is a dry substance, it is moistened with distilled water and covered with a small square of linen and a square of rubber tissue, which is held in position by a patch of adhesive plaster. This is left in place for approximately twenty-four hours, and the reactions are then noted. A positive reaction consists of redness and the formation of small vesicles at the point of contact. There is an important point to be considered at this time—namely, that occasionally a definite reaction does not appear until twenty-four hours after the patch has been removed, and also that it is sometimes necessary to leave the patch on an additional twenty-four or forty-eight hours before obtaining a positive reaction that otherwise would have been called negative. The "patch test" is probably the most reliable of the direct contact tests, such as the drop, scratch, and intradermal methods. The most important contribution to the subject of the usefulness of the "patch test" is to be found in the *Archives of Dermatology and Syphilology* for March, 1931.

Prevention in Factories and Workshops

In conclusion, I would summarize the excellent exposition in the current volume of the Factory and Workshops Report of the principles to be observed in preventing industrial skin disorders in factories and workshops.

"First, a barrier should be placed between the skin and industrial irritants by means of a protective film of ointment. According to the demands of the work this ointment may be greasy, non-greasy, or waterproof. Gloves may have to be worn where there is contact with powerful irritants.

"Secondly, after work the skin should be thoroughly washed, but without recourse (except in the case of contamination with oil and where there is much staining of the skin) to cleansers. The preliminary protective film applied to the skin will make this possible. Where a chemical cleanser is necessary for removal of oil, dyes, french polish, etc., the appropriate solution (never in solid form) should be used as weak as makes for effectiveness, and should itself be invariably removed with warm water and a bland (not soft) soap. Nail brushes are intended for cleaning the nails only; much damage can be done by plying these as scrubbing brushes to the skin.

"The value of a regular inspection of workers' hands by a careful observer cannot be over-emphasized. The necessary precautions are then more likely to be observed, and the early signs of skin irritation can be detected and relieved before the resistance of the skin breaks down."

Jiménez Díaz and two others (*Rev. Españ. de las Enferm. del Aparat. Digest.*, January, 1935, p. 5) believe that phosphatase (that is, phosphorus in organic combination) as found in the blood is derived from various sources, such as bone, liver, kidney, intestine, and muscle. Its percentage in blood plasma estimated by Kay's method averages 0.142 in adults and 0.26 in children. It is high in rickets but fails as the disease is overcome. It may be fifty times higher than the normal figure in Paget's disease, fibrocystic disease, osteomalacia, and during repair of fractures. In osteoporosis the percentage is in proportion to the extent and intensity of the process. In the "degenerate" forms of rheumatism there is an increase not observed in the infectious forms, although in tuberculous joint disease this increase is present. In liver diseases—hepatitis, hepatosis, cirrhosis, and obstructive and catarrhal jaundices—the phosphatase increase is in proportion to the functional state. In the healthy, ingestion of glucose does not affect the percentage, nor is any alteration noted in diabetes, Addison's disease, and the muscular dystrophies; but in hyperthyroidism with osteoporosis it is elevated. The plasma of the pregnant is unaffected until the final weeks, when a rise lasting through the early days of the puerperium is seen.

CLINICAL INTERPRETATION OF THE ARNETH COUNT

BY

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While it is well established that infections tend to produce a shift to the left in the Arneth count (Arneth,¹ Cooke and Ponder,² etc.) we have observed in the course of clinical work that the count sometimes fails to show a shift to the left in acute infections, and that it may show a left-handed shift in the absence of infection. Such exceptions to the rule detract considerably from its clinical utility. Our observations indicate, however, that the apparent failure to conform to expectation is to be associated with the percentage method of recording the count; and by expressing it in absolute figures per c.mm. of blood, errors in its clinical interpretation can generally be avoided.

Methods

The method employed has been that of Cooke,² which consists in classifying 100 polymorphs into five classes, the class numbers corresponding to the numbers of nuclear lobes of the cells in each class. Cooke also determined the average number of nuclear lobes per cell, the result being termed the "weighted mean." In the following observations this figure has been expressed as the total number of lobes per 100 polymorphs, thereby eliminating the fraction. The percentage sign has been employed to indicate the percentage counts, and to differentiate them from the absolute counts. Cooke included any cells with more than five nuclear cells in Class V, but as the presence of such cells is almost always of pathological significance they have been given additional classes when present, and their full value computed in the total lobes per 100 polymorphs.

Cooke's² average count for ninety persons of both sexes between 12 and 25 years of age, stated to be healthy, is shown in Table I.

TABLE I.—Normal Arneth Counts

Average Arneth Count per 100 Polymorphs (Cooke ²)						Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.				
Classes	I	II	III	IV	V			I	II	III	IV	V
	10	25	47	16	2%	275%	3,000	300	750	1,410	480	60
							5,000	500	1,250	2,350	800	100

Two normal absolute counts are also shown in Table I, calculated from Cooke's normal average percentage count, one based on 3,000 and the other on 5,000 polymorphs per c.mm. To Classes I and II belong the polymorphs occurring normally in the bone marrow,⁴ and the sum of these two classes may be employed as an indication of the marrow output of polymorphs, including as it does only cells which have recently passed from the marrow to the peripheral blood. Normally this figure lies between 1,000 and 2,000 per c.mm.

In Cooke's normal counts the numbers of lobes in 100 polymorphs varied from 247 to 311, but we have not met with counts over 290 without being able to find evidence of some disturbing factor. We regard the normal range as 240 to 290, but it will be shown that counts between these two figures do not necessarily represent a normal state of the polymorphs.

Normal Percentage Arneth Counts in the Presence of Infection

Such counts are shown in Table II. Case 1 was shown, through operation, to have a suppurating salpingitis, but had no pyrexia during nine days in hospital prior to

operation, in which period the count recorded was obtained. The absolute count shows increases in all classes.

TABLE II.—Normal Percentage Counts in the Presence of Infections

Case	Day of Admission	Arneth Count per 100 Polymorphs	Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.
1		6.41/35/15/3 %	268 %	8,400	5.4/3444/2910/1263/252
2	7th	10/37/37/16/0 %	259 %	15,600	1560/5772/5772/2496/0
	11th	26/38/34/2/0 %	212 %	8,700	2262/3305/2958/174/0
	16th	21/45/32/2/0 %	215 %	15,200	3192/4840/4864/304/0

Case 2 had an intermitting pyrexia due to a renal infection. The first count (seventh day of admission) was obtained a few hours after the commencement of a pyrexial attack, the temperature being 102° F. This followed an apyrexial period of at least six days. The count shows no percentage shift to the left, but there are absolute increases in Classes I to IV. Later counts show percentage shifts to the left and absolute increases in Classes I to III.

An explanation of these findings is suggested by Ponder's experimental work in animals.³ By a single injection of thyroxine in the rabbit he supplied a stimulus to polymorph output and observed the subsequent changes in the Arneth count. In one typical experiment, shown in Table III, there ensued first a shift to the left lasting three days, with a return to the normal by the fifth day,

TABLE III.—Arneth Count in Rabbit following Thyroxine Injection (Ponder³)

	Arneth Count per 100 Polymorphs	Lobes per 100 Polymorphs
Normal pre-injection average	12/31/38/8/8 %	266 %
1 day after injection	46/20/20/7/7 %	209 %
2 days " "	32/36/22/6/4 %	214 %
3 " " "	28/44/18/7/3 %	213 %
5 " " "	18/38/26/10/8 %	252 %
6 " " "	10/28/40/13/9 %	283 %
11 " " "	12/24/36/18/10 %	290 %
16 " " "	11/32/34/10/13 %	282 %
21 " " "	11/34/37/9/9 %	271 %

followed on the sixth by a shift to the right of the pre-injection average, which persisted till the sixteenth day. By the twenty-first day the count had returned to the pre-injection state. These results were ascribed to the increased number of polymorphs first entering Classes I and II, and later passing on to the older classes as they aged. It may be noted that in this experiment the shift to the left existed on not more than four days, while a shift to the right existed on at least eleven days. This shift to the right following the stimulation of polymorph output has received little attention, but it appears to be of clinical importance.

The histories of Cases 1 and 2 indicated that the patients had probably been suffering from their infections for some time, with exacerbations and remissions of activity or of toxic absorption. If one assumes that the increase in polymorph output produced by the observed exacerbation was counterbalanced by an already existing right-handed shift due to a previous stimulus, the resulting normal percentage figures might be accounted for.

As the usual method of expressing the Arneth count gives the cells in each class only in relative percentages, the relative number in any class depends not only upon

the actual number in that class, but also upon the numbers in each of the other classes. A change in the number in one class will alter the figures in the other classes, even if the absolute numbers in these classes have remained constant. Thus, in the phenomenon just described the absolute increases in the older classes result in lower relative figures for the younger classes than would otherwise be the case. If both old and young cells are equally and absolutely increased the percentage Arneth count will show no change. There may, therefore, be a failure with the percentage system to demonstrate an actual increase in the younger classes when the stimulus is a recurring one. In the course of routine clinical work this has been found to occur not infrequently.

Left-handed Arneth Shifts without Evidence of Infection

Shifts to the left in the percentage count occur in the absence of evidence of infection, although infection may be difficult to exclude. Theoretical and practical considerations, however, indicate that the erroneous suggestion of infection here may again be due to the percentage mode of expression. Such shifts can occur in two ways—first by reduced polymorph output without delay in removal, and secondly by earlier removal with or without a normal output.

1. *Reduced Polymorph Output in Agranulocytosis.*—Here the output of polymorphs is reduced, while the normal removal agencies may attempt to maintain the usual rate of removal. As the latter incidence falls most heavily on the older classes owing to their longer exposure in the blood stream, the numbers in the older classes become relatively as well as absolutely reduced, giving a shift to the left. This appears to be the most reasonable explanation of the condition usually found in aplastic conditions without infection, in which absolute counts show that the cells in the first two classes are reduced as well as those in the older classes, the latter being reduced to a greater degree, so that a percentage shift to the left is shown. The functional derangement in such circumstances is a diminished production of polymorphs, and the effect of the normal removal agencies becomes relatively excessive; thus the presence of an infective stimulus is not required to explain the change. Usually a more or less steady state is ultimately reached in chronic cases, when the output and removals are approximately equal, so that it appears that the reduction in the number of cells at risk of removal eventually results in a diminished but earlier removal. An example of the condition, in a case of chronic aplastic anaemia, is shown in Table IV.

TABLE IV.—Chronic Aplastic Anaemia with Percentage Shift to the Left (Case 3)

Date	Arneth Count per 100 Polymorphs	Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.
9/11/32	32/52/16/0/0 %	184 %	800	256.416/128/0/0
29/12/32	33/49/16/2/0 %	187 %	800	264/392/128/16/0
17/1/33	38/42/19/1/0 %	183 %	700	266/294/133/7/0
10/3/33	60/33/17/0/0 %	147 %	1,060	636/350/74/0/0

No evidence of infection could be found in this case, which showed no pyrexia during three months in hospital, except for a few days after a transfusion. Other cases of aplastic anaemia with agranulocytosis, acute and chronic, showing polymorphs of Classes I and II only, with the total polymorph count below 1,000 per c.mm., have been encountered. One such case is shown in Table V (Case 4), along with, by way of contrast, two inflammatory cases (5 and 6), in which the polymorph removal was so active that only Classes I and II were found in the peripheral blood. Both were cases of ulcerative colitis which ended fatally, and there were probably unusual degrees of polymorph losses in the intestinal discharges.

TABLE V.—Similar Left-handed Percentage Counts of Dissimilar Causation

Case No.	Arneth Count per 100 Polymorphs	Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.
Aplastic Anaemia with Reduced Polymorph Output				
4	64/36/0/0 %	136 %	100	64/36/0/0/0
Ulcerative Colitis with Increased Output and Marked Polymorph Loss				
5	94/5/0/0 %	106 %	6,300	5322/378/0/0/0
6	85/15/0/0 %	115 %	8,900	7476/1424/0/0/0

Although the percentage counts are similar, the absolute counts show a striking difference. Combinations of agranulocytosis and infection are occasionally met with, and result in markedly left-handed shifts. The condition of a normal output with a shift to the left occurs in some infections, notably undulant fever, counts from three cases of which are given in Table VI.

TABLE VI.—Percentage Shift to Left but No Increase in Output. Undulant Fever

Case No.	Arneth Count per 100 Polymorphs	Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.
7	49/43/7/1/0 %	160 %	1,600	784/688/112/16/0
8	55/36/8/1/0 %	155 %	1,400	770/504/112/14/0
9	49/35/15/1/0 %	168 %	1,100	539/385/165/11/0
..	30/40/26/4/0 %	204 %	2,900	870/1160/754/116/0

This infection frequently fails to increase polymorph output, and even appears to depress it at times (Case 9), although causing an earlier removal from the the circulation, and therefore the usual shift to the left. The count may then resemble that of hypersplenism (discussed below), but such similarity is unlikely to cause difficulties in diagnosis. Such counts are uncommon in infection, and should not be accepted by themselves as proof of its presence. A similar condition appears to have been produced in experimental tuberculosis in the rabbit by Ponder and Flint,⁴ although their results may have been due to the onset of aplasia.

2. *Accelerated Polymorph Removal with Normal Output.*—A left-handed shift can also be produced by a removal agency, such as a hyperactive spleen, which does not act by increasing polymorph output like infective stimuli, whatever may be its ultimate causation. The older classes are reduced by earlier removal, giving a left-handed percentage count. An absolute count, however, may show the first two classes to be normal, in which event the percentage count cannot be interpreted as evidence of infection. Such a condition can arise in splenic anaemia and allied conditions, and counts of this type obtained from two such cases are shown in Table VII.

TABLE VII.—Splenic Anaemia with Left-handed Arneth Shift, but Normal Polymorph Output

Case No.	Arneth Count per 100 Polymorphs	Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.
10	25/38/36/1/0 %	213 %	3,000	750/1140/1080/30/0
..	24/47/26/2/1 %	209 %	2,400	576/1128/624/48/24
11	30/49/15/6/0 %	197 %	2,200	660/1078/330/132/0

Whether such conditions are of inflammatory origin or otherwise cannot be settled by consideration of the Arneth count, but it may be stated that where there is a normal or reduced polymorph output a percentage shift to the left is not satisfactory evidence of the existence of an infection.

Discussion

Ponder⁵ has discussed the relation of the percentage Arneth count to the total polymorph count in endeavouring to show the nature of the added polymorph population in certain deflected states of the count. Although he has not recorded absolute counts of the individual Arneth classes, in referring to a method of studying the changes experimentally produced in the percentage count he states: "We are inclined to think that it supplies us with so much extra information that polynuclear counts made without simultaneous polymorph counts suffer from a great disadvantage." In clinical work we have found the total counts essential.

Summary

1. The Arneth count expressed, as it commonly is, by the percentage method only may give rise to diagnostic errors.

2. Percentage shifts to the left may occur in the absence of evidence of infection, and normal percentage counts may occur in the presence of active infection.

3. Absolute counts are essential for the interpretation of the Arneth count, and generally enable errors of interpretation to be avoided, but a normal polymorph output may occur in the presence of infection, notably in undulant fever.

4. In addition to infections, left-handed percentage counts may occur in agranulocytosis and in hypersplenism.

5. Right-handed percentage shifts may occur after inflammatory reactions, as well as in certain other conditions.

6. An absolute increase in polymorph output is necessary for the interpretation of a count as evidence of infection.

7. An absolute increase in output and an absolute reduction in the older classes due to accelerated removal are the best evidences of inflammatory activity, but the latter change is not always present.

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A. Puigvert Gorro (*Journ. d'Urol.*, May, 1935) describes a case of renal tuberculosis which occurred in a man of 45 years. He had frequency of micturition and pain for about a year, which were followed by haematuria with large clots. A diagnosis of cystitis was made, and injections of silver nitrate were given, and electrocoagulation was carried out for the destruction of vesical ulcers which were present and which were thought to be the cause of the haematuria. There was no improvement, and as the symptom tended to increase in severity cystoscopy was carried out and showed acute cystitis, oedema, and ulceration of the wall of the bladder, which were specially marked at the trigone. The orifice of the left ureter could not be distinguished owing to the oedema and ulceration; the orifice of the right ureter was rounded and enlarged. After the injection of indigo-carmin spurs appeared from the right ureter after five minutes, whilst at the end of nineteen minutes there had been no secretion from the left ureter. As a result of this examination a diagnosis of renal tuberculosis of the left kidney was made. Pyelography was carried out, followed by left nephrectomy, which was very difficult on account of surrounding adhesions. Examination of the left kidney after its removal showed evidence of fibro-cavernous tuberculosis of the closed type with an almost complete absence of kidney substance. The patient died two days later. Post-mortem examination showed that the right kidney was enlarged, and there was extensive cavitation at the upper pole, whilst the lower part of the kidney appeared normal.