

# PHYSICAL AND EMOTIONAL PERIODICITY IN WOMEN

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(With Figs. 1-19 in the Text)

CONTENTS		PAGE
Introduction . . . . .		571
I. Method of investigation . . . . .		572
Collection of the data . . . . .		572
Analysis of the data . . . . .		575
A comparison of some results obtained by questionnaire and by day-to-day records . . . . .		576
II. Material . . . . .		580
III. Results . . . . .		582
Individual records . . . . .		582
Length of the menstrual cycle . . . . .		589
Duration of the menstrual flow . . . . .		592
Diurnal variations in onset of menstruation . . . . .		592
Phenomena associated with ovulation . . . . .		592
Intermenstrual pain . . . . .		592
Intermenstrual haemorrhage . . . . .		593
Cyclical variations in the incidence of:		
Fatigue . . . . .		593
Pain in the abdomen and back . . . . .		594
Headache . . . . .		595
Breast changes . . . . .		596
Sexual feeling and intercourse . . . . .		597
Depression . . . . .		599
Elation . . . . .		601
Tendency to cry . . . . .		601
Irritability . . . . .		602
Effort required for intellectual work . . . . .		602
Tension . . . . .		603
Other signs and symptoms . . . . .		603
IV. Conclusion . . . . .		603
V. Summary . . . . .		603
References . . . . .		604

## INTRODUCTION

THE interaction of endocrine and mental functions presents problems of fundamental significance to physiologists, psychologists and medical men, and this interaction is nowhere more apparent than in the human oestrous cycle. The occurrence of a female reproductive cycle in women, comparable to those of the lower Mammals, indicates a hormone periodicity, and of this physiologists have told us much in recent years. At certain parts of her cycle moreover, a woman suffers at least some inconvenience and often considerable mental

and physical distress. This makes her aware of the disabilities inherent in her sex and establishes a psychological element in her total response.

No sustained attempt seems to have been made hitherto to obtain systematic records of these psychological and of the subjective physiological changes which accompany the oestrous cycle in women, and the main purpose of our work has been to establish a method of doing so and to set out the results of a preliminary investigation.

## I. METHOD OF INVESTIGATION

### *Collection of the data*

The primary object of the investigation was to obtain a day-to-day record of the feelings of a large number of women over a period of 6 months. This might possibly have been done through the medium of ordinary diary keeping, but it was considered that the interpretation and correlation of a large number of diaries, each written in the subject's own words, would be an impossible task. It was decided, therefore, to ask the volunteers to fill in a set form every day, using only well-defined symbols. This made the analysis relatively easy and had the additional advantage of drawing the subjects' attention to the same point every day, so that each might be accorded the same measure of attention throughout the monthly cycles. For this purpose a set of forms was prepared for each person consisting of:

(a) An explanatory sheet stating in general terms the scientific interest of the subject, the impossibility of investigating it except by day-to-day records, and a note to the effect that it had been found by trial that the time required to fill up the forms each day would not exceed 2 min.

(b) A sheet of *general instructions*, the essential parts of which follow:

“Try to dismiss from your mind any previous views as to changes which occur in connexion with your periods and simply record from day to day the actual variations that you observe in your physical and mental condition, irrespective of their place in the menstrual cycle. Only record definite and well-marked variations from the usual level of your physical and mental state; if there is nothing to record during the day opposite any certain heading leave the space blank; do not feel bound to record something under every heading. It is possible that some of these changes will never be experienced by you throughout the period of observation, for the questionnaire has to be drawn up to apply to all women and not to you alone.

“It is very important that this record should be filled in daily and that no attempt should be made to look back and fill up ‘sins of omission’ several days before; it is far better to leave a blank than to attempt this.

“With regard to the headings on the subject of sexual feeling and intercourse, we have no desire to force a confidence from anyone, but notes on this subject would add greatly to the value of the work.

“All information obtained in the course of this investigation will be regarded as absolutely confidential, and we should be very glad of the names

and addresses of all those who do not object to giving them, in case we wish to communicate with them over any points of special interest arising from their records.

“Many people seem to think that because they feel no changes worth recording, that their records are therefore of no value. This is not so; a completely blank record sheet is just as valuable as one containing many observations.”

(c) A preliminary sheet for information as to the following: name, address, age, married or single, number of pregnancies with dates, present occupation, age at onset of menstruation, regularity of menstruation and the association of pain or discomfort with it.

The subjects were asked to return this sheet with the first month's record.

(d) A sheet of special instructions and six forms, one for each of the 6 months over which the records were to be kept. The special instructions follow, and some of the completed forms are reproduced on pp. 583 *et seq.* (Records 1-6).

#### I. *Fatigue*

1. If definitely greater than usual, but not making it necessary to curtail work or other activity.

2. So severe as to cause curtailment of usual activities.

Write 1 or 2 according to the degree of fatigue felt.

#### II. *Digestive disturbances*

Note any marked symptom, such as nausea, vomiting, loss or increase of appetite.

#### III. *Bowel action*

Write 0, 1, 2, etc., for the number of times the bowels are opened.

#### IV. *Pain*

Record not only pain felt during the menstrual period, but any similar kind of pain felt at other times. If obviously indigestion, record under “Digestive disturbances” in column II.

Write 1, 2, or 3 according to whether it is:

1. Only felt if attention is directed to it.

2. Difficult to neglect.

3. Impossible to neglect.

*Site.* Write *a* for abdominal pain.

Write *b* for backache.

Write *c* for headache.

Any other site write in full.

*Duration.* Write approximate time, e.g. 6-8 p.m.

#### V. *Illnesses*

Note any illness such as influenza, a cold, etc.

#### VI. *Breast changes*

Write discomfort, pain, swelling, itching, etc., according to what change is noticed.

#### VII-XII

Try to apply to each of these the meaning given in the definitions below.

Record any definite change, even if it is only felt for a few hours.

Write 1 if the change in feeling, though definitely present, can be overcome with an effort.

Write 2 if the change is so marked that the feeling cannot be thrown off by any effort.

*Definitions*

*Depression.* Sadness, hopelessness, a loss of flavour to life. Normal interests lose their value and life does not seem worth while. The usual flow of interest and activity seems slowed down.

*Elation.* The opposite to depression, unexpected lightheartedness, a feeling of energy and increased interest in life, difficulties seem easier to tackle.

*Anxiety and worry.* Commonplace worries seem worse than usual, and it is more difficult to make decisions about small problems. Everyday risks to oneself and to people whom one cares about become exaggerated in importance.

*Irritability.* "Touchiness", a tendency to take offence easily, to lose one's temper and to be annoyed by other people's mannerisms and habits.

*Tension.* An uncomfortable feeling of being "strung up", restlessness and difficulty in settling down quietly to anything.

*Sudden changes of mood.* A tendency to change within a short time from one state of feeling to another without obvious cause, e.g. from elation to depression or from quietness to irritability.

*XIII. Tendency to cry*

Write + if you notice that you cry more easily than usual, or feel you want to cry.

*XIV. Social reactions*

Write 1, 2, 3, or 4 if you notice any of the tendencies below more marked than usual, or 2 and 3, 2 and 4, etc.

1. If you feel particularly friendly and sociable.
2. If you feel unusually shy and unwilling to go about and meet people.
3. If you feel critical of other people and their behaviour.
4. If you feel that other people seem more critical than usual.

*XV. Capacity for intellectual work*

That is, degree of concentration required for making a routine mental effort.

Write 1 if you are more aware of the effort than usual.

Write 2 if you can succeed only with a great effort.

Write 3 if the effort is unsuccessful.

*XVI. Menstrual period*

On the day that the flow begins write M and the time when it was first noticed, e.g. M 10 a.m.

Write M each day until the flow ceases.

If any bleeding, however slight, occurs between the periods write I opposite the day.

*XVII. Amount of loss*

Write 1 if scanty, 2 if moderate, 3 if profuse, on each day of the period.

*XVIII. Sexual feeling*

Write 0 if sexual matters are definitely repugnant.

Write 1 if sexual feeling is present to a slight degree or easily aroused.

Write 2 if sexual feeling is present to an intense degree.

Leave the space blank if such feeling is neutral or in abeyance.

*XIX. Sexual intercourse*

Write 1 for each occasion of sexual intercourse.

*XX. Remarks*

(a) Note anything that you think is relevant and that is not included under the other headings.

(b) Qualify any entry that you feel is not sufficiently explained by the symbols supplied.

(c) N.B. If there is any definite reason for depression, elation, anxiety, irritability, tension or fatigue, make a note that such a reason was in operation, with a brief description of its nature: e.g. "My child was ill", "I passed an examination", "I went for a very long walk".

The selection of subjects was somewhat limited by the fact that clearly, from the nature of the investigation, only women of a certain degree of intelligence would be able to carry it through. A considerable number of subjects were obtained at once through the personal influence of one or other of the authors, but it was obvious that bulk sources would have to be tapped to obtain large numbers. In this, difficulties of two kinds were encountered. First, several persons in this country or visitors from the colonies expressed great interest in the method of investigation and asked to be allowed to take 50 or 100 forms, and get them completed. These were always supplied, but no completed forms were ever returned. Secondly, the heads of some women's colleges and even of some medical schools took exception to forms on the grounds that sexual feeling was abnormal in unmarried women students (*sic*) and that no forms containing such words could possibly be allowed to circulate in their institutions. This was doubly unfortunate. The inability to obtain complete records from these medical students was bad enough, but the failure to obtain their co-operation in getting other, preferably married, women to keep complete records was much worse. The authors, moreover, were none of them in a position in which they came into professional contact with numbers of suitable women. There is no doubt that a very large number of subjects could be obtained by persons suitably placed, for few women once approached on the matter objected to keeping the records. In one or two instances a woman's husband objected, and the record had to be abandoned.

#### *Analysis of the data*

It was at first thought that interest would chiefly lie in the individual diaries. The individual records, therefore, were transferred to books, and in order to make the menstrual period occupy the central position the cycles were assumed to begin 14 days before the menstrual period. Each symptom was entered separately (see, for example, Charts 1-5, pp. 577-9). This enabled the individual records of each symptom to be inspected, but when it became necessary to combine all the results a difficulty was encountered, for some of the cycles were so short that the massed results began to be affected by this soon after the menstrual period was over, and were valueless by the 28th day. The following method was therefore adopted for assembling all the results. A cycle was defined as the interval between the onset of one menstrual flow and the onset of the next. All days except those forming completed cycles were discarded. This meant a considerable loss of material, since the record began and ended at any day in the cycle, but was the only way of ensuring satisfactory results.

There were left 780 completed cycles, and these were classified according

to their lengths. Each symptom was then dealt with in the following way: The total number of entries for each day was found separately for each group of equal length cycles. These cycles were then reduced to an equivalent 28-day cycle. (The use of a 28-day cycle as standard was of course quite arbitrary.) The reduction amounted to stretching out uniformly the shorter cycles and contracting the longer ones, i.e. altering the scale of time. For instance, taking a 23-day cycle, the 23 intervals were replaced by 28 intervals each  $23/28$  as long as the original interval. The number of entries per interval was accordingly reduced in the ratio 23 : 28. The 28 new entries were each obtained from fractions of two adjacent entries in the original 23-interval cycle. A table of fractions used for each cycle length was made up for convenience.

The method used weighted the entries on each day in the longer cycles more heavily than those on each day of the shorter cycles, but the total number of entries per cycle was unchanged. In collecting the results for the various symptoms, cycles below 21 days and above 37 (in some cases 34) days were neglected, because there were so few of these cycles that their reduction was not considered worth the extra labour involved. For most symptoms the 27- and 28-day groups were large enough to show by themselves the same periodicities as were shown by the combined results.

When it came to adding up the individual figures, if the instructions asked the diarist to record the intensity of phenomena as 1 or 2, a 2 was taken as equivalent to two entries. Analogously 0 in the sexual-feeling records was counted as -1 (see Instructions, p. 574). In combining the results, all entries were included for two reasons, even if a specific cause was assigned to them by the subject. First, the cause assigned might have been inappropriate or inadequate; secondly, all these causes, being environmental, were irrelevant to the menstrual cycle and should therefore have had a random distribution.

In calculating the number of times any two symptoms should occur together by chance, each day of the 21- to 34-day groups of cycles was treated separately. The entries under both headings were added up (2's being counted as 2's) and their product divided by the number of cycles in the group concerned. This treatment eliminated any association of the two symptoms due merely to a similar distribution throughout the cycle. The sum of all these results gave the expected number of coincidences. In calculating the actual number of coincidences the number of times entries were made simultaneously was determined, irrespective of whether each entry was a 1 or a 2. The error (see above) introduced by counting 2's as 2's was a small one and was considered unimportant for the present purpose.

*A comparison of some results obtained by questionnaire and by day-to-day records*

A comparison of the preliminary sheets with the day-to-day records often reveals considerable discrepancies, and these are so frequent that they throw considerable doubt upon the value of any work on this subject based upon

Chart 1. *Showing the absence of rhythm in the entries of a symptom (irritability) believed by the subject in retrospect to have been "assuredly rhythmic"*

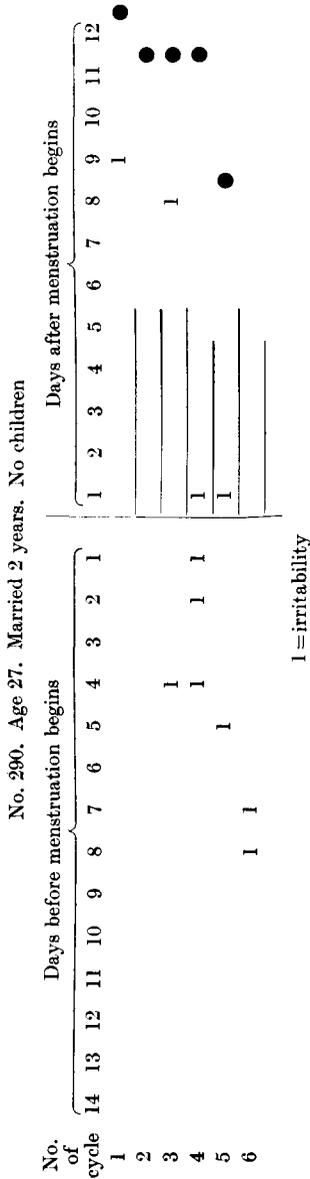
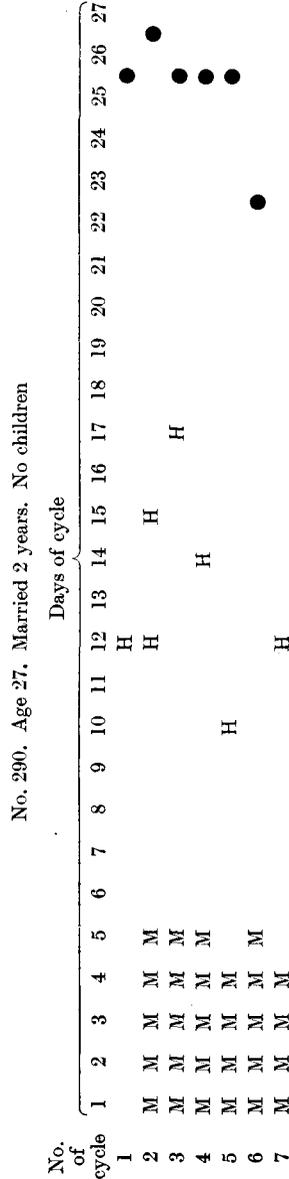


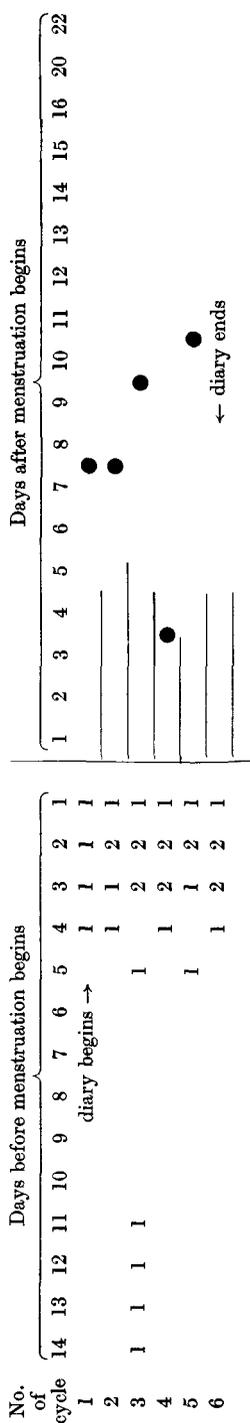
Chart 2. *Showing the relationship in one woman of intermenstrual haemorrhage to the menstrual period*



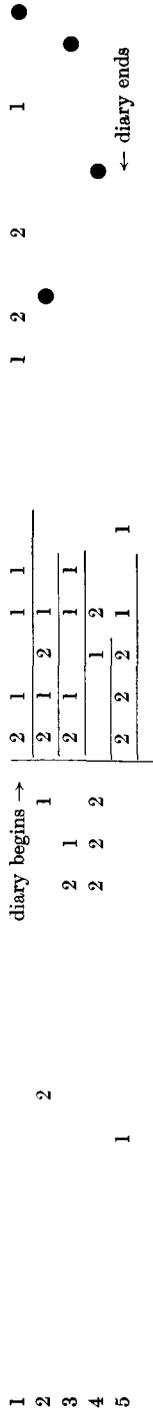
M = Menstruation, H = intermenstrual haemorrhage, ● = close of cycle. The first and last cycles were incomplete. The first H occurred 14 days before the first menstrual period and this cycle has been taken to be 25 days in length. The last H fell on the 12th day of the last cycle but the length of the last cycle is not known. No H was recorded in the 6th cycle.

Chart 3. Individual rhythms (depression)

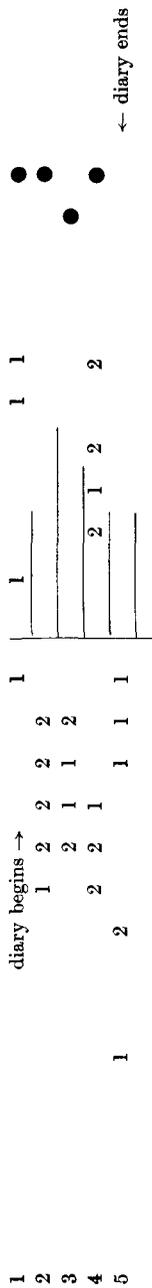
No. 23. Age 27. Married 6½ years. 1 child



No. 219. Age 22. Single



No. 296. Age 25. Single



The menstrual days are underlined. 1 and 2 = different degrees of depression. ● = close of cycle.



histories or a questionnaire. Others have commented upon this (Knaus, 1934; Hartman, 1936). A preliminary questionnaire followed by a day-to-day record for a year and closing with a second questionnaire identical with the first would probably reveal considerable differences between the two methods of approach. In this study the preliminary sheet was so brief that only a few points are available for analysis. To the question "Do you usually feel pain or any other uncomfortable symptom in connexion with your periods?" one woman (No. 8) replied "Not now" and recorded pain every month sometimes lasting for days. A second (No. 242) replied "Usually a little pain on the first day", but made only one entry under pain in the whole 6 months bearing any relation to her menstrual period, and that entry was on a premenstrual day. A third (No. 288) stated that she felt no pain or discomfort and recorded severe pain lasting 2-7 hours at three out of her five menstrual periods. A fourth (No. 317) replied "Generally have a headache the day before the flow begins". None was recorded. Many similar discrepancies might be quoted in regard to pain.

One woman stated spontaneously on her preliminary sheets "Deepest depression just before". During her 6 months' diary only five entries were made under "depression". Two were intermenstrual, only one was premenstrual (2 days before her fourth period), and this was counterbalanced by the fact that of a total of two entries under elation, one was premenstrual (one day before her fifth period). One woman (No. 290) stated in retrospect in a letter accompanying her last sheet, "Except for irritability which is assuredly rhythmic, and fatigue which is partly that and partly circumstantial, my record is mainly blanks". Chart I, p. 577, shows this woman's entries under the heading of "irritability". An unbiased observer could hardly describe them as "assuredly rhythmic".

Some of the replies to the question "Are your periods usually regular or not?" are very illuminating, and a few have been collected together in Table I. It is evident that the replies bear more relationship to the interpretation placed by the woman upon the word "regular" than they do to the lengths of the cycles.

Table I. *Comparison of preliminary statements with actual records*

Subject	Statement (in answer to question "Are your periods regular")	Recorded cycle lengths in days
No. 8	Very regular	34, 26, 29, 29, 27, 25
No. 18	Very regular	28, 27, 27, 27, 27, 27
No. 24	Interval varies from 26 to 30 days	25, 29, 26, 24, 26, 25
No. 101	No, sometimes 3 weeks and others a month	27, 28, 27, 28, 30, 34
No. 105	Most irregular	28, 30, 30 (records only kept for 3 months)
No. 124	No, not regular for the last few years	23, 24, 24, 24, 24, 27, 24

## II. MATERIAL

The records supplied by 167 women were complete enough to be of value to the investigation. Some of these did not finish the full period of 6 months, but the majority did so. On the whole the diary forms were extraordinarily

well kept, and reflect great credit on the willingness and co-operation of the subjects who frequently felt (and stated on their records) that they were sure that nothing of any value could be obtained from their diaries. Records of 780 complete menstrual cycles were supplied by these women, an average of 4.72 per person. The average would have been higher if the subjects had been asked to begin their records on the first day of a cycle (*vide supra*). Of these women 109 were single and one was a widow, making a total of 110 women who have been classed as single for record purposes. Of these, 6 stated spontaneously that they were engaged, but more may have been, for they were not asked to make any statement on this point. One got married and another began to have regular sexual intercourse during the time the records were being kept. Fifty-one of the women were married and living with their husbands, but to these have been added, for record purposes, 5 other women recording sexual relationships, making a total of 56 "married" women. Of these, 30 had been pregnant, and between them they had had 45 living children, and there had been 4 miscarriages.

The ages of the single women varied from 20 to 47, but there was only one of 20 and the average age was 29.2. The ages of the married women varied from 23 to 45, and their average age was 30.6. Thus the ages were well distributed throughout the reproductive period.

Drawn very largely from the educated middle classes, perhaps the most stable section of the community, these women cannot be taken to be representative of the whole female population. The class from which they were drawn, however, is so much the most suitable for a preliminary investigation of this kind that no apology need be made for the somewhat limited scope of the material. The occupations of the subjects are given in Table II.

Table II. *Occupations of the 167 subjects*

Occupation	No.
Teachers and/or research workers ...	25
Doctors ... ..	31
Students ... ..	28
Secretaries and almoners ... ..	21
Nurses or welfare workers ... ..	17
Masseuses or games instructresses ... ..	6
Writers or journalists ... ..	4
Gardeners ... ..	2
Designer ... ..	1
Household duties ... ..	32
	167

Many of those not in the last group recorded that they ran their own homes in addition to their stated occupations.

Sixteen women supplied records which for various reasons have not been included. Some of these records were kept for only part of a cycle, some were fragmentary and incomplete, but extended over several months, one or two of the women were obviously menopausal, and one became pregnant soon after she began the record. In addition to these, 31 medical students from one

institution kept records on special forms printed without the headings for sexual feeling and sexual intercourse. One of these women was 30, the others all between 19 and 24, the average age of the whole group being 21.2. These records were not so valuable as the others, since they were done under conditions tending to prevent them being the true and confidential records which the others obviously were. The data obtained from this group have been used in computing cycle lengths, but it was finally decided not to include their subjective symptoms in the assembled results.

### III. RESULTS

#### *Individual records*

In spite of the fact that almost all the entries were in signs or figures, some of the subjects imparted considerable individuality and character to the diary forms by their marginal notes. Records 1-6, which are reproductions of typical individual diaries but without the marginal notes, show the character and appearance of the completed forms. As may be seen, these display considerable individual differences and sometimes very few entries. They illustrate well the material out of which the whole of the results have been compiled, and they should be compared with each other and with the combined results (Figs. 5-13 and 15-19).

Quite a number of the women recorded pain, breast changes and other physical symptoms regularly enough to establish their rough relation to the menstrual periods. In a few individuals there was an indication of rhythm in other subjective symptoms (see Charts 3, 4 and 5). In the majority, however, no rhythm was demonstrable during the period of 6 months. Periodicity might have been brought out in many more cases had the records been kept for a longer time. Thus periodicity in a record of sexual intercourse, not visible over a period of 6 months, appeared over a period of 8 years (Fig. 14). In certain instances the periodicity displayed by certain individuals (Charts 3 and 4) differed considerably from that of the combined results (Fig. 15 and p. 603). While unable to explain the divergencies at present, similar idiosyncrasies have been found by other investigators (Kirihara, 1932; Moore & Barker, 1923; Sowton and Myers, 1928), and these individual variations may be of the greatest importance in medicine.

Careful scrutiny of the individual records has failed to establish internal evidence bearing on the relative scientific reliability of the observations made by different subjects. Possibly others, more experienced psychologists or psychopathologists, could have succeeded, and one of the motives of publishing this material is to induce a repetition of the work by more experienced and competent investigators.

Similarly, inspection of the individual sheets has so far failed to show any consistent interrelation between different entries, but particular instances are given in Chart 3, No. 219 and Chart 4.







Record 4. No. 2 (4). Age 31. Married. Two children

Date ...	December																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Fatigue	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digestive disturbances	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bowels	0	1	1	0	2	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0			
Pain	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Duration (hours)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Illnesses	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Breast changes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Depression	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elation	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anxiety and worry	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Irritability	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tension	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sudden changes of mood	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tendency to cry	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Social reactions	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Capacity for intell. work	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Menstrual period	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amount of loss	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sexual feeling	2	1	1	1	1	1	1	1	1	1	1	2	1	2	1	2	1	1	1	2	1	1	2	2	1	2	2	2	2	2	2	2	2	2	1	
Sexual intercourse	1	.	.	1	1	.	1	.	1	1	.	1	1	1	1	1	.	1	.	1	1	1	.	1	.	1	.	1	.	1	.	1	.	1		

\* 6 a.m.

Record 5. No. 235. Age 27½. Single

Date ...	April																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Fatigue	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digestive disturbances	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Powells	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	2	2	2	1	1	
Pain	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Site	.	.	.	.	.	<i>a, b</i>	.	.	.	.	.	.	.	.	<i>h</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Duration (hours)	.	.	.	.	.	<i>Sl</i>	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Illnesses	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Breast changes	<i>Sw</i>	<i>Sw</i>	<i>Sw</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Depression	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Elation	1	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Anxiety and worry	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Irritability	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Tension	.	.	.	.	1	.	.	1	.	.	.	2	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.		
Sudden changes of mood	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Tendency to cry	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Social reactions	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Capacity for intell. work	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Menstrual period	.	.	.	.	M*	M	M	M	M	M	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Amount of loss	.	.	.	.	1	2	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Sexual feeling	1	.	.	.	.	.	1	1	1	1	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Sexual intercourse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

\* 5 p.m. Definitions as on Records 1-3.



*Length of the menstrual cycle*

Most biological measurements distribute themselves normally about a mean. There is no sharp "cut off" but a gradual decrease in frequency as one gets further from the mean. This statement would be expected to apply to cycle lengths, duration of the menstrual flow (period lengths) and to the date of ovulation, just as much as to other natural phenomena. As will be apparent later, a number of authors do not appear to have appreciated this (see also Papanicolaou, 1933).

For the main group the distribution curve was approximately normal, with a most frequent length of 26-27 days, and an average of 27.54 days. The standard deviation was 3.35 days. The group of 120 cycles from students gave an interesting confirmation of the results from the general group, with a most probable value of 27, an average of 27.98 and standard deviation of 3.04 days. The main group gave cycles from 17 to 44 days and the student group 16-36 days (Table III and Fig. 1).

Table III. *Distribution of cycle lengths*

Length in days	General group		Student group	
	No.	%	No.	%
16	—	—	1	0.8
17	1	0.1	—	—
18	1	0.1	—	—
19	1	0.1	1	0.8
20	2	0.3	—	—
21	5	0.6	—	—
22	14	1.8	1	0.8
23	23	2.9	4	3.3
24	45	5.8	6	5.0
25	71	9.1	11	9.2
26	120	15.4	9	7.5
27	120	15.4	20	16.7
28	109	14.0	14	11.7
29	69	8.8	16	13.3
30	74	9.5	12	10.0
31	39	5.0	11	9.2
32	26	3.3	8	6.7
33	20	2.6	3	2.5
34	13	1.7	2	1.7
35	10	1.3	—	—
36	4	0.5	1	0.8
37	4	0.5	—	—
38	—	—	—	—
39	1	0.1	—	—
40	2	0.3	—	—
41	1	0.1	—	—
42	2	0.3	—	—
43	2	0.3	—	—
44	1	0.1	—	—
	<hr/>		<hr/>	
	780		120	

In Table IV the present results are compared with those of certain other workers. Further references may be found in an article by Bartelmez (1937).

Table IV. Variations in cycle lengths

No. of cycles	Age group years	Average age years	Cycles		Authors
			Average days	Standard deviation days	
780	20-42	30.1	27.54	3.35	General group of McCance, Luff and Widdowson
120	19-30	21.2	27.98	3.04	Student group of McCance, Luff & Widdowson
523	19-35	—	27*	—	King (college)
354	17-35	—	27*	—	King (industrial)
747	18-29	—	30.4	11.53	Fluhmann
883	—	—	30.96	4.92	Ogino

\* Most frequent length.

The present results agree quite well with those of King (1933), working at Baltimore, who obtained 27 days as the most frequent length of cycle for a group of 17 college women, and of 37 industrial women. Fluhmann (California), on the other hand, found an average of 30.4 days and a standard deviation of 11.53 days, and Ogino (Japan) an average of 30.96 days with standard deviation of 4.92 days. In compiling these figures from Ogino's data cycles recorded as 43+ have been taken as being 43 days. If these cycles could have been assigned their true values, Ogino's average length of cycle would have been higher than 30.96. The standard deviation would also have been higher. Fluhmann's high standard deviation was due to the large number of very long cycles (nearly 3½ per cent fell between 50-100 days). These long cycles also affected the average, but the fact remains that Fluhmann's most frequent intervals were 28-29, and Ogino's 30 and 31 days, i.e. several days higher than those of King or of the present authors. It is possible that these differences are climatic or racial in origin.

Many studies of this subject have been based upon questionnaire methods. Fluhmann (1934) has enumerated a number of these and criticized their results. Their fallibility is obvious and only two examples need be quoted, neither of which was given by Fluhmann. The Medical Women's Federation (1930) issued the following question with regard to monthly periods in schoolgirls: "Are they regular? If so, how many days elapse between the first day of the one period and the first day of the next?" In general the questionnaires were not even answered by the subjects themselves, but by some adult who knew them. The authors themselves commented on the tendency of the answers given to favour lengths of 3, 4 and 5 weeks, and ascribed this to predilection for round numbers. Kosakae *et al.* (1933), employing a similar method, reported a maximum frequency (21 per cent) at 30 days, 1 or 2 per cent on 29 and 31 days, and 19 and 12 per cent on 28 and 32 days respectively. It is clear that all results obtained in these ways are open to very grave criticism.

It should be pointed out that if records are kept over a given period of time (as in the present investigation) the results obtained do not give a true

representation of the frequency distribution of cycle lengths, since more short cycles than long cycles will be recorded. This can be corrected for in calculating the averages by weighting the frequency of occurrence of each length of cycle in proportion to its length. If records are kept for a given number of cycles this weighting becomes unnecessary. The total 900 cycles (780 main group, 120 student group) treated in the way described gave the following results:

	Average length in days	Standard deviation in days
Uncorrected	27.8	3.4
Corrected	28.1	4.0

Several authors, including Knaus (1934) and Richards (1935), have given details as to the lengths of cycles of individual women over a considerable number of years. Richards (1935) discussed at some length the deviations in his thirteen cases, seven of which were taken from King (1933). Two distinct points are involved, for it would seem that both the average length of cycle and the scatter about this average, i.e. the irregularity, may be characteristic of the individual. Thus a case has been recorded by Papanicolaou (1933) which was observed over a period of 21 years. This woman menstruated very regularly every 25–26 days, and the average was “slightly over 25 days”.

The present data include a record of 110 cycles occurring during 8 out of a period of about 10 years in a non-parous married woman between the ages of 26 and 36. The results are given in Table V. The mean almost coincided

Table V. *Distribution of one individual's cycle lengths*

Length cycle in days	Frequency of occurrence	Frequency %
25	4	3.6
26	13	11.8
27	25	22.8
28	30	27.4
29	19	17.3
30	15	13.7
31	4	3.6

Average length 27.98 days; standard deviation 1.44 days.

with that of the general group, and the lengths of the cycles were distributed approximately normally about it. The average length of the individual's cycles and their irregularity were investigated for the general group in subjects giving records of four or more cycles. The average lengths of the individual's cycles varied from 22.0 to 34.8 days. The percentage irregularity of each woman was taken as  $\frac{\text{average deviation} \times 100}{\text{average length}}$ , and the histogram is given in

Fig. 2. In no case was the deviation less than 1 per cent. The most probable value was 3–5 per cent and the average 6 per cent, i.e. about 2 days. Only one of the seven cases showing over 7 per cent irregularity could possibly have been menopausal. It is highly probable that these individual characteristics may be altered by pregnancy, change in the mode of life, or by illness, etc.

There is some evidence for instance (Knaus, 1934; Hartman, 1936) that the irregularity of the cycle lengths is greater at puberty than in later years. It was this individual irregularity no doubt which inspired Fränkel's remark that "das einzig regelmässige an der Regel ihre Unregelmässigkeit ist" (Hajek, 1933).

#### *Duration of the menstrual flow*

The method of entry was an "M" on every day on which there was any haemorrhage. This will in general give a total length of period 1 day longer than the number of 24-hour intervals over which there was bleeding. For instance, if bleeding were to start at noon on one day and finish at noon 5 days later, there would be five entries, but the period would have lasted 4 days. In the following, "period" is used to mean the length as entered, not the real length of the period.

Some individuals were found to have characteristically short and others characteristically long periods. Thus the duration of No. 362's six periods were 3, 3, 3, 3, 3, 3 days and of No. 232's 8, 7, 8, 9, 7, 9 days. The general distribution is given in Fig. 3. The average was 5.3 days with a standard deviation of 1.2 days and a real value of about 4.3 days. Fluhmann (1934) obtained an average of 4.6 days from 747 cycles of women between 18 and 29 years of age, but it is not clear from his paper whether he measured the actual length of the period or the number of days on which there was haemorrhage. Fluhmann's observation was confirmed—that the length of the period (in days) is more regular in an individual than the length of the cycle.

#### *Diurnal variations in onset of menstruation*

The subjects were asked to state at what hour their periods began and most of them did so. In all, the onset times of 920 periods were given. The answers showed a strong predilection for whole numbers, for the great majority of the times were given to the nearest hour. No previous information on this subject has been found. The results, which are given in Fig. 4, show that menstruation seldom began during the night hours, while many women commenced to menstruate soon after getting up. This may merely have been due to the onset having passed unnoticed during sleep, but it is also possible that the assumption of the erect attitude and the commencement of the daily activities may have been determining factors. Some diurnal variation in endocrine activity cannot, however, be excluded. An attempt is being made to control these findings by records from hospital nurses on night duty. The increased onset about bed time is interesting, but may not be significant.

#### *Phenomena associated with ovulation*

##### *Intermenstrual pain.*

Intermenstrual pain is a well-recognized if uncommon phenomenon (Eberhart, 1932), and is generally considered to be associated with ovulation (Cotte, 1931). It was probably first described by Priestley (1872). This

“Mittelschmerz” or “crise intermenstruelle” of the continental writers may be associated with pathological changes in the ovaries or tubes, but not, it seems, invariably. The wording of the instructions gave the subjects every opportunity of recording intermenstrual pain if they experienced it, but very few women noted it regularly enough to enable one to say that any one entry was more than a chance one. In the combined results there was a definite indication of a “Mittelschmerz” (see Fig. 6), but very few women seemed conscious of it as such. One woman noted on her preliminary sheets that she had experienced regular intermenstrual pain at the age of about 16. Another (single, age 35) sent in records which indicated that she may have experienced this type of pain, sometimes associated with headaches. Croom (1896) recorded the association of headaches with intermenstrual pain, so that this is not a new observation. Unfortunately, both for herself and for purposes of record, this woman also suffered from abdominal pain and headaches for some days before and also during her periods. Her cycles, moreover, were not of equal length, nor did she invariably suffer from the mid-menstrual pain, so that it is impossible to interpret the records accurately, but it would be interesting to know what the answer of this woman would have been to the direct questions “Do you suffer from intermenstrual pain, and if so at what time?”

#### *Intermenstrual haemorrhage.*

Although common in female monkeys, this is a much rarer human phenomenon than intermenstrual pain, but it is well recognized and not necessarily pathological (Hartman, 1929, 1936; Papanicolaou, 1933). Croom (1896) reported one case in which intermenstrual pain and haemorrhage were associated. Simpson & Evans (1928) recorded one case. One woman in this series recorded it during five cycles out of the six, and commented upon it as follows. There is “always a mid-period of very slight haemorrhage, when I always have a slight return of all the pre-menstrual psychological signs. I’ve always had it, but since my marriage it’s been far more regular.” The phenomenon is so rare in women that the complete menstrual diary has been given in Chart 2, p. 577. If this bleeding is really associated with ovulation it is clear that the latter did not invariably occur 15 days before the succeeding period (Knaus, 1934).

#### *Cyclical variations in the incidence of fatigue*

Fatigue was a symptom which all the subjects understood and appreciated. Most of them mentioned it on one day or more while they were keeping the diary, but some entered it very much more frequently than others. A few appeared to suffer from a state of chronic fatigue, which if genuine, bordered on the pathological. The sum of all the tokens (1’s and 2’s) entered came to 3520. (The actual number of days on which entries of fatigue were made was less than 3520, owing to the scattered days on which a 2 was entered. Analogous remarks apply to the entries of most of the subsequent symptoms. The conclusions would in no case have differed if every positive entry had been

assigned an equal value and the negative entries, e.g. under sexual feeling, omitted.) The distribution of these entries throughout the cycle is shown in Fig. 5. The incidence was lowest on the 20th day of the cycle, but was very much the same throughout the intermenstruum between the 9th and 22nd days. After the 22nd day the incidence rate climbed steadily to the 28th day, which is of some interest and requires explanation. On the 1st day of the menstrual period the incidence of fatigue was just three times as great as it was on the 20th day of the cycle. The 2nd day was almost as high, and thereafter the incidence fell until the 8th or 9th day, by which time it had reached the intermenstrual level. The figure leaves no doubt about the association of subjective fatigue with the menstrual period. It does not of course constitute any contradiction or even criticism of work such as that of Hubert (1934), who made use of objective methods and found that the performance capacity of a small group of healthy women was unaffected by menstruation.

*Cyclical variations in the incidence of pain in the abdomen and back*

Pain is a symptom which so frequently accompanies menstruation that the association is obvious. Only some 10 per cent of the women taking part in this investigation recorded no pain with their periods, but this does not of course mean that all the rest had dysmenorrhoea. Many of the others only mentioned pain with their menstruation once or twice during the 6 months' diary, and that only for a short time.

Fig. 6 shows the incidence of abdominal pain throughout the cycle. The sum of the entries came to 696. The incidence was low throughout the whole of the intermenstruum, but there was some evidence of a rise about the 15th day which may be the so-called "Mittelschmerz". From a very low rate on the 20th day the incidence rose slightly to the 26th day and rather more definitely on the 27th and 28th days. The onset of the period was accompanied by an enormous increase in abdominal pain. Sixty per cent of the entries were made on the 1st or 2nd day of the menstrual period. The rate fell steadily and rapidly in the succeeding days. By the 5th day the incidence was once more low, but the rate continued to fall till the 8th day.

Fig. 7 shows the distribution of pain in the back. Superficially this resembles the incidence of pain in the abdomen, but there are one or two points of difference. First, the sum of the entries only amounted to 398, so that this symptom was only about half as common. Secondly, the proportion of incidence throughout the intermenstruum was greater than that of abdominal pain, showing that there was relatively more backache than abdominal pain due to non-menstrual causes. There was no evidence of a "Mittelschmerz". As with abdominal pain, however, there was a small pre-menstrual rise and a sharp peak on the 1st day of the period. By the 5th day the incidence had returned to its intermenstrual level.

It is generally considered that the common form of dysmenorrhoea is relieved by pregnancy. The present investigation lends some slight support to this view, but the figures are not very convincing. The results are given in Table VI, and data for fatigue and breast changes have been added as controls.

Table VI. *A comparison of parous and non-parous women with respect to pain and other symptoms*

	Parous	Non-parous
Entries of abdominal pain per cycle	0.72	1.03
„ back pain per cycle	0.53	0.50
„ headache per cycle	1.05	1.33
„ fatigue per cycle	5.70	4.15
„ breast changes per cycle	1.36	1.38

Suggestions have been made that pain at the onset of a period is more severe (a) if the preceding cycle has been longer than usual, (b) if the bleeding started early in the day. Investigation of these points from the available data was very difficult and no definite conclusions were established.

#### *Cyclical variations in the incidence of headache*

There is some evidence that headache may be associated with menstruation. Thomson (1932), in reporting on twenty-five cases of intermittent headache, stated that fifteen of them only suffered at their menstrual periods, and that the remainder suffered mainly but not only at this time. In seventeen the headache began before the period, in three with the period and in the remainder up to 4 days later. He pointed out that this association of headache and menstruation had been recognized in acromegaly, and he claimed that in seventeen of his cases abnormalities in the sella turcica had been demonstrated. He also recorded that two women who subsequently developed pituitary tumours had previously suffered from menstrual headaches. Fishbauch (1927), in reviewing 8500 women's "histories", found that forty-seven of them mentioned menstrual headaches. He claimed that glandular therapy had proved efficacious for a number of the sufferers, and artificial menopause in others. Menstrual migraine appears to be a recognized phenomenon (Martin, 1930; Mayer, 1935), and one form of this may apparently culminate occasionally in menstrual cerebral haemorrhage (Hoff, 1936). The pain has been attributed to enlargement, or to overactivity of the pituitary. This latter explanation is not very satisfactory, since the pituitary activity of pregnancy, which is much greater, does not give rise to headache. No systematic records of headaches in normal women have been found.

Fig. 8 shows the distribution of headaches throughout the menstrual cycle as recorded by the women in this study. The sum of the entries came to 1018. Headaches naturally were reported at all stages of the cycle, but there were striking variations in the incidence. The lowest was in the late intermenstruum. Between the 20th and 26th days there were minor fluctuations which are probably not of significance. On the 28th day, however, the incidence rose

to twice its previous level and continued to rise to the 3rd day of the new cycle. On this day it was between three and four times as great as it had been 5 days before. After this the incidence fell at first steeply, and then more and more gradually until the 20th day. No association between headache and menstruation was anticipated when this investigation was commenced, and the result obtained was unexpected. It is, however, sufficiently definite to demand an explanation, and this unfortunately is not easy. The particular features which require explanation seem to be: (a) the fact that the incidence is variable at all; (b) the fact that in contrast with fatigue, abdominal pain, etc., the maximum incidence is on the 3rd day of the cycle; (c) the fact that the incidence continues to fall from the 3rd to the 20th day and so there is no prolonged intermenstrual level. In considering any explanation the questions seem to be: First, is there any physical basis for this headache distribution? Could it, for example, be due to enlargement of the pituitary or to changes in the systemic blood pressure? It must be admitted at once that no physical change at present known seems to offer a satisfactory explanation. Secondly, could the headaches be an expression of mental exhaustion following the sensations of pain and physical fatigue, or could headache incidence of this type be attributed to psychological factors alone? In this connexion a suggestion has been made that there is a high incidence of headache on the first two as well as on the 3rd day, but that its appreciation is inhibited by the simultaneous abdominal pain. The present figures bear this out to some extent. Out of 831 cycles there were 335 entries of abdominal pain and seventy of headache on the 1st day. Of these only thirteen occurred simultaneously, whereas one would expect  $\frac{70 \times 335}{831}$ , i.e. 28.2. Simultaneous entries on the 2nd day were nine compared with an expected 14.9, and on the 3rd day five compared with an expected 4.2.

At present there does not seem to be enough evidence on this matter to make further discussion profitable.

#### *Cyclical variations in the incidence of breast changes*

The instructions left the subjects free to record these changes in their own words. Most wrote the sensation experienced as a single word, e.g. tingling, or its abbreviation (see Records 2, 3 and 5). In collecting the results for statistical purposes each entry has been given the value 1, and dealt with thereafter in the usual way. In all 1060 entries were made, and their distribution over the cycle is shown in Fig. 9. The results are very different from those of pain or fatigue. From a low point at about the 15th day the incidence rose steadily and with increasing speed to the 27th day. The 28th day was very little higher, and by the 1st day of the new cycle the incidence rate had already fallen sharply, and continued to do so until about the 8th day, by which time it had reached its lowest level where it remained for the next week.

Incipient growth changes have been demonstrated in human breast tissue in the premenstrual phase of the reproductive cycle (Pallot, 1935). The main stimulus to the mammary tissue to develop has been shown to come from the corpus luteum (Newton, 1936), which is formed after ovulation, i.e. about the 15th day, and continues to exert its influence with increasing power on both uterus and breasts for the next fortnight, when it suddenly degenerates just before menstruation commences. Fig. 9 appears to give a quantitative representation of the action of the corpus luteum on the human mammary glands, and as such requires no further comment.

*Cyclical variations in the incidence of sexual feeling and intercourse*

Periodicity of desire is one of the most characteristic features of the sexual cycles of the lower mammals, and the female will as a rule receive the male only during the limited period of the cycle when she is said to be on heat. This period generally coincides with, or just precedes, the time of ovulation, and is therefore in all probability the time of maximum fertility. There is not the same obvious periodicity of desire in women or in many female monkeys, for sexual intercourse may take place at any stage of the cycle, so that the question has often been raised as to whether there is any fluctuation of desire in these species. According to Hamilton (1929), Davis (1929) and Stopes (1931), who worked by questionnaire methods, periods of increased desire do occur in women. Stopes (1931) considered that the major peak was to be found just before menstruation. Davis (1929) would agree with this on the whole, but recorded that in about one-third of the women of her investigation, desire followed menstruation. Apart from the possible fallacies of a questionnaire method, the findings of these authors may be criticized in that the periods of increased desire found by them are not easily reconciled with what is known of the physiology of the cycle. Thus it has been established in the last 10 years that ovulation in women and female monkeys takes place as a rule 13–17 days after the commencement of the preceding menstrual period (Parkes, 1931; Hartman, 1929; Newton, 1936; Allen, 1935). Physiologically one would expect the period of greatest sexual desire to precede or accompany this, not, as suggested by Stopes and Davis, to follow it. It has been shown by several people that in women conception is unlikely to follow intercourse during the last 10 days of the menstrual cycle (Bolaffio, 1932). This is in keeping with the known time of ovulation (Papanicolaou, 1933, and others), but at variance with Stopes and Davis' periods of greatest desire. Recently Ball & Hartman (1935) have studied sexual desire by an objective method in female monkeys, and conclude that the period of maximum desire precedes or accompanies ovulation, which was determined accurately in each case by rectal palpation. Billings (1934) attempted to obtain the required information in women by an indirect objective method. He determined by pedometer the activity of a number of women throughout their menstrual cycles. In lower mammals there

is a definite association between physical activity and the sexual cycle, and in the monkey the peak of activity follows menstruation. Women were found to show a post-menstrual burst of activity which gradually declined to the next period. It is implied that this burst of activity which preceded ovulation would have been accompanied by heightened sexual desire. Papanicolaou (1933), who made a very exhaustive study of human vaginal smears, described the 8th to the 12th days of the menstrual cycle as the "copulative phase".

Of the 110 single women in the present investigation, fifty, i.e. 45.5 per cent, recorded some degree of heightened sexual feeling. Davis stated that 86.8 per cent of the single women in her investigation admitted sexual feeling, so that the present figures are lower. The sum of these fifty women's entries came to 1246, an average of 4.6 per cycle. Of the married women, all but five recorded some degree of sexual feeling and the entries of the remaining fifty-one came to 1618, an average of 6.9 per cycle. In all 1123 acts of sexual intercourse were recorded by the married women, but four of them had no sexual intercourse, so that these were all recorded by the remaining fifty-two. No woman had sexual intercourse more than three times in one day, but two was not uncommon. The greatest number in one cycle, taking the lengths of the cycles into account, was eighteen in a 29-day cycle, and the greatest frequencies over longer periods of time were ninety-eight in 177 days, and forty-four in 84 days. The frequency distribution diagram of sexual intercourse is given in Fig. 10.

Fig. 11 shows the incidence of sexual feeling throughout the cycle in single women. The periodicity is obvious. On the day on which menstruation began there was a sharp fall in the incidence of sexual feeling, and it is natural to associate this with the onset of the flow and its attendant symptoms. There was a further small fall on the following day, which is probably due to the fact that this would have been the first full day of menstruation for all subjects, since many can have begun to menstruate only towards the close of the day before. The incidence then rose steeply and regularly, and on the 8th day sexual desire was recorded about three times as often as it had been on the first 2 days of menstruation. Thereafter the incidence fell, with minor fluctuations, to the 20th day, rose slightly to the 26th and fell slightly again on the last 2 days. The main peak was obviously on the 8th day, and this agrees reasonably well with the objective work which has been done on women and monkeys, and which has already been discussed. It is satisfactory that the greatest degree of desire should precede ovulation, but if, as Zuckermann (1936) maintains, the human sperm can rarely live in the female generative tract for more than 2 days, it is difficult to see why 7 days should elapse between the period of maximum desire in the female and her time of ovulation. On the other hand, many authors, reviewed by Hartman (1936), agree in considering the 8th day of the human cycle to be the most fertile. The evidence has been criticized by Hartman, but is distinctly interesting in the light of the present results.

Fig. 12 shows the incidence of sexual feeling throughout the cycle in married women. The resemblance to the curve of the cycle in single women

is striking. The main peak was again on the 8th day, and these results indeed confirmed those of the single women in all important features. There were, however, interesting points of difference. In the first place, in married women the fall at onset of menstruation was greater and the rise began 1 day later than it did in the single women. After the 8th day the increased desire was more sustained and there was a suggestion of a second peak about the 12th-13th day. It is natural to attribute these points of difference between the married and single women to the constant presence and influence of their husbands upon the former. This view was borne out by a study of the chart of sexual intercourse, the product of their mutual activities. This is shown in Fig. 13. There was a very steep fall at the onset of menstruation, intercourse during the first 3 days being comparatively rare. There was again a peak on the 8th day, followed by a sharp drop and a secondary hump lasting from the 11th to the 17th day. The general resemblance to the curves of sexual feeling is clear, but the fall at the onset of the period and the second hump were both more exaggerated than they were in the curve of the married women's sexual feeling. In other words, the latter in both respects lay midway between the curve for the sexual feeling of the single women and the curve for the sexual intercourse recorded by the married women themselves. The second subsidiary hump in the diagrams for sexual desire and intercourse in the married women is interesting, in that it just precedes the accepted time of ovulation, so that intercourse at this time would be most likely to result in fertilization. Intercourse was maintained at a fairly steady level throughout the last 15 days of the cycle.

One woman was able to supply a day-to-day record of her sexual intercourse over a period of 8 years (110 cycles). Only 6 months of this record were, of course, included in the combined results. In collecting this individual's entries, twelve cycles were omitted during which the woman was away from her husband. The remaining ninety-eight cycles were reduced to a 28-day basis, and the distribution of intercourse throughout this 28-day cycle is shown in Fig. 14. The average frequency was 3.7 per cycle. This figure resembles that of the combined results (*a*) in a rapid rise of frequency in the early days of the cycle, (*b*) in a peak soon after menstruation, (*c*) in a fall on the 9th and 10th days, (*d*) in a second hump between the 11th and 14th days, (*e*) in a lower frequency over the last 15 days. It differs (*a*) in the fact that the first peak is earlier (on the 5th day), possibly due to the fact that this woman had short (3-day) periods, (*b*) in the relatively lower level over the last 15 days. This is a most interesting record, particularly in the light of the combined results.

#### *Cyclical variations in the incidence of depression*

Judging by the literature there should be a very great increase in this symptom at or about the time of the menstrual period. Marshall (1922) mentioned the association in his book on the physiology of reproduction. The

questionnaire investigations support this in a remarkable way. Thus Hamilton (1929) found that out of 100 American women only eighteen said "No" to the question "Are you likely to be depressed shortly before, during, or immediately after menstruation?" Fifty-four admitted to pre-menstrual depression. Hirschmann-Wertheimer (1927) found that 72 per cent of the German women in her investigation felt pre-menstrual depression and 55 per cent felt depressed during their menstrual periods. Kosakae *et al.* (1933), working on Japanese students, found that over 58 per cent felt sensations of depression in connexion with their menstrual periods. Goldschmidt (1934), studying American college women, found that out of thirty-one women who remained up and about during their periods, twenty-five associated them with feelings of depression. Only seven recorded no association. Of twelve women who had to take to bed each month for a short time, nine felt depressed before or during their periods. These overwhelming figures are supported by the association which is said to exist between menstruation and suicide (Steiner, 1926; Peller, 1935; Mayer, 1935). It is also believed by many that exacerbations of psychotic depression frequently accompany the menstrual period in female patients. Strachan & Skottowe (1931-32, 1933) found this to occur in only 19 per cent of their series of patients, and considered that others had perhaps exaggerated the connexion.

In this investigation depression, as defined on p. 574, was a symptom relatively frequently recorded. The sum of the entries came to 1933, that is to say, there were not so many as for fatigue or sexual feeling, but many more than for abdominal pain or headache or breast changes. There was some association between fatigue and depression, for the actual number of coincidences was 610, whereas the expected number was only 330. Only three of the individuals could be said to show any definite rhythm, and these are given in Chart 3, p. 578. All showed some association of depression with menstruation, and No. 23's record was most striking, but the differences in the time relationships make any explanation very difficult. One of these women (No. 219) recorded a rhythm for tension (Chart 4, p. 579) similar to her rhythm for depression. The others did not. Fig. 15 shows the distribution rate of the combined results throughout the menstrual cycle. It is at once evident that the entries were fairly evenly distributed. There was a tendency for the incidence to increase just before and during the early stages of the period, but there was by no means the overwhelming menstrual incidence that other investigators would have led one to expect. Three explanations may be advanced: First, that English women do not feel this association so acutely as American, German or Japanese women. Secondly, these were a special class of women. Thirdly, the differences are technical in origin. Previous studies on normal women have relied upon questionnaires or histories. Such methods are apt to be most misleading in individual cases because of the vagaries of memory (*vide supra* and Hartman, 1936), and further, unless the questionnaires are very carefully worded the answers obtained may be suggested by the form of the questions.

*Cyclical variations in the incidence of elation*

Seventy per cent of the women made records under this heading, the sum of the entries being 1221. The distribution throughout the cycle is shown in Fig. 16. It will be noted that as with depression there was no spectacular monthly variation. There was, however, a rise from a low incidence on the 1st day to a peak on the 8th, and except for a drop on the 10th day the high incidence was maintained fairly well until a pre-menstrual fall set in after the 18th day. The distribution was in some ways similar to those of sexual feeling and sexual intercourse. The two symptoms occurred together on 280 days in the 21-34-day cycles compared with an expected 176. Thus there was some association, but as elation was recorded on only some 10 per cent of the days on which sexual feeling was entered, it does not seem that the variations in the incidence of elation from day to day could have been directly caused by those of sexual feeling.

The distributions of elation and depression were not complementary, that is, an increase in one was not necessarily associated with a corresponding decrease in the other. This is particularly noticeable round the 20th-23rd days, where there was a low incidence in both. Many of the other recorded symptoms, viz. fatigue, pain and sexual feeling, showed a minimum at this stage of the cycle. This would seem to indicate that this period is characterized by emotional stability. Just as there is a time of intense feeling and activity a week after the commencement of the cycle, there is this dull, unemotional period a week before it begins.

There was one striking exception to the above statement that depression and elation were not complementary in distribution. A glance at Chart 5, p. 579, will show that this woman put down elation so frequently that the absence of an entry under this heading appeared to be of more significance than its presence. Depression was rarely entered and always about the menstrual period. Here elation and depression do seem to be complementary. Was this due to a difference in the interpretation of the directions from that of all the other women? Or was this woman really a manic depressive, hypermanic type? This is a question the present authors are not competent to answer.

*Cyclical variations in the incidence of a tendency to cry*

There were only 598 entries under this heading (as compared with 3520 under fatigue). The low number of entries made chance fluctuations larger compared with periodic variations, but in spite of this a definite monthly rhythm was revealed (Fig. 17). Unlike other symptoms, the distribution was symmetrical, resembling a sine or cosine curve.<sup>1</sup>

<sup>1</sup> Such a curve was fitted by the method of least squares to the (unweighted) percentage of entries on each day. The equation is

$$y = 3.57 + 1.24 \cos(12.8t - 5.5)^\circ,$$

$$t = 1, 2, 3, \dots, 28 \text{ corresponding to the day in the cycle,}$$

where  $y$  = percentage of entries.  $y$  is shown on the distribution diagram by the broken line. The

*Cyclical variations in the incidence of irritability*

The sum of the entries of this symptom (see p. 574) was 1139, so that, while much less common than fatigue or depression, irritability was recorded about as often as elation or headache and more frequently than pain or a tendency to cry. Fig. 18 shows the incidence throughout the cycle, and the rhythmical variations are clearly shown. There was a striking fall between the 1st and the 5th days of the cycle. This was followed by a small rise towards the time of ovulation, and subsequently there was the suggestion of a fall before the large pre-menstrual rise set in. As with other symptoms, a study of the individual records gave little indication of any personal rhythms. One woman, it is true, No. 219, recorded irritability predominantly during her periods. This woman recorded a similar and rather more definite periodicity for depression and tension (Charts 3 and 4, pp. 578 and 579), but there was little "association" of the symptoms when the individual's records were subjected to analysis. The combined results, however, did show such an association in the case of irritability and tension, for the two symptoms occurred together on 154 days compared with an expected 48. Another recorded irritability eleven times in her 6 months' diary, and always within 2 days before and 3 days after the commencement of a cycle, but these were exceptional records, the majority showing scattered entries without obvious rhythm.

*Cyclical variations in the effort required for intellectual work*

The sum of the entries made under this heading was 943, and their incidence throughout the cycle is to be found in Fig. 19. Least effort seemed to be required about the 20th day, which is a low point for many symptoms (see above). Thereafter, a small pre-menstrual rise set in and a further large increase on the 1st day of the menstrual flow. Both these features have been observed in other symptoms. After the post-menstrual fall there was the suggestion of a rise about the 15th day. It is to be noted that the main variations of this symptom were larger than many of the others. Thus there were seven times as many entries on the 1st as there were on the 20th day.

This reduction in intellectual efficiency during menstruation is in keeping

observed distribution did not differ significantly from the theoretical distribution above on a  $\chi^2$  test (Fisher, 1932).

With the evidence available it is exceedingly difficult to establish whether the symmetrical distribution of such a symptom is of any significance, or what its causal relationship may be to others. An attempt has been made to do so, but with little success, and in the present state of our knowledge it seems best merely to give the record and leave its interpretation, subject to confirmation of the results, to others.

This is the only symptom distribution to which a curve was fitted. In most, curve fitting was difficult, although the type of variation was sometimes obvious; for instance, the entries under "breast changes" follow two exponential curves, and sexual feeling and intercourse resemble the equation  $y = e^{-ax} \cos bx$ , giving also the oscillatory discharge of a condenser. In general, however it was felt that little was to be gained by a mathematical expression of such data.

with the work of Johnson (1932), Freund (1930) and Kiriara (1932). Sowton & Myers (1928) found that menstruation made little difference to short objective tests, but the evidence taken as a whole suggests that there may be a real reduction in the performance capacity of menstruating as compared with non-menstruating women (see also Chadwick, 1932).

#### *Cyclical variations in the incidence of tension*

The sum of the entries of this symptom (defined on p. 574) came to 823. There were no major trends, and the day-to-day variations were unusually large. In fact the  $\chi^2$  test gave no significant deviation from a constant value. One individual's record (No. 219) has already been given (Chart 4, p. 579).

#### *Other signs and symptoms*

"Bowel action" has not been analysed. The heading was inserted on the sheets largely to emphasize the need for a day-to-day record. "Sudden changes of mood" and "social reactions" have not been analysed because the entries were so fragmentary. "Digestive disturbances" and "anxiety and worry" have been analysed and show no significant variations throughout the cycle.

#### IV. CONCLUSION

The present results demonstrate in a quantitative manner that many physical and mental symptoms in women are obviously and in some cases unexpectedly rhythmical. Other phenomena show comparatively little periodic variation, although even here a few individuals may show rhythm. There is room for a great deal more work along lines such as the present ones, for while some of the findings are definite enough to require little confirmation, others should be redemonstrated on larger numbers or on other nationalities. Many of the results, moreover, have still to be explained.

*Note.* The original records of this investigation are being deposited in the library of the National Institute for Medical Research, Hampstead, where they may be consulted if desired.

#### V. SUMMARY

1. The day-to-day records over a period of 4-6 months of 167 normal women's physical changes and subjective phenomena have been collected by a new method. These women submitted data from 780 complete menstrual cycles. In addition, a smaller group submitted data which have been used for physical changes only. One woman's individual record of certain phenomena was obtained over a period of 8 years.

2. The average length of the menstrual cycle was 27.8 days with a standard deviation of 3.4 days. Some individual's cycles were characteristically short or long, regular or irregular. No woman menstruated with complete regularity (measured in days) over a period of 6 months. Twenty-three per cent of the

menstrual periods began between 7.30 and 9.30 a.m., and the average duration of the flow was about 4-5 days.

3. Records from one case of intermenstrual, probably ovulatory, bleeding were obtained over a period of 6 months (Chart 2).

4. The periodicity of each subjective phenomenon as shown by the combined results has been recorded graphically, and these figures themselves constitute a summary of the results. Thus for fatigue, abdominal pain, backache, headache, breast changes, sexual feeling and intercourse, depression, elation, tendency to cry, irritability, intellectual capacity and tension see Figs. 5-19. Individual data of interest have been discussed in the light of the combined results.

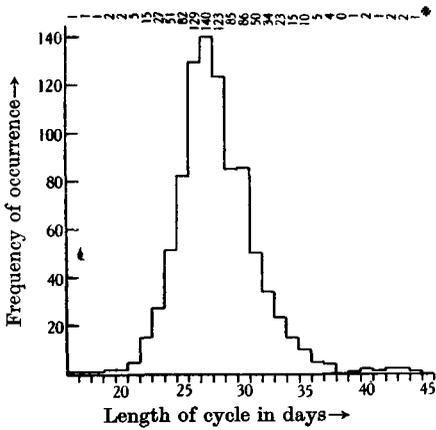
ACKNOWLEDGEMENTS. One of us (R. A. M.) was working as a Pinsent Darwin Student when this work was commenced, and all the authors wish to thank the Managers of the Pinsent Darwin Studentship, and particularly Dr MacCurdy, for the interest which they took in the project and the assistance which they gave over the elaboration of the method of investigation. M. C. L. is indebted to the Medical Research Council for a part-time grant, and also to Dr Mapother, Superintendent of the Maudsley Hospital, for the facilities with which the earlier part of the work was carried out. Every thanks are also due to the subjects themselves, without whose co-operation the investigation would have been impossible.

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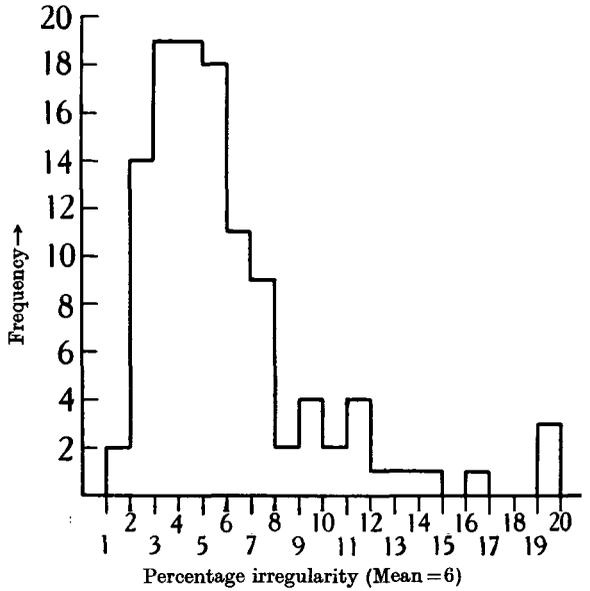
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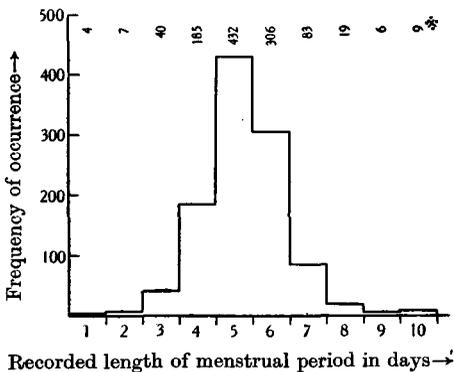


\* These are the numerical values of the frequencies.

**Fig. 1.** Frequency distribution diagram of cycle lengths. Total number 900. (General group 780, student group 120.)

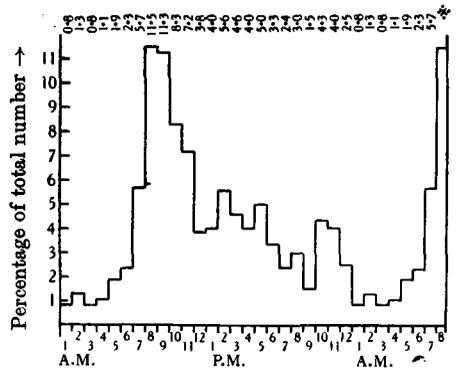


**Fig. 2.** Irregularity in individual cycle lengths.



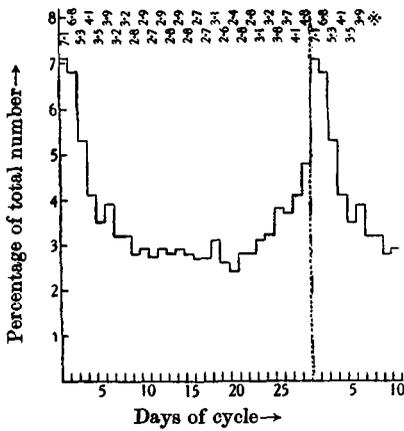
\* These are the numerical values of the frequencies.

**Fig. 3.** Frequency distribution diagram of period lengths. (Total number 1091.)



\* These are the actual percentages of the total number.

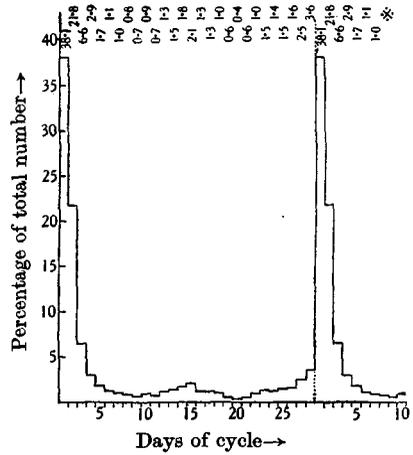
**Fig. 4.** Distribution of the time of onset of menstruation throughout the 24 hours. Data from 920 menstrual periods.



Sum of all the entries of the 21-34-day cycles = 3522

\* These are the actual percentages of the total number.

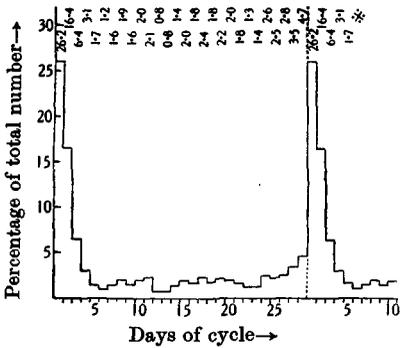
Fig. 5. Variation in the incidence of fatigue throughout the menstrual cycle.



Sum of all the entries from 21-34-day cycles = 700

\* These are the actual percentages of the total number.

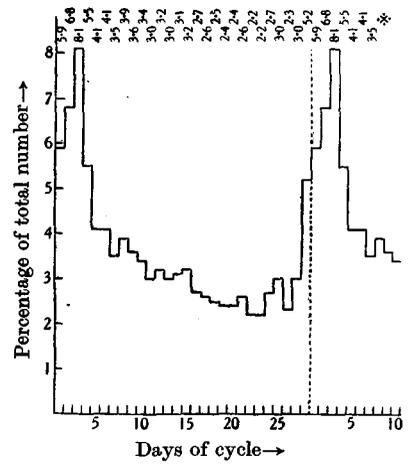
Fig. 6. Variation in the incidence of abdominal pain throughout the menstrual cycle.



Sum of all the entries from the 21-34-day cycles = 397

\* These are the actual percentages of the total number.

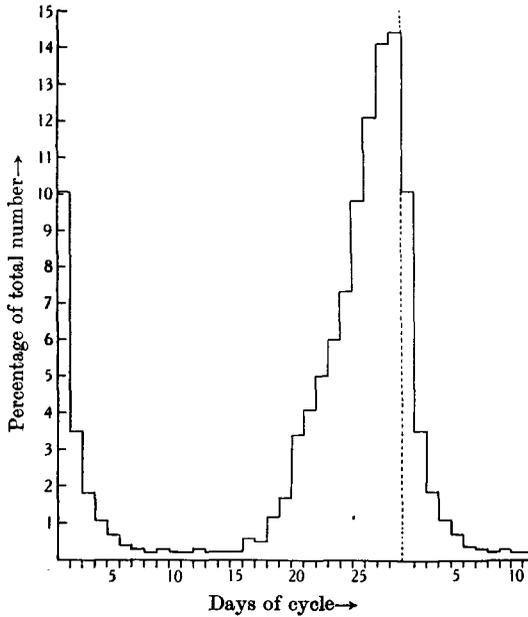
Fig. 7. Variation in the incidence of pain in the back throughout the menstrual cycle.



Sum of all the entries from the 21-34-day cycles = 1018

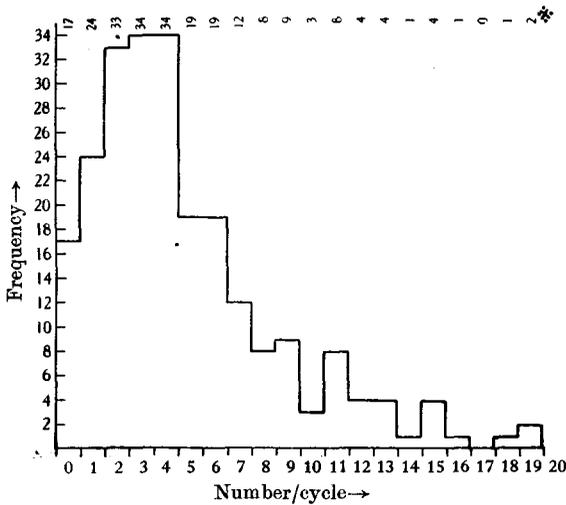
\* These are the actual percentages of the total number.

Fig. 8. Variation in the incidence of headache throughout the menstrual cycle.



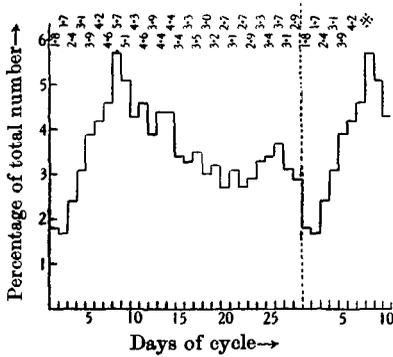
The total number of entries from the 21-37-day cycles was 1062

**Fig. 9. Variation in the incidence of breast changes throughout the menstrual cycle.**



\* These are the actual frequencies.

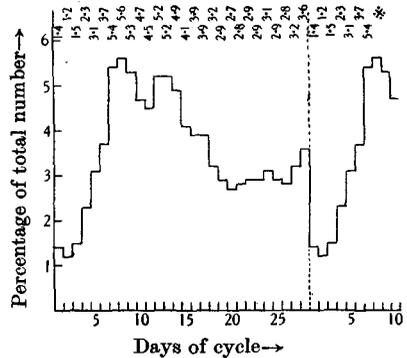
**Fig. 10. Frequency distribution diagram of sexual intercourse/cycle, among married women. Mean number/cycle = 4.75.**



Sum of all the entries from the 21-37-day cycles = 1246

\* These are the actual percentages of the total number.

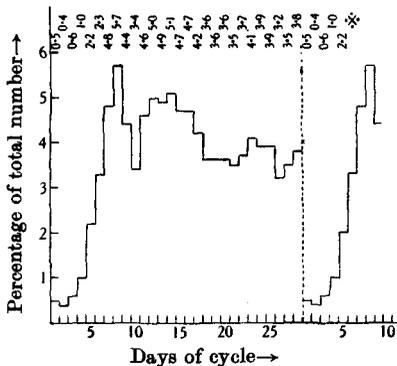
Fig. 11. Variation in sexual feeling (single women) throughout the menstrual cycle.



Sum of all the entries from the 21-37-day cycles = 1618

\* These are the actual percentages of the total number.

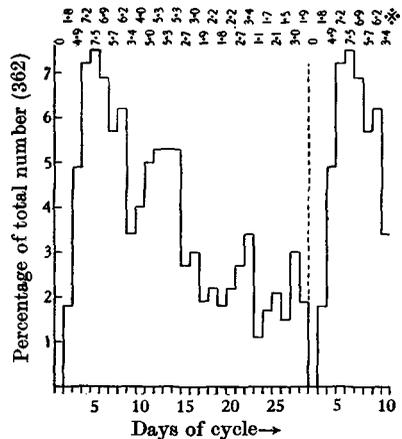
Fig. 12. Variation in the intensity of sexual feeling (married women) throughout the menstrual cycle.



Total number (21-37-day cycles) was 1124

\* These are the actual percentages of the total number.

Fig. 13. Variation in the frequency of sexual intercourse throughout the menstrual cycle.

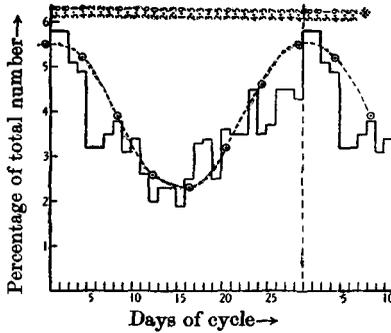


Total number of acts of intercourse 362

\* These are the actual percentages of the total number.

Fig. 14. Variation in the occurrence of sexual intercourse throughout the menstrual cycle of one individual.

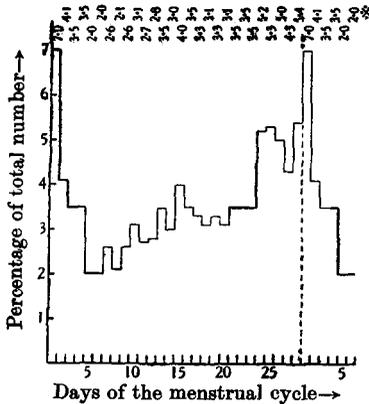




Sum of all the entries from the 21-37-day cycles = 600

\* These are the actual percentages of the total number.

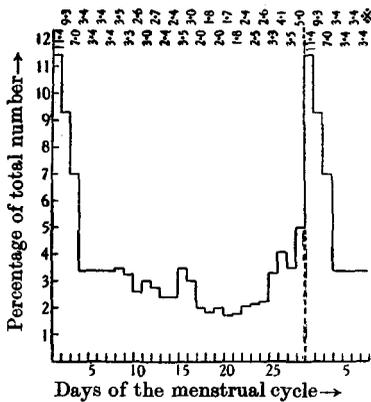
Fig. 17. Variation in tendency to cry throughout the menstrual cycle.



Sum of all the entries from the 21-34-day cycles = 1139

\* These are the actual percentages of the total number.

Fig. 18. Variation in the incidence of irritability throughout the menstrual cycle.



Sum of all the entries from the 21-34-day cycles = 943

\* These are the actual percentages of the total number.

Fig. 19. Variation in the effort required for intellectual work.