

When 10 c.c. of fluid which gave a slight reaction were boiled, the precipitate, washed and suspended in 1 c.c. of saline, gave a very strong reaction.

The reaction, then, appears to depend on the globulins present in the spinal fluid. In the colour constituting a positive result it is not unlike the Hopkins-Adamkiewicz reaction, in which a violet colour is produced by the addition of strong sulphuric acid to a solution of protein in the presence of glyoxylic acid. The association between the two reactions is demonstrated by a further test. Two identical series, each of 15 fluids, were arranged, the first 10 being spinal fluids from various parietic, meningo-vascular, tabetic and non-syphilitic cases. The remaining 5 were solutions of egg-albumin, blood-serum, caseinogen, peptone and gelatin. To one series the acetic anhydride-sulphuric test was applied, on the other the Hopkins-Adamkiewicz reaction was carried out by adding 5 drops of glyoxylic acid solution, and then, drop by drop, 0.8 c.c. of strong sulphuric acid. The two reactions gave identical results. The peptone and gelatin were negative in each case; in the remaining pairs of tubes the colour and degree of colour were practically the same in the two tests.

Conclusions.

The acetic anhydride-sulphuric reaction is positive in almost all cerebro-spinal fluids. As a test for general paresis it is valueless, since many other fluids give just as strongly positive results. The reaction depends on the presence of protein in the spinal fluid, and is probably identical with the Hopkins-Adamkiewicz test.

I am indebted to Dr. R. C. Turnbull, of Severalls Mental Hospital, for permission to publish the results of these tests.

Reference.—(1) Boltz, O. H., *Amer. Journ. of Psychiat.*, July, 1923.

The Time-Sense. By W. WINSLOW HALL, M.D. Edin., M.R.C.S. Eng.

THERE is no lack of evidence that a subconscious measurement of the lapse of time takes place. For example, domesticated animals are often strikingly punctual; some idiots manifest an accurate faculty for time measurement; many men can judge the hour correctly without looking at a clock; others can wake at a predetermined minute; and, as a rule, post-hypnotic suggestions take effect with startling and cryptic punctuality. Investigators are agreed that time-gauging is much more accurate during sleep and trance than in the waking state—in other words, is now more a subliminal than a supra-liminal faculty.

I have experimented on my own time-sense and that of others in three ways: (A) By guessing at the precise minute shown on an unseen watch; (B) by willing, beforehand, to consult my watch at a precise minute; (C) by willing, before sleep, to wake at a precise minute.

Let me report on these in turn:

A. Watch-guessing.

Three methods were tried: (1) A prompt, unreasoning guess was made. (2) The look of my watch-face was deliberately imagined. (3) A deliberate and reasoned opinion was given.

1. A prompt, unreasoning guess was made. To begin with, I and three others agreed that, when challenged, we would give a guess before the lapse of five seconds; later, to get further away from reflection, we agreed that, at a given signal, our guesses should be shouted, and that the first audible guess should be noted. The results of 100 trials following the first plan of challenge may be tabulated thus:

Exact guesses 9%	<i>i.e.,</i>	Exact guesses 9%
1 min. wrong 11%		Not more than 1 min. wrong 20%
2 " " 8%		" " 2 " " 28%
3 " " 18%		" " 3 " " 41%

A series of 100 guesses on the second plan of challenge gave the following results:

Exact 10%	<i>i.e.,</i>	Exact 10%
1 min. wrong 17%		Not more than 1 min. wrong 27%
2 " " 6%		" " 2 " " 33%
3 " " 13%		" " 3 " " 45%

These guesses were made at the same times as the 100 reasoned opinions given in A.3.

Further, it is interesting to note that out of 43 guesses on the first plan of challenge, only 6.9% were exact, while out of 57 guesses on the second plan 15.2% were exact. This suggests that reflection, however brief, confuses the time-sense.

2. The look of my watch face was deliberately imagined. While the watch was still in my pocket I first of all imagined the position of the hour hand; then I imagined the position of the minute hand. While imagining the latter I often felt a conviction (before seeing the hands clearly) that the time was so and so; and then I would see the hand pointing to the right minute. For example, on October 19, 1917, I imagined the hour hand approaching five. Then, on trying to see an image of the minute hand, I had a conviction that the time was twenty-two minutes to five; whereupon I could see, in imagination, the minute hand so placed. On looking at my watch I found that the hands pointed to twenty-two minutes to five exactly.

Two successive centuries of these watch-imaginings were carried out. The results may be tabulated as follows:

First century, April 1 to May 29 inclusive:

Exact 14%	<i>i.e.,</i>	Exact 14%
1 min. wrong 6%		Not more than 1 min. wrong 20%
2 " " 11%		" " 2 " " 31%
3 " " 11%		" " 3 " " 42%

Second century, May 30 to June 25 inclusive:

Exact 9%	<i>i.e.,</i>	Exact 9%
1 min. wrong 13%		Not more than 1 min. wrong 22%
2 " " 13%		" " 2 " " 35%
3 " " 12%		" " 3 " " 47%

The two centuries averaged:

Exact 11.5%	<i>i.e.,</i>	Exact 11.5%
1 min. wrong 9.5%		Not more than 1 min. wrong 21%
2 " " 12%		" " 2 " " 33%
3 " " 11.5%		" " 3 " " 44.5%

One would expect to find that the longer one practised dial-imagining the more accurate one would become. To test this, I have divided the 200 trials into eight batches of twenty-five each, and I find that the exact guesses in each batch come out as follows: 2, 1, 6, 5, 2, 1, 3, 3. From this it is clear that practice caused a sudden improvement in the third and fourth twenty-fives; but that, thereafter, staleness caused a sudden lasting deterioration. Again, one notes that although in the first century 14% of the trials were exact against 9% in the second century, yet, in the second century, 47% of the trials were not more than 3 min. wrong, against 42% in the first. This suggests that though practice diminishes accuracy, it increases approximity.

An isolated experiment in dial-imagining is worth record. On October 10, 1917, I was challenged to come home, without consulting my watch, exactly at 12.15 p.m. by the drawing-room clock. Accordingly, after 8.16 a.m., I looked at no timepiece of any kind. I did my usual indoor work; and then I went out, probably soon after ten, to write in one of the cliff shelters. Several times I imagined the face of my watch, but I did not consult it. At last I felt sure that it was time to go home; and precisely at 12.15 by the drawing-room clock I walked in. Probably no one was so much surprised at my success as I was myself.

3. A deliberate and reasoned opinion was given. The method was as follows: The four experimenters mentioned in A.1 gave, when challenged, a deliberate opinion as to the time shown by my watch while the watch was still in my pocket. The process adopted by each experimenter seemed to me to vary. Thus, while X. inferred from many various data, Y. guessed carelessly and confidently, Z. reasoned as to how my watch would differ from two timepieces which were visible, and W. (myself) tried to imagine the hands on the face of my watch. From the records jotted down at the moment I have worked out the following tables:

(a) Total results from four guessers:

Exact guesses 54%	<i>i.e.</i> ,	Exact guesses 54%
1 min. wrong 26%		Not more than 1 min. wrong 80%
2 " " 10%		" " 2 " " 90%
3 " " 4%		" " 3 " " 94%

(b) Average results from the four guessers:

Exact guesses 13.5%	<i>i.e.</i> ,	Exact guesses 13.5%
1 min. wrong 6.5%		Not more than 1 min. wrong 20%
2 " " 2.5%		" " 2 " " 22.5%
3 " " 1%		" " 3 " " 23.5%

(c) Results from each of the four guessers:

(1) X., æt. 45.

Exact guesses 10%	<i>i.e.</i> ,	Exact guesses 10%
1 min. wrong 21%		Not more than 1 min. wrong 31%
2 " " 14%		" " 2 " " 45%
3 " " 13%		" " 3 " " 58%

(2) Y., æt. 16:

Exact guesses 19%	<i>i.e.</i> ,	Exact guesses 19%
1 min. wrong 13%		Not more than 1 min. wrong 32%
2 " " 12%		" " 2 " " 44%
3 " " 17%		" " 3 " " 61%

(3) Z., æt. 15:

Exact guesses 14%	<i>i.e.</i> ,	Exact guesses 14%
1 min. wrong 13%		Not more than 1 min. wrong 27%
2 " " 17%		" " 2 " " 44%
3 " " 15%		" " 3 " " 59%

(4) W., æt. 54:

Exact guesses 19%	<i>i.e.</i> ,	Exact guesses 19%
1 min. wrong 18%		Not more than 1 min. wrong 37%
2 " " 21%		" " 2 " " 58%
3 " " 13%		" " 3 " " 71%

(d) Results from the first twenty deliberate opinions compared with the last twenty:

(1) The first twenty:

Exact guesses 8%	<i>i.e.</i> ,	Exact guesses 8%
1 min. wrong 5%		Not more than 1 min. wrong 13%
2 " " 4%		" " 2 " " 17%
3 " " 3%		" " 3 " " 20%

(2) The last twenty :			
Exact guesses	13%	<i>i.e.</i> ,	Exact guesses 13%.
1 min. wrong	6%		Not more than 1 min. wrong 19%.
2 " "	0%		" " 2 " " 19%.
3 " "	1%		" " 3 " " 20%.
(e) Results from the last twenty deliberate opinions before a break of 53 days compared with the first twenty after the break :			
(1) Last twenty preceding the break :			
Exact guesses	11%	<i>i.e.</i> ,	Exact guesses 11%.
1 min. wrong	5%		Not more than 1 min. wrong 16%.
2 " "	2%		" " 2 " " 18%.
3 " "	0%		" " 3 " " 18%.
(2) The first twenty following the break :			
Exact guesses	11%	<i>i.e.</i> ,	Exact guesses 11%.
1 min. wrong	7%		Not more than 1 min. wrong 18%.
2 " "	0%		" " 2 " " 18%.
3 " "	1%		" " 3 " " 19%.
Perhaps one ought to add here that personality seems to affect the efficient working of the time-sense. The four tables which epitomize the results of W., X., Y. and Z. suggest this, and confirmation is given by the following experiment: V., æt. 18, was induced to give a deliberate time-guess on 35 occasions, but it was always done scornfully. "Anyone," said V., "can guess the time accurately when the customary routine is going on." Yet V.'s achievement was not in keeping with this assertion. The following tables contrast strikingly with those of Z., Y. X. and W.			
(f) Results of V.'s time guesses :			
Exact guesses	0%	<i>i.e.</i> ,	Exact guesses 0%.
1 min. wrong	8.5%		Not more than 1 min. wrong 8.5%.
2 " "	25.7%		" " 2 " " 34.2%.
3 " "	17.1%		" " 3 " " 51.3%.

From the foregoing tables some interesting conclusions may be drawn :

1. That a time-sense exists. For, in 100 trials, one or other of the four guessers hit the exact minute no less than 54 times (see A.3.a). This could not have been due to chance.
2. That deliberation favours accuracy in guessing. For the average accuracies by deliberate opinion (A.3.b) were one-third more than those by prompt guessing (A.1)—that is, 13.5 to 10.
3. That hastiness favours proximity in guessing. For the approximate successes by prompt guessing (A.1) were almost double those by deliberate opinion (A.3.b)—that is, 45 to 23.5.
4. That reasoning confuses the time-sense. For the accuracies in prompt guessing were more than doubled when time for reasoned thought was shortened (see note to A.1)—that is, 15.2 to 6.9.
5. That some process analogous to sense-perception best mirrors the findings of the time-sense. For the methods of forming a deliberate opinion (see A.3) were successful in the following order: (a) Imagining the dial. (b) Careless guessing. This was inferior to (a) only in the approximate successes. (c) Inferences from visible dials. (d) Inferences from all available data.
6. That practice improves time-guessing. For the accuracies in the third batch of dial-imaginings (see A.2) were treble those of the

first batch (6 to 2). Again the accuracies in the last twenty deliberate opinions (see A.3.d) were more than half as much again as those of the first twenty (13 to 8).

7. That staleness may deteriorate time-guessing. For the accuracies in the sixth batch of dial-imaginings (see A.2) were only one-sixth of those in the third batch (6 to 1).

8. Yet a prolonged break in the experiment may not cause greater success on resuming. For a holiday of 53 days (see A.3.e) was followed by exactly the same number of accuracies in the next twenty reasoned opinions as in the twenty reasoned opinions preceding it (11 to 11).

9. That personality affects the efficient working of the time-sense (see A.3.f).

B. Time-willing with a Waking Interval.

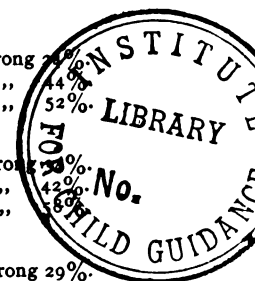
The method employed was to will beforehand that, at a precise minute, I should consult my watch; and, while thus willing, I was wont to visualize the face of my watch at the predetermined minute. In the intervals I was absorbed in my usual occupations. Thus at least three processes were involved: 1. The conscious self imposed a task on the unconscious self. 2. The unconscious self was expected to keep count of the passing minutes. 3. The unconscious self was expected to report to the conscious self at the predetermined minute. My strong impression is that the unconscious self always did its work accurately, but that it often failed to win the attention of the conscious self.

During these tests two plans were tried: (1) In 50 trials I chose varying intervals between the time of resolve and the time for acting on the resolve. (2) In 50 trials I chose a uniform interval of 15 minutes. The following three sets of tables give the results:

1. The first 50 trials with varying periods:		
Exact 16%	<i>i.e.,</i>	Exact 16%.
1 min. wrong 8%		Not more than 1 min. wrong 44%
2 " " 20%		" " 2 " " 44%
3 " " 8%		" " 3 " " 52%
2. The second 50 trials with a 15 min. period:		
Exact 16%	<i>i.e.,</i>	Exact 16%.
1 min. wrong 18%		Not more than 1 min. wrong 22%
2 " " 8%		" " 2 " " 42%
3 " " 16%		" " 3 " " 58%
3. The whole 100 trials:		
Exact 16%	<i>i.e.,</i>	Exact 16%.
1 min. wrong 13%		Not more than 1 min. wrong 29%
2 " " 14%		" " 2 " " 43%
3 " " 12%		" " 3 " " 55%

From these trials one can infer:

1. That a time-sense exists. For chance would hardly give exact success in 16% of these trials; still less would chance have



enabled me to be not more than 3 min. wrong in 55% of the trials.

2. That success was exactly the same whether the interval was varied or uniform (16% to 16%).

3. That successes were about half as much again as in watch-guessing (16 to 9 or 10), or in watch-imagining (16 to 11.5); and about one-seventh greater than in deliberate guessing (16 to 13.5).

4. That success was largely due to visualizing.

5. That practice does improve time-willing. For though successes were exactly equal in the two series of 50 trials, yet, when one ranges the trials, chronologically, into batches of 25, one finds that the accuracies in the successive batches come out as follows: 2, 4, 3, 7. Thus, allowing that there was a falling-off through staleness in the third batch, there was yet, on the whole, a rise in efficiency.

c. *Time-willing with a Sleep Interval.*

The method used was as follows: Before falling asleep I willed to wake at a certain minute, and I invariably visualized what the face of my watch would look like at the minute resolved on.

Waking at a predetermined hour is, of course, a common accomplishment. Most regular workers do it. William James, for example, states that he himself, independently of sleep, was in the habit of rising suddenly every morning at the same minute by the clock (*Principles of Psychology*, vol. i, p. 210). Again, Mr. C. E—, a greengrocer, tells me that he always awakes at 5.55 a.m. by his watch, and that he can awake at any unusual hour, *e.g.*, 4 a.m., by thinking of that hour fixedly before he goes to sleep. He does not visualize the watch-face; he just says to himself, "I must wake at 4 o'clock."

I have experimented on myself in relation to (1) night sleep; (2) early morning sleep; (3) early afternoon sleep.

(1) Night sleep: My experiments with regard to night sleep were vitiated by the following two facts: First, that when I went to bed I was often too tired to will at all; and, secondly, that bodily pain almost invariably woke me many times before the resolved-on hour. One experience, however, is quaint enough to be recorded. On July 10, 1917, at 10.30 p.m., I resolved to wake at 4.30 a.m. Pain awoke me thrice before that hour, but thrice I dozed off again. At last I dreamed that I was looking at a dirty, pink handbill, upon which TRUTH was printed in large black letters. Thereupon I woke with the certainty that now was the appointed time. And my watch showed 4.31 a.m. Moreover, on the following afternoon, two handbills, of the exact size, shape and

colour seen in my dream, were pushed under my front door ; but (alas !) the "TRUTH" was not in them. My reading of this accurate absurdity is that my subliminal self made use of my visualizing tendencies for signalling purposes ; but why my subliminal self used such a ludicrously oblique visualization is more than I can say. A vision of my watch-face would have been much more to the point.

Though, as I have said, my night-results are of little value, I did make 100 trials, and I give the figures for what they are worth :

Results of 100 night trials :

Waking was exact in	18%	<i>i.e.</i> ,	Exact 18%.
15 min. or less wrong	35%		Not more than 15 min. wrong 53%.
15 to 30 min. wrong	22%		" " 30 " " 75%.
30 to 45 " "	6%		" " 45 " " 81%.

Moreover, the number of accuracies in the four successive batches of 25 were 5, 5, 2, 6. The marked drop in the third batch may be accounted for by the fact that during these 25 trials the sudden illness and death of a near relative marred my sleeping. The accuracies in the other three batches are curiously similar in number.

(2) My experiments with regard to early morning sleeping were even more vitiated by my bodily infirmities ; so much so that I abandoned them, and the few results obtained are not worth giving.

(3) My only satisfactory experiments were with regard to early afternoon sleep ; for then, at the time of willing, I was wide awake and comparatively untired ; and I was also so free from pain as to be able to sleep uninterruptedly. The following table gives an abstract of 100 consecutive trials :

Waking was exact in	16%	<i>i.e.</i> ,	Exact 16%.
1 min. wrong	3%		Not more than 1 min. wrong 19%.
2 " "	12%		" " 2 " " 31%.
3 " "	6%		" " 3 " " 37%.

These afternoon trials were made between April 1 and August 9, 1917, and I was conscious, as they proceeded, that exact successes were growing fewer. Having divided the 100 records into four batches of 25 each, I found that in the four successive twenty-fives the accuracies were : 6, 4, 4, 2. No doubt this falling-off was partly due to staleness ; but, seeing that oversleeping, and not undersleeping, was the invariable fault in the last batch (23 out of 25), and considering that, just then, I was getting unusually little sleep at nights, I believe that tiredness may have been partly responsible.

In 72% of these afternoon trials an irregular period of sleep was willed ; and in 28% a regular period of 15 min. was willed. The results in these two sections compare as follows :—

(a) 72 irregular periods :

Waking was exact in	18%	<i>i.e.</i> ,	Exact 18%.
1 min. wrong	4.15%		Not more than 1 min. wrong 22.15%.
2 " "	11.11%		" " 2 " " 33.26%.
3 " "	4.15%		" " 3 " " 37.41%.

(b) 28 fifteen-minute periods :

Waking was exact in	10.7%	<i>i.e.</i> ,	Exact 10.7%.
1 min. wrong	0%		Not more than 1 min. wrong 10.7%.
2 " "	14.2%		" " 2 " " 24.9%.
3 " "	14.2%		" " 3 " " 39.1%.

The following inferences from my sleep-willing trials are drawn from the afternoon series alone :

(1) That a time-sense exists. For chance would hardly enable one to wake at the predetermined minute in 16% of the trials ; nor would chance enable one to wake within 3 min. of the resolved-on time in 37% of the trials.

(2) Persistent practice tends to diminish accuracies, probably through staleness. This is against the theory that habit accounts for success.

(3) Habit is further discounted by the facts that the afternoon trials were made at ever-varying times, and that, in 72 of them, irregular periods of sleep were willed.

(4) Accuracies were nearly twice as frequent when an irregular period of sleep was willed as when a regular period was willed (18 to 10·71). But tiredness, as well as staleness, may account for this result.

(5) Approximate successes were slightly less in the irregular-period section than in the regular-period one (37·41 to 39·1).

CONCLUSIONS.

These experiments in watch-guessing, in time-willing and in willed waking seem to warrant the following conclusions :

(1) That a time-sense exists.

(2) That the time-sense works best below the threshold of consciousness.

(3) That the time-sense, therefore, is evidence of a subconscious self.

Clinical Notes and Cases.

An Unusual Form of Suicide. By G. A. AUDEN, M.D., Ph.D.,
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FROM time to time cases of suicide occur in which the methods employed to bring about death have considerable psychological interest. The following case appears to fall within this category, and to be worthy of permanent record :

X. Y. Z., æt. 24, carried on a fish business in conjunction with his father, who suffered from epilepsy. So far as is known he appeared to be perfectly normal in health, mental capacity and behaviour, belonged to a local football club, and possessed a motor bicycle. On the morning of February 4, 1927, a police constable called at his house to verify his address in reference to an inquiry from the police of a neighbouring town, where he had been reported.