*-ray was oblique to the epiphysial line. In the following table therefore this epiphysis has been ignored.

We have considered union complete if (*i*) bony structure was continuous between diaphysis and epiphysis, or (*ii*) if the epiphysial line was completely replaced by a thin line of dense bone. All films were examined with a strong convex lens to decide these points.

The scholars have been grouped into age groups as follows :—

13-14, 14-15, 15-16, 16-17, 17-18, 18-19, 19-20; boys and girls separately. The percentages of union of each epiphysis in each age group and either sex are shown in the following tables :—

Boys total 189

Age group	Number in group	Radius		Ulna, lower end	Humerus		Base, first metacarpal
		Upper	Lower		Lateral	Medial	
		ends			condyle		
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
13–14	10	0	0	0	50	10	0
14–15	22	19	0	0	60	18	0
15–16	67	22	1½	6	80	25	3
16–17	48	33	4	6	98	42	12
17–18	24	86	25	40	100	90	53
18–19	8	88	40	62	100	88	62
19–20	10	100	40	50	100	100	90
Girls total 49							
13–14	3	0	0	0	33	0	0
14–15	10	70	20	40	90	70	0
15–16	7	85	30	30	85	70	14
16–17	9	100	33	55	100	88	33
17–18	10	90	50	60	100	100	70
18–19	5	100	60	60	100	100	80
19–20	5	100	80	80	100	100	80

The numbers are of course too small for statistical treatment and the mathematical margin of error must be very high. But, as far as they go, they suggest that in more than 50 per cent of cases each epiphysis will be found united at the following ages for children in the North West Frontier Province.

The average age for European and American children has been taken from Shanks, Kerley and Twining's *Textbook of X-ray Diagnosis* where the findings of many authors have been collected.

Our findings support the view that epiphysial union takes place earlier in India than in Europe.

In girls union appears to take place earlier than in boys; in some epiphyses as much as two years earlier.

In collecting data of our 238 children we took notes on the number of teeth and age at onset of menses. Our findings under these heads were as follows :—

Epiphysis	Age of union		Average age of union in European and American children of both sexes
	Boy	Girl	
Radius, upper ..	17–18	14–15	16–19
Radius, lower ..	Above 20	18–19	20
Ulna, lower ..	18–19	16–17	20
Humerus, lateral condyle	14–15	14–15	17–18
Humerus, medial condyle.	17–18	14–15	18
First metacarpal base ..	17–18	17–18	18–20

Boys

Age group	Number in group	Less than 28 teeth.	28 teeth	More than 28 teeth	
		Per cent	Per cent	Per cent	
13–14	10	0	80	20	Of 147 boys below age 17 years, 28 (19 per cent) only had more than 28 teeth.
14–15	22	8	87	5	
15–16	67	4	72	24	
16–17	48	3	79	18	
17–18	24	1	50	49	Of 42 boys above 17 years, 18 (43 per cent) had more than 28 teeth.
18–19	8	14	62	24	
19–20	10	0	60	40	

Girls

13–14	3	33	66	0	Of 29 girls below 17, only one (3 per cent) had more than 28 teeth.
14–15	10	0	100	0	
15–16	7	15	85	0	
16–17	9	11	77	11	
17–18	10	10	60	30	Of 20 girls above 17, 7 (35 per cent) had more than 28 teeth.
18–19	5	0	60	40	
19–20	5	0	60	40	

The detailed number of teeth in each group was as follows :—

Boys

Age group / Teeth	27	28	29	30	31	32
13–14	0	8	1	0	0	1
14–15	2	19	1	0	0	0
15–16	2	48	7	5	2	3
16–17	2	38	3	2	0	3
17–18	0	12	2	4	5	1
18–19	1	5	0	1	0	1
19–20	0	6	0	1	3	0

Girls

13–14	1	2	0	0	0	0
14–15	0	10	0	0	0	0
15–16	1	6	0	0	0	0
16–17	1	7	0	0	0	1
17–18	1	6	0	1	2	0
18–19	0	3	0	1	1	0
19–20	0	3	0	0	1	1

These tables regarding the eruption of teeth are interesting and show how very variable are the ages at which the teeth appear. The girls appear to get their wisdom teeth later than boys, although their epiphyses unite earlier.

In the absence of *x*-ray the teeth are widely used to base the estimate of age, but the above tables suggest that the number of teeth present is a very unreliable evidence as to age.

Of the 49 girls included in our investigation 47 had started menstruation.

The ages at which these 47 girls started menstruation were :—

At age 11 years	2 per cent	By age 14, 54 per cent had menstruated.
12 „	6 „	
13 „	25 „	
14 „	21 „	
15 „	21 „	By age 15, 75 per cent had menstruated.
16 „	17 „	
17 „	6 „	

These figures show that 46 per cent had not menstruated till after 14th year, as compared with Colonel Townsend's figure of 14 per cent and 25 per cent had still not menstruated at end of 15th year. Colonel Townsend's figure is 3 per cent.

Perhaps the later age of menstruation in the North West Frontier Province compared with the United Provinces is connected with the long cold weather here, more comparable to the European climate.

It is clear that an opinion as to the age of any adolescent cannot be given with great accuracy, even after consideration of the state of union of six epiphyses *plus* teeth *plus* date of menstruation. Any opinion must leave a margin of about six months older or younger than age given.

Before giving an opinion as to age in any medico-legal case we now complete the form shown in the protocol. This seems helpful in framing the opinion and also gives the support of facts and figures which is of assistance in maintaining the opinion given when opposed by counsel in court.

(*Continued at foot of next page*)

THE PRESENCE OF AN ENZOOTIC OF RICKETTSIAL INFECTION IN WILD RATS OF CALCUTTA

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COVELL (1936) drew attention to the existence of typhus infection in the wild rats of Simla Hills, and considered that these rodents acted as reservoirs of the infective agent for the spread of typhus fever. Cases of typical typhus fever are rare in Calcutta, but there is a possibility of the presence of mild and atypical cases which are not diagnosed correctly. Lepine and Bilfinger (1934) and Nicolle and Sparrow (1934) have described strains of typhus of feeble virulence. Typhus infection in wild rats, in the absence of any cases of the disease in human beings, has been reported. In view of these findings we determined the presence and nature of rickettsial infection in the local rodents.

A number of rats (*Rattus norvegicus*) caught in certain parts of Calcutta were examined as follows :—

The rats were killed by drowning and the brains were removed with sterile precautions and a saline suspension of the brain was injected intra-peritoneally into one or more male guinea-pigs. In a number of experiments, a variable number of the inoculated guinea-pigs died within 24 hours. Although the brains were removed with great care, still a number of organisms were found to be present; they will be referred to later. In view of the presence of the secondary bacterial infection in certain rats, the technique was modified. The brains were kept in the refrigerator and the bacterial purity was controlled by broth culture; only bacteria-free brains were used for guinea-pig inoculation. The temperature of the guinea-pigs was recorded every morning and those showing definitely a febrile reaction on more than one day were sacrificed and their viscera examined. Covell (*loc. cit.*) found that the rise of temperature was generally up to 103°F., rarely exceeding 104°F., after the infection, and during the first four passages it was unusual for the pyrexia to persist for more than 3 or 4 days, but in later passages it continued for 10 to 12 days on several occasions. We had different experience in Calcutta. The stock guinea-pigs had a temperature range of 102°F. to 103.6°F., the temperature occasionally rose to 104.2°F. and very rarely reached 105°F. The thermometer was pushed up to two inches from the anal aperture to get this temperature. The temperature was lower by 0.5°F. to 1°F. when the mercury bulb was just introduced into the anal canal. These figures relate to the temperature taken in summer months between 10 a.m. and 10-30 a.m.; there was a rise of temperature of about 0.5°F. by 11-30 a.m. The range of temperature was lower in winter months, *i.e.*, 100.4°F. to 102.4°F., occasionally going up to 103°F.

One hundred and one rats caught in certain areas of Calcutta were examined; the results were as follows :—

Area	Number of rats examined	Number positive	Number negative
Kidderpore ..	68	60	8
Burra Bazar ..	16	10	6
Tropical School	17	2	15
TOTAL ..	101	72	29

The guinea-pigs showing a mild febrile reaction and slight thickening and congestion of the tunica vaginalis after an incubation period of 4 to 21 days were considered to be positive. The rise of temperature was from 1°F. to 3.6°F., fever lasted generally from 3 to 4 days, but was present irregularly in some cases up to at least three weeks. Smears taken from the tunica vaginalis, spleen, and brain, and stained with dilute Giemsa's stain for 18 hours at 37°C., showed the presence of rickettsial bodies both intra-cellular and extra-cellular. They were pleomorphic, varying from minute coccal forms to moderately long bacillary forms. The infection was passaged from one guinea-pig to another but tended to become attenuated. Bacteria-free suspensions of tunica vaginalis inoculated on the chorio-allantoic membranes

(*Continued from previous page*)

PROTOCOL

Form for age computation

Boy / Girl

Name .....

Father's name .....

Address .....

Marks of identification (1)

(2)

I. Age by appearance and general development

II. Number of teeth ..... age .....

III. Date of onset of menstruation ..... age .....

IV. *X*-ray:—

Epiphysis	Age of union		United or not	Balance of age by *x*-ray
	Boys	Girls		
Radius, upper end	17–18	14–15		
Radius, lower end	Above 20	18–19		
Ulna, lower end	18–19	16–17		
Humerus, lateral condyle.	14–15	14–15		
Humerus, medial condyle.	17–18	14–15		
Base of 1st metacarpal.	17–18	17–18		
Probable age			Final opinion is —	