Exner, Sigmund - Hirsch, A

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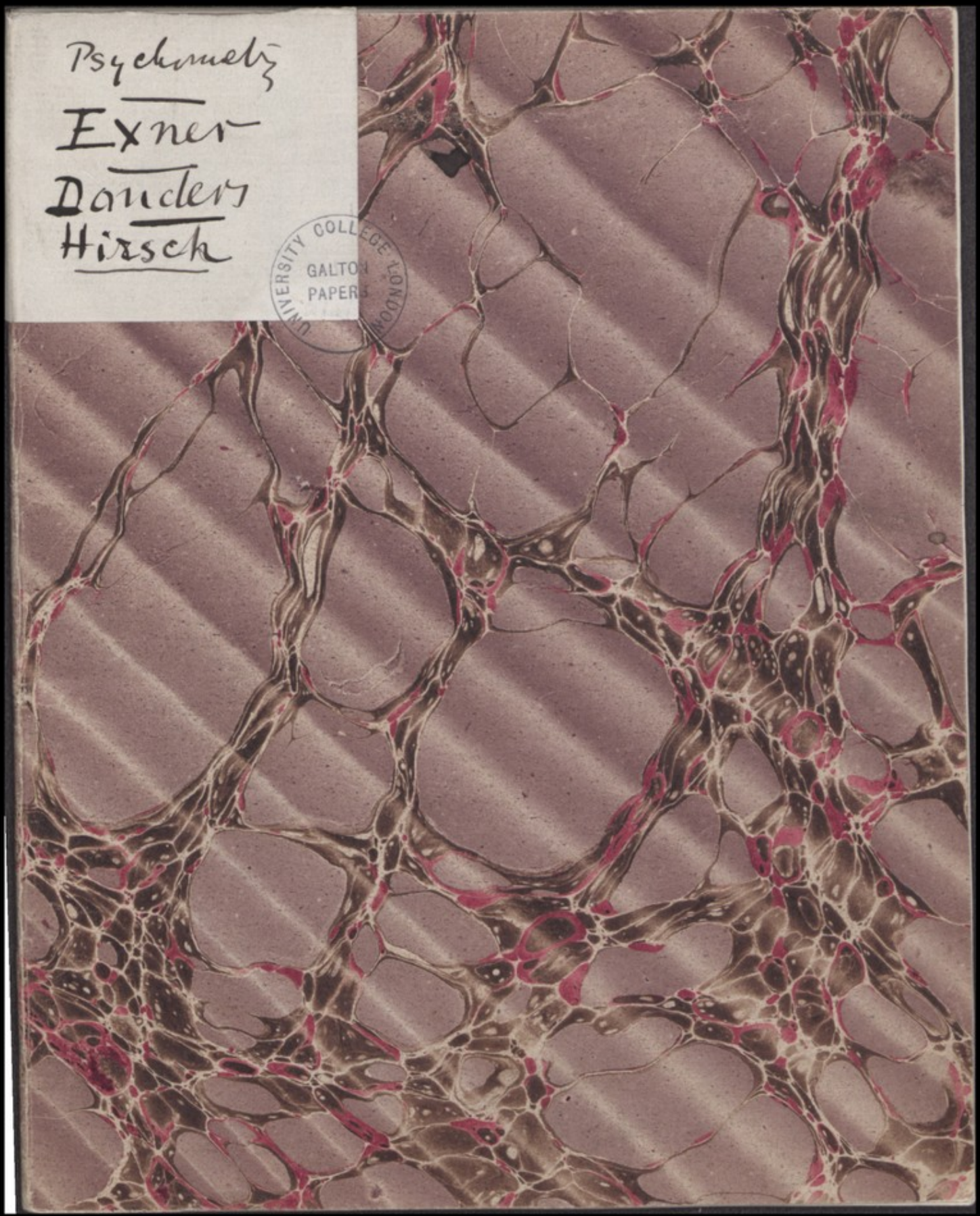
Psychometrie

Exner

Donders

Hirsch



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Pflüger. M 14 | 330, 529.
13 | —
12 | 87.
11 | 403. 581.
10 | ½
9 |
8 | 526
7 | 101

Exner Experimentelle untersuchung der Einfachsten psychischen Processen von D^r Sigm. Exner Pflüger's archiv. bols VII, 101 — VIII, 526. — XI, 403, 581. (1873)

In 1870 Helmholtz, & Bast publ: 2^d paper on the rate of motor nerve transmission in man in the K. Academie der Wissenchaften zu Berlin — & showed it was much slower in cold than heat — it could be doubled in some conditions this makes one think there must be some chemical reaction in going & old; common & phlegmatic people. Dr Exner with Schiff tried Helmholtz method of measurement in people of contrasted temperament. (the arm is bedded in plaster of Paris) with a thermoelectric ball under the arm. An old man of 75 from the an Asylum & Schiff act 22 were compared — results were negative as to affects the median nerve.

Speaks of personal equation — gives an elaborate history &c. Speaks among the things of Hirsch's observations — &c a long list of authorities & writers upon it.

p. 610. Speaks of his apparatus an electro motor - rotation apparatus as described by him in Wien Acad: d. Wissensch. 1868

flar 1

Dr. Sigm: Exner

Experimentelle untersuchung der einfachsten Psychischen Processe. Pflügers Archive VII. 601

Personal Equation In March 1870 Helmholtz & Baxt read their 2nd memoir at the Akadem: Wissen: Berlin on the rate of nerve transmission & showed that it was doubled by warmth (within the range of their experiments). This makes one think that the rate must vary under many other circumstances such as youth & age, a cool & a phlegmatic temperament, & deserves investigation

The author tried with this view an old man from a pauper asylum & a young doctor Schiff, but found no note worthy differences between them, so he was discouraged and tried that investigation no farther

But these negative results showed that such differences in personal equation as exists, may reside in the brain and in the nerves. So he experiments on what he calls the Reactionzeit (time of reaction)

Vorher he gives the history & literature of Personal equation & shows that hardly any inquiry had been made into its nature since it first was pointed out.

There are 2 methods Signal and Pointing. The first is the simplest, a star approaches the wire & the

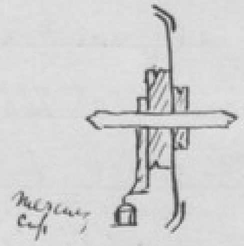
408. ~~finger~~ signal is given at the time it crosses it. This case is not simple for the observer has to calculate the required time for the muscular action to take place

The Pointing Eye & ear method is quite different. He deals with the fractions of the time interval between 2 beats of the clock that precede & follow the transit

Reaction time

The experiment to determine this is due to Bessel who used a sudden signal to be responded to, & found the time much less than that of the Personal Equation — Helmholtz subsequently tried this & afterwards Hirsch

410. He describes the apparatus he himself used, one of Helmholtz electro motor rotation apparatus described by him. (Exner) in Wien Akad d Wissensch 1868)



He tried the reaction time in different individuals, in different organs & endeavoured to ~~show~~ its dependence on different conditions.

His signal was an induction spark, to the (say middle finger of) left hand, the signal was responded to by the right hand. The primary current was that re-opened by the dipping of a wire into a mercury cup. The times were in thousandths of

seconds

	Mean in thous of secs
1	134
2	331
3	{995 / 335}
4	175
5	256
6	129
7	138

. In taking means he discarded extreme cases where there had been a break between them and the continuity of the medium cases, those in which the experimenter declared he had performed badly. After He had thought of adopting the minimum instead of the medium time, but this means the time accompanying strained attention, there are also cases in which the signal is responded to too soon. ~~Each The characteristic of each of the men is appended to the table~~ To each observation the opinion of it as entertained of the experimenter is given. The opinion that it that he uttered immediately after making it & while still in ignorance of the actual result (No 3 in the old paper) Practice has great influence on the result. Many only took men who had never tried before — The Reaction time does not depend on age. It is apparently shortest in those who can concentrate their attention the best, & contrary wise Phlegmatic & lively men do not differ ~~so much~~ on that account. "He will shew later that the difference in reaction-time ~~between~~ individuals is (? more or less) constant whatever be the organ that receives the stimulus see p 5 of this MS

On first experimenting every one feels how little he is master of his own movements, the quickness of ~~the start~~ giving the grip & the time lost before beginning to give it are both to some degree independent of our will. After the grip, we generally have a fair idea

whether we have been too slow or too quick. If we attend to ourselves we find that when we are in strained attention our sensorium is in a state that makes the quickest reaction possible it is almost independent of the will – that is to say ~~besides~~ after the stimulus nothing has to go on before the reaction commences. That which in ordinary cases has to go on, we call an act of will

When one is tired a slight stimulus often produces no reaction – the man feels it (it does not sufficiently prompt him to act) but delays to act, & the ~~time~~ ~~goes~~ opportunity is lost.

~~Sensorium not formed of one~~

617 If the attention is momentarily a little diverted, the
618 reaction time is increased. The mind is conscious of the delay [illegible] expressed himself that it seemed as if there was an obstacle that required time to overcome. Attention is everything to the success of the experiment; even if any one is in the room the reaction-time is prolonged. This strain of the attention is most exhausting. Exner sweats all over as he sits on his stool. Hence he prepares the observer for the occurrence

When the induction spark is so strong that the man cries out & starts, the reaction time is especially short. He thinks there may be a substantial difference between
619 this & the ordinary case – but he has not been able to

excitement as the conditions are difficult. When one is in a very strained state, so as to tremble with excitement then a local stimulus will affect the whole or a large part of the body. Under these conditions the reaction time is marked less than under the ordinary mes of experiment

Reaction time according to locality of stimulus in 1/1000 of sec.

	SE	Bolo paper	EF	A & W	ES
Electric shock on left hand	128	(187)	129	175	331
Electric spark as seen	151	201	162	190	—
Sudden sound	134	201	175	—	214

In every case where a shock was sent directly through the retina the reaction-time was the shortest of all.

When the right hand which gives the signal is stimulated, the reaction-time is longer than when the left hand is stimulated. Exner thinks it is harder to direct the attention to two events in the same part of the body (both to the right-hand), than to different parts.

A sharp blow may give a direct stimulus to the nerve (like electrifying the retina). But takes time to pass through the cuticle - Slight touches like tickling give very irregular results

He tries experiments of light of a spark of varying brightness; the reaction time diminishes with increase of brightness (for visual nerve)

b/ p3v

b2b. Reaction-time diminishes after practice — He therefore always uses the earliest results [Why not the latest; - those of highest possible education? — If no education we know nothing] The old man by practice rose from 995 to 187 $\frac{1}{1000}$ sec

Fatigue shows itself in increased Reaction time towards close of protracted experiments — those with "good" effects then became greater & greater.

Tries medicaments. He took strychnin, but found no effect; a friend took morphia, it appeared to him that he acted more slowly but the measurements proved matters another friend drank two bottles of wine Reaction time increased from 190 to 297, yet the man thought he was acting more promptly & gave his signal with such vivacity that the instrument was in danger. He saw the experimenter that he had lost the musical scale.

Analysis of the Reaction-time.

1. The time ~~does~~ occupied by the sense apparatus in communicating with the nerves
2. The time of nerve transmission to the Central nervous system
3. The time spent in passing along the spinal marrow (not always happens)
4. The time spent in the centre
5. reverse of 3
6. reverse of 2
7. time of setting the muscles in motion.

2 & 6 are well known – also 7
remain to find out 1, 3&5, and 4. He calls the
latter (viz 4) the reduced reaction-time. It is the total time
less what takes place outside the brain

In order to find (1), we must get reaction time as described
above, ~~then again by direct~~ i.e. stimulate the organ of sense & signal the time of its arrival at the centre; then stimulate
directly the nerves leading from the organ of sense & proceed as before
The difference gives the time in which the stimulus lay
latent (so to speak) in the organ of sense.

Sight is the only practicable sense to experiment upon with.
Now the reaction time of electrising the retina is 114, or seeing a
spark 151, or 37 thousandths sec for ~~duration of the~~ time consumed
in (1) in the sense apparatus; this is far beyond the limits of experimental
error. This is not a quite satisfactory experiment, the correct
thing would have been to stimulate the centre of vision itself – but it is an
impossibility apparently to do this in equal measure with the
stimulus to the eye – there are other difficulties. Still we may consider
assume (1) to be a probable fact even when the retina is directly
electrised. When a signal is given to the eye (1) is certainly
shorter as the brightness of the signal is increased

32 As regards 3&5 (Spinal marrow)

He tried toe against finger, in the one case 175 in the other 128 $\frac{1}{1000}$ secs
Whence he calculates rate of spinal transmission as 8 metres in 1 sec;
in the sympathetic that the rate of simple nerve transmission is 62 metres in 1 sec

f 4v

Then roughly, length of foot nerve 130 cm, of hand nerve 98 cm
diff in length = 32 cm. — time thus differentially lost = .005 sec

(for 62 metres in/sec = 32 in .5 sec roughly ~~= .032 in~~ or 32 cm in .005 sec)

~~(= total .005 = sec. lost)~~

~~length of spinal marrow = 32 cm, or say .005 sec. for 1 metre~~

total time differentially lost = 174.9 − 126.3 = 048.6

less differential nerve loss as above = 005.0

= 043.6

or 043.6 in a length of spinal marrow = 32 cm

126.3 thousandths of a sec for 1 metre

= 1 sec for 8 metres.

633 All this is doubtful reasoning — It does not follow that all parts of the spine transmit with equal velocity. Also the nerves of hand may have some spinal marrow retardation He tried his old mean but bad results — nevertheless his rate of spine transmission seemed much the same as Exner's He tried electricity the forehead as against the foot but the reaction time was large than by finger. He tries to account for this

He tries jaw against the Trigeminus The man had to bite when he felt the stimulus [better to open the jaw as if to bite & then, the difference between these two would be worth trying]

He makes sensible remarks about the limited conclusions to be drawn from his spinal marrow researches — nerve transmission is there very probably a very complicated process.

Leiden × Wittich have written on this subject Virchows Archiv 1869 & 1872 but they have mixed together the effects of nerve & of spine marrow transmission.

36 ~~[illegible]~~ (4) (b) Reduced Reaction-time. This occupies much the larger part of the whole reaction-time The delay is in the brain, not in the peripheral nerves The reduced R.T. obtained by subtracting time lost in nerve transmission in 7 individuals is as follows

	SE	ES	JR (old manuscript)	AvW	FvW	EF	SvB
RT	26	23	76	224	20	22	35
RT − 1000 sec	83	28	{943 / 305}	123	205	77	90

(This gives an idea of the variety found.) & corresponds very nearly to the reaction-times unreduced

What was said about influences upon the RT must be understood to apply almost wholly to the RRT. — about which we regard attention. It is hard to say about the case of bodily start, where one shrinks all over. Less time is required to get a muscle from strain to contraction, than from rest to contraction

The effect of practice is very curious. It is not a steady improvement but goes in leaps. After rest there is improvement as often. One learns through rest as a skater improves by a summer rest & a swimmer by a winter one.

p5v

639) **III. The central time-standard**

How great must the time be, between sense stimulus and motor impulse, to be appreciable by us?

We know well when we have responded badly to a signal, even to $\frac{1}{100}$th of a second

We tried 2 ways (1) To make a simultaneous signal with the actual moment of occurrence of an event previously seen approaching, as transit of star — (2) Rythmic repetition of a stimulus, with rythmic response by signals — to make them simultaneous

(1) the results are used for accordingt that those of the reaction-time as described already. the errors seen by practised astronomers are in many tenths of seconds. When Exner worked with his disc revolving 5 times per minute, & he made a carriage mark before a fixed mark, he made often great errors Again in ordinary RT obser: we have seen the best result to be when the attention is so strained that on the appearance of the signal the reaction follows involuntarily. This state of things cannot occur in the (1) method

(2) Is not a very good plan the great experiments in which the hand signals a rythmic sound. — Also by rythmic sparks to left hand & simultaneous signals with right — Also a Also a mark was fixed to the lever & the sight of it & the sound of the signal were compared.

His and Obersteiner's "Neuramoebometer" made by F Heinitz mechaniker IV Theresiengasse 31. Vienna which in its most complete form costs 30 fl ö.W.

Exner's Second paper. Pflügers Archiv Bd. I 526
On reflex time, and spinal marrow transmission
(This does not bear on physychometry in the way that I am interested in it)

Exners Third paper Pflügers archiv, vol II. p 403
Personal Equation, second part.
403 Exner prefers his regret that he had not known of Hirsch's memoir "Experiences chronoscopiques sur la vitesse &c.."
Soc. Sc: Naturelles Neuchâtel. VI. 1862. He also refers to Oberst Eisner in Virchow Archiv LIX.
He vindicates his plan of ignoring exceptional values when taking the mean & says that he & Hirsch measure two different things
Hirsch the average reaction time for use as personal equation,
Exner the necessary time for a reaction to take place.
Recent question is a stimulus a is received, then a stimulus b
what interval must elapse in order that a & b shall be
recognised as distinct?. (the stimuli may affect the
same organ or part of organ, or not) – He names this interval
the "least difference". Mem: the question is different whether we
seek the "least difference" or to know the interval required in order
to say which stimulus comes first.
404 Sight 415 Hearing ~~422 15~~
422 Between different organs of sense. Here attention plays a
very prominent part. – 423 Eye & Ear. revolving disc: the electric spark

was viewed in a mirror. It followed that the ear was quicker than the eye, experiments being made on several persons

426. Touch × ear

426 Touch × eye

III. "Smallest difference" in different persons. — It very different

428 Summary table of results

IV. Subjective Observations

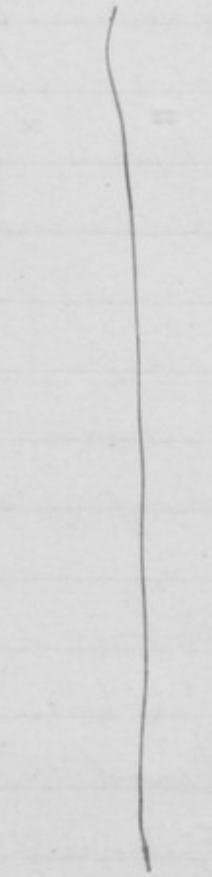
428 All the experiments in least difference are very trying and require the greatest patience owing the disagreeable sense one has of not being master of ones own sense organs

When one ~~wither~~ approaches the moment of expected sensation, something goes on in the Sensorium which deadens it for other impressions and makes it less capable of motor impulse. All its energy is concentrated on the expectation. This will call attention. It is very difficult to sustain the attention in these experiments. Attention is like the surface of water, which we can agitate × ~~from~~ throw into waves though we have no power over the several wave summits. Hence we cannot ~~expect~~ to sustain attention, attention at any fixed moment × sometimes does or signals better, sometimes worse. We know whether we shall signalled in a favorable or unfavorable moment, but even these unfavorable moments are better than that in which the attention has not been excited at all.

430. Between Immediate Cage & Ear Either can be made to appear the first, by preparing the attention for it (according to Wundt)

431. In 2 light signals one is very apt to think that the one has moved to the place of the other - & so with some other matters

Exner, ~~Fourth~~ Paper same vol as last viz II p. 586
On the Zones of sensibility in the eye.
(of no use to me)



f7v

"F.C. Donders, Harlem archives Néerlandaise II. 1867
"Deux instruments pour les mesures des temps
nécessaires pour les actes psychiques" p. 247

(1) noématachographe determine the duration of
operations such as le complex of the mind
(2) noématachometre measures the minimum of
time necessary to a simple idea.

(1) is a cylinder, like that of the phonautographe on which a
tuning fork registers its beats - By the side of these is
registered the (instant of stimulation) F.C. & the (instant of reponse) F.C.
of signals - between induction sparks - transparent letters
illuminated from behind by a strong spark - Sound
by .... x the head of King modified, in which is stretched
an elastic membrane x which communicates by two
tubes with different embouchures. Response by
an electro magnet not recommendable on account of its variable period of retardation, by voice or above,
or by turning a stop in communication with an interrupting
lever. which marks letter & right & left. The last
is the best

(2) is a prism supporting a horse shoe & suspended
by a thread behind a vertical board. By burning the
thread the prism falls and in its descent displaces a

a touch cork lever & thereby open a galvanic current of which one sees the spark and immediately after, or before it loses its luminosity caught by 2 rods of copper & one hears the sound of it. In the part in which the horse shoe rests & the point which moves the lever can have their positions or the prism varied, one can calculate the interval between the two events in the data of their velocity of the fall at the moment

(I cannot understand the prism & the mode of support of the horse shoe)

F.C. Donders – La vitesse des actes psychiques (Harlem Archives Néerlandaises III – 296.) 1868.

Première Partie. Jean Müller 25 years ago (?1843) said the rate of nerve transmission could never be known. but in 1845, Bois-Reymond showed it a general way how to determine it & in 1850 Helmholtz actually did it.

Now, how to measure the time requisite to form an idea or for an act of will – The "physiological time" of Hirsch Thus for touch sound & sight is respectively about $\frac{1}{7}$, $\frac{1}{10}$ & $\frac{1}{5}$ of a second. But how much of this is due to the purely psychical act. There are 12 processes in play (and as I never has since laid down) the sum of

16) f8v

which may occupies these short period. Donders plan
is to interpolate new physiological actions & to see
how much the period is lengthened by doing so. - This will
give the duration of the interpolated acts. Then he tries
a dilemma & find it to require an additional $\frac{1}{5}$ or $\frac{1}{6}$ second
when the eye was used, $\frac{1}{12}$ when the ear
p 304 a list of the times occupied in the various dilemmas

(nothing very much results from it all)

Hirsch Bulletin de la Societe des sciences
naturelles, Tom VI. Nov 8 / 1861.

17) p. 7. The Society gave the Observatory to hear M Hirsch's
communication of the experiment just made with Hipp's
chronoscope on the rate of sensation. - This is described
p. 100) in same Journal in Abhandlg p. 100. "sur la vitesse des
differents sensations". - He finds traces of personal
equation & of physiological correction - refers to
Dubois-Reymond's famous work "Untersuchungen über
thierische Electricität" - & to Helmholtz experiments on
frogs - Then theory of Hipp's chronometer which is somewhat
faulty owing to the uncertain action of the electro magnetic
stop. ~~accom~~ He experiments with a falling balls - Mean
error due to this cause within .002 sec - The rate of the

chronoscope in company with a chronometer was found to
108 be quite good. For sound, a ball is held between clips.
On opening these with great rapidity the current is interrupted
& the ball falls & hits a plate & thereby stops the current
or by disturbing the wires otherwise the blow opens the current &
the hand stops it again — Result for sound six cases, from 20 to 11 trials with each
varying between 0.149 & 0.243 sec or as 5:8 — Hipp
who has a very sharp ear is the slowest.
110 Sight. The current bifurcated, half to the primary of
an induction coil, half to the electro mag: of the chronoscope
on breaking the current the latter began to work & the spark was
seen — Results for 3 cases about 50 trials with each
111 0.197 to 0.209. — Then for ~~compare~~ an experiment
more accordant with transit observ: he endeavoured to
note the instant of the hand of the chronoscope covering
a mark on the lower dial.
112 Touch, used an induction spark. On the face, hand
& (3) foot — the times from one observer making some 50 or 40
trials were (1) 0.110; (2) 0.142; (3) 0.149 with a
probable error of 0.002

As above tom X. 1873 p 13. "Sur quelques recherches
récentes concernant l'équation personnelle et le temps
physiologique" by Hirsch — (a review of Exner very
bitter) — p. 5. Hirsch has had experience of personal

Exner of many people & confirms Lewis view that age has little effect, nor temperament, but the person of keen attention has. He agrees with Lewis that the tension of attention has no connection with volition but when once produced, volition does not subsequently intervene (between the stimulus & the response) When the tension is insufficient (owing to fatigue) or the stimulus weak, the response takes place & the experimenter is vexed — this precisely proves that volition does not intervene. — Exner finds that feeble stimuli give not only more variable periods of response, but also longer ones — Besides attention, practice diminishes the interval — he says fatigue prolongs it but astronomers find that it makes it more variable. He strongly criticises Exners rate of nerve transmission & Hirnd maintains Exners Basal finds good variability in rate of nerve transmission according to temperature

14. He proposes to repeat his experiments on many people & with different temperatures.

f10 15