

# André-Thomas (1867–1963), Initiator of Neonatal Neurology

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## Keywords

André-Thomas · History of neurology · Neuropediatrics · Neonatology · Newborn's reflexes

## Abstract

After a brilliant career as a clinician and anatomopathologist, André-Thomas (1868–1963) spent the last 30 years of his life validating the components of neurological examinations of newborns and infants. This novel approach was developed through long examinations of several hundreds of normal and sick children, notably those with anencephaly. By combining his vast knowledge of physiology with the results of his experimental work, André-Thomas built the foundations of a speciality that did not exist before his time: neuropaediatrics. His *Études neurologiques* (neurological studies), medical in nature but also very literary, echoing his illustrious predecessors of the 19th century, made him a transmitter of knowledge, a man of transition, from the anatomoclinical method of the 19th century to the standardised investigation techniques of the 20th century.

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## Introduction

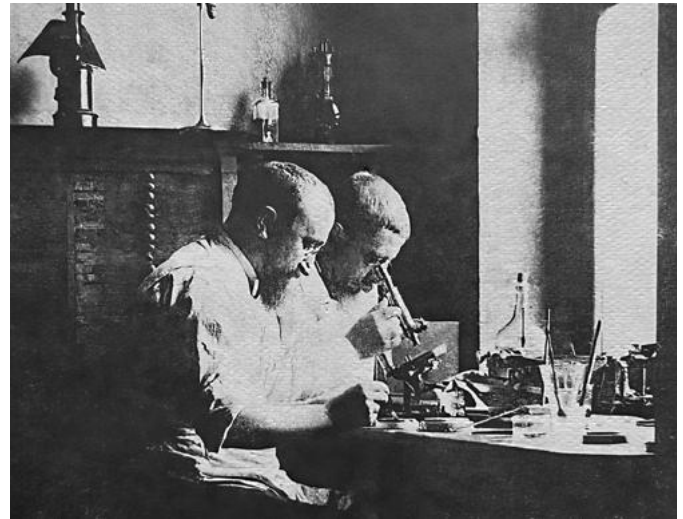
It seems necessary to make a clarification at the outset: the physician who will be discussed here, Antoine Henri André Thomas, undoubtedly embarrassed by a last name that could have been mistaken for a first name, chose to

go by André-Thomas. When Henri Hécaen (1912–1983), one of the first neuropsychologists, recounted the life and career of André-Thomas (1867–1963), his venerated master, for the centenary of his birth in 1967, he was in awe of the fact that he had written his article so soon after André-Thomas's death [1]. However, what was most extraordinary was not André-Thomas's long life, but rather his starting, after his retirement at 65 years old in 1932, a new career by founding an unprecedented discipline: pre- and postnatal neurology after having been a very close colleague of Jules Dejerine (1849–1917) for around 15 years.

Before shining a spotlight on how André-Thomas's contribution to paediatric neurology was fundamental, we turn now to a brief account of his life. André-Thomas was born in Paris on November 19, 1867. He finished his secondary education at Lycée Condorcet, where he was a brilliant student. He was immersed in a religious institution whose rigour strongly discouraged him, gifted as he was with a critical and anticonformist mind throughout his life. The attentive care his family physician bestowed on him when he was 12 years old to treat his tuberculosis seems to have been the source of his medical vocation. Once he had passed the examination for non-resident students in 1889, he worked under Fulgence Raymond (1844–1910) in 1891 before passing the resident's examination in 1892. In 1893–1894 at Bicêtre Hospital, then in 1895–1896 at La Salpêtrière Hospital, he was a resident under Dejerine: "From this choice arose a fruitful scientific



**Fig. 1.** André-Thomas seated to the right of Jules Dejerine at Bicêtre Hospital in 1900 (OW Collection).



**Fig. 2.** André-Thomas and Jules Dejerine (OW Collection).

collaboration, profound reciprocal affection, and a nearly brotherly connection that no dark cloud could ever alter” [2] (Fig. 1).

André-Thomas was thus close to Dejerine and Augusta Klumpke-Dejerine (1859–1927) when the couple was refining the microtome of Bernhard von Gudden (1824–1886) and undertaking the study of the brain using serialised microscopic sections to show the various fibres, notably during degeneration (Fig. 2). The result was, indirectly, the first magisterial work of André-Thomas, his thesis on the cerebellum, combining anatomic, anatomopathological, clinical, and experimental studies. Defended in 1897 [3], it contained among other things the seminal description of olivo-ponto-cerebellar atrophy. His biographer, Yvonne Sorrel-Dejerine (1891–1986), daughter of Jules and Augusta Dejerine, raised the following question: “André-Thomas, despite his significant value and against all odds, never passed the exam to become a hospital physician, nor the *agrégation* (opening the way to academia), and while we may regret that the university did not hold on to this eminent man, we may also ask whether, weighed down by all of the responsibilities of a great instructor, he could have accomplished a scientific output just as considerable” [2]. It was only after the death of Dejerine that he left the clinic of nervous system disorders at La Salpêtrière Hospital.

During World War I, André-Thomas treated the wounded at La Salpêtrière Hospital, and then accompanied Augusta Dejerine to the French National Institution of incurable patients, after the death of his teacher,

in order to care for paraplegics. In addition to the work, he conducted on the sympathetic system and the pilomotor reflex [4], in 1918 he published “*Étude sur les blessures du cervelet*” (study of injuries to the cerebellum), as he never gave up his research on the cerebellum through to the end of his career. After the war, the neurological office he opened in 1911 at Saint-Joseph Hospital in Paris became a real neurology department, attracting many French and foreign students. When he officially retired in 1932, he did not interrupt his practice. He opened an infantile neurology office at Trousseau Hospital in the department of Étienne Sorrel (1882–1965), Dejerine’s son-in-law. After the obstetrician Edmond Lévy-Solal (1882–1971) tasked him with examining a living anencephalic child, he began his research on “pontine reflexes.” Continuing his collaboration with obstetricians, notably Maurice Lacomme (1897–1986), he developed the normal and pathological semiology of newborns, then the semiology of premature babies.

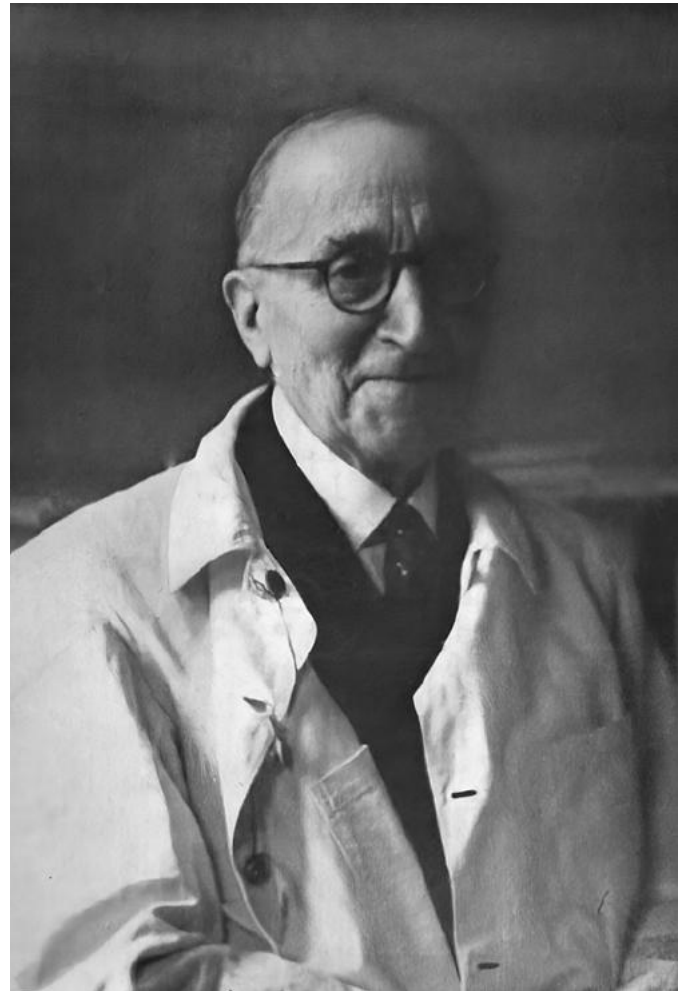
Honoured late in life, he was elected to the French Academy of Medicine in 1946. On June 08, 1955, the French Society of Neurology paid homage to him and published a jubilee book edited by Georges Guillain (1876–1961). “This great scholar was solitary and modest. He opposed any compromise and had integrity and morals that were exceptionally high” [2] (Fig. 3). He never lost his taste for hard work, and he had the habit of repeating, “I age while learning something new each day.” He passed away on July 21, 1963, at his home on 28 rue Marbeuf in Paris (*VII arrondissement*) (Fig. 4).



**Fig. 3.** André-Thomas in 1926 (© Gallica, public domain).

### Accoucheur of Neonatology

Hécaen left this account: “I was André-Thomas’s student when he was already old. He was nevertheless at the beginnings of a new career. Responding once again to his need to be a pioneer, he would succeed in developing a neurological examination method for children based on the study of normal behaviour starting with birth and through to their first years” [1]. The approach used by André-Thomas was to constantly bring in a non-systematic clinical examination but one that was underpinned by his knowledge of physiology and the results of his experimental work. He considered the normal state as a harmonious integration of multiple elementary actions and sought to suss out the deficient elementary action at the origin of a deviation compared to the normal state, or a pure pathology, then turned to experimentation to find the origin of the defect in order to explain it (for example, with the help of Auguste Durupt (1890–1977),



**Fig. 4.** André-Thomas in 1955 (OW Collection).

he pursued in 1912–1913 experimental research on the dog and the monkey, in order to specify the problem of cerebellar localizations [5]). This is another clinico-pathological approach very close to that used by his close friend, Jean Lhermitte (1877–1959).

For André-Thomas, the newborn could not be considered a small adult. Each individual had a dynamic individuality. His student Suzanne Saint-Anne Dargassies (1918–2017) explained it this way: “It’s through the close correlations between the neuromuscular structures and functions that the newborn’s metamorphosis must be monitored over time” [6]. Ultrasound did not yet exist in André-Thomas’s day. To evaluate the maturity of the child starting from the embryonic phase, he thus examined non-viable fetuses starting from birth, expelled during miscarriages at various terms. This work would not have been conducted without the support provided by Port Royal

Hospital and Baudelocque Clinic in Paris, where the names changed over time, from 1947 to 1953. André-Thomas worked in the Laboratory of the National Institute of Hygiene at the Obstetrical Baudelocque Clinic, then after 1953, in the Neonatal Biological Research Centre of the Claude Bernard Association of the Paris Public Hospital Administration. Finally, his students Saint-Anne Dargassies and Suzanne Autgaerden continued his oeuvre after 1966 in the intensive care and neonatal medicine department, which became Alexandre Minkowski (1915–2004) Centre.

### Neurological Studies of Newborns

The various stages of the central nervous system are not simultaneously completed. In particular, myelination follows a caudorostral progression, as the cortex lags behind the functionalities relative to the basal ganglia, and even more so compared to the spinal cord. For André-Thomas, the infant “incessantly transforms its neurality”; it is thus necessary to examine “the being from the first day,” the point of departure for monitoring a complex evolution during which the entire future is prepared: “Observing their spontaneity is good, calling upon their responsiveness is even better!” [7]. With an initial existence that is mainly subcortical, at the truly psychological phase, the cortex, which is a mix of exteroceptive, interoceptive, and proprioceptive afferences, continues with its development, moving from functioning that is essentially reflexive, then automatic, before the infant’s personality sets in through the play of dynamic interactions with their mother.

At a time when there were already tests for evaluating intellectual development, based on evaluating the capacity to perform coordinated acts, and thus for evaluating already established psychomotor capabilities, there was a lack of an objective, reproducible methodology for assessing the capacities of normal, premature, and sick newborns. Clinicians examining newborns had to know their executive possibilities for undergoing tests and had to be able to evaluate performance by controlling the relevant stages and the temporal maturation of their physiological capacities. André-Thomas, through an accumulation of countless observations, was able to correlate the infant’s cognitive-behavioural maturity with clinical manoeuvres, making it possible to measure normal and pathological development.

Once neurological maturity is complete at 41 weeks, the newborn is fit to change their life environment, to face daylight, to perceive both cutaneous and interoceptive sensations (hunger and satiety, notably) but also pain. From the second semester of life, the examination is

oriented towards evaluating the intentionality of behaviours, the appropriateness of adapted responses, and the intelligence of affect states, that is, of cortical activity.

### André-Thomas’s Contributions to the Neuropsychological Examination of Newborns

Newborns have just undergone a traumatic experience combining the compressive power of uterine contractions and the relative crushing necessary for moving through the maternal pelvic-genital canal. Compressed, concussed, and weakened, the newborn moves from life in an aquarium to a life surrounded by air, with the necessity of ensuring autonomous breathing as rapidly as possible. This ordeal and the corollary adaptation are variable from one baby to another, but the examination assesses invariants established during intrauterine growth; that is, osteotendinous reflexes, cutaneous reflexes, and tonus. André-Thomas built the foundations of examining newborns by evaluating these elements, by visual observation alone, then by a series of manoeuvres, of which the methods described below are summarised in his book *Étude neurologiques sur le nouveau-né et le jeune nourrisson* (neurological study of newborns and young infants) published in 1952 [7].

The visual exam evaluated spontaneous movements, their harmonious execution, and their amplitude. André-Thomas then assessed tonus. Using movements in the limbs, he distinguished between very pronounced extensibility and passivity manifested as swinging. Trunk tonus had two components, postural tonus and static tonus, bearing in mind that the foetus’s curled position in intrauterine life limits extension. Thus, the head lolled in every direction, whereas the limbs were tonic (Fig. 5).

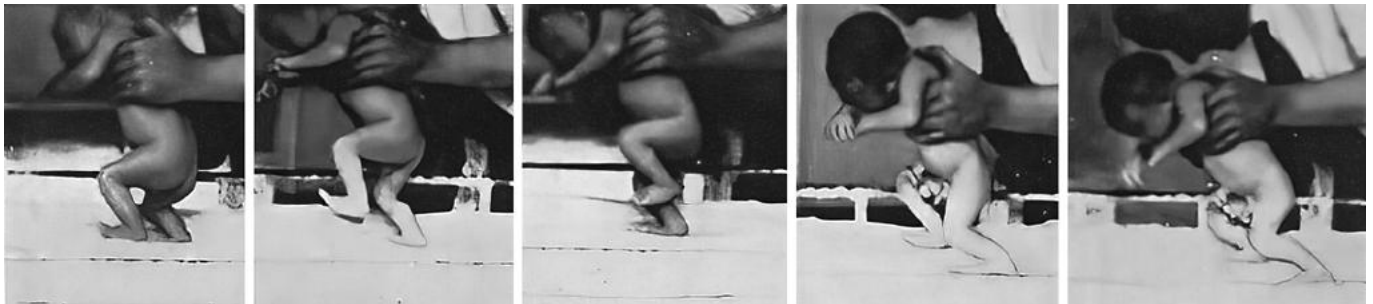
The reaction of cervico-cephalic muscles was evaluated by pressure on the various regions of the head, i.e., occipital, frontal, and lateral regions. The amplitude of the various inclinations was noted as well as the degrees of resistance where it appears. The neck firmed up in around 10 days, becoming more and more resistant to pressure. In his examination, André-Thomas introduced reactions to the stimulation of the nasal wall or the concha of the ear, in order to trigger a rotating movement of the head, most often contralaterally so as to avoid the stimulation. Related to sucking, the rooting reflex test (*épreuve des points cardinaux*) highlights, through stimulation of the two labile commissures, of the median tubercle of the upper lip, then of the middle of the lower lip, the linked orientation of the head and tongue towards the origin of the stimulation, showing the innate capacity to catch hold of the nipple to be able to eat (Fig. 6).



**Fig. 5.** Positioning of body and limbs, the body horizontally suspended, with the belly or back facing downward (OW Collection).



**Fig. 6.** Rooting reflex test performed by André-Thomas (OW Collection).



**Fig. 7.** Demonstration of an innate aptitude for walking (OW Collection).

The positioning to initiate rhythmical, alternating movements of the lower limbs, calling walking to mind, was present from the ligation of the cord (Fig. 7). André-Thomas meticulously described the steps for revealing responses. In succession: triggering cutaneous reflex, pre-tibial brushing, or brushing the front of arch of the foot, followed by a rhythmical, alternating automatism in addition to a straightening of the trunk and head. André-Thomas underscored the lability of this action in the same child, and from one child to another; it was thus impossible to reach a conclusion based on a single failure. Only the repetition of the test could provide a prognostic argument.

In 1918, Ernst Moro (1874–1951) described the eponymous reflex which André-Thomas named “the cross-arm reflex” [8]. He saw it as a counter-manoeuve to free the thorax in order to improve ventilation after thoracic compression during the pelvis-genital crossing, a reflex manoeuvre resulting in a large inverse extension of the intrauterine foetal position. Actually, this reflex is conceived as a protective response to the abrupt disruption of body balance. The absence of this reflex suggests damage to the cortical-subcortical tracts, whereas its asymmetry attests to organic prenatal hemiplegia or hemiplegia during birth. The absence of the Moro reflex during the neonatal period is highly useful for prognosis, always



FIG. 1. — ABSENCE DU RÉFLEXE DES BRAS EN CROIX PAR DÉPLACEMENT SOLIDAIRE DE LA TÊTE ET DU CORPS.

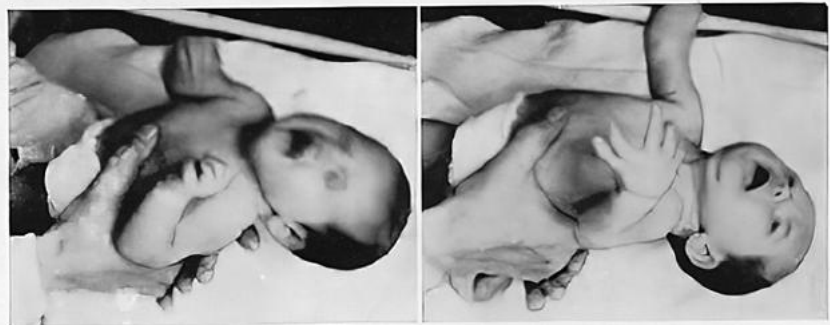


FIG. 2. — RÉAPPARITION DU RÉFLEXE PAR EXTENSION BRUSQUÉE DE LA TÊTE SUR LE TRONC.



FIG. 3. — RÉFLEXE DES BRAS EN CROIX PAR DÉPLACEMENT BRUSQUE DE LA TÊTE EN ARRIÈRE. Les membres inférieurs sont saisis, puis brusquement soulevés au-dessus du sol, entraînant le corps; la tête est déplacée brusquement en extension.

Fig. 8. Moro reflex, or André-Thomas's "cross-arm reflex" (OW Collection).

indicating profound damage to subcortical functioning. The reflex centre is probably situated in the lower region of the pons and down into the spinal cord. All primitive

reflex seem necessary for newborn survival (Fig. 8). The phylogenetic significance of these archaic reflexes remains under discussion today. Is that the evolution of a

**Table 1.** Summary of André-Thomas's neurological examination of newborns

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Observation of body position and spontaneous gesticulation
Study of passive tonus
Flexion extension rotations of the head
Return to flexion of the upper limbs
Scarf manoeuvre
Study of the popliteal angle
Dorsiflexion angle of the foot (0°)
Heel-to-ear rapprochement manoeuvre
Study of anterior and lateral flexion of the trunk
Study of active tonus
Straightening of the head and trunk
Straightening of the lower limbs
Study of primary automatisms
Rooting reflex
Grasping
Moro reflex
Cross-lengthening reflex of the lower limbs, stepping reflex

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The neurological examination at birth was repeated in the subsequent days. The signs depended on the child's awareness and their willingness to cooperate. A single examination was never enough to make conclusions.

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survival mechanism like the one of the *paramoecium* retracting at the contact of a drop of acid, becoming, in the course of time, the automatic withdrawal of a segment of member? Evolution is possible in the absence of variation, selection, and competition. It occurs not through competitive exclusion such that only the fittest reproduce, but through the assimilation, restructuring of behaviours [9].

André-Thomas discussed the methods of looking for the palmar grasp reflex. It appeared to be mediated in the spine. In his discussion, he did not address its possible phylogenetic survival in human newborns. In non-human primates, he cited the infant's clutching of the mother's fur starting in the first hours of life, an indispensable function for the infant's survival [10]. Finally, he was also interested in the capacities of the five senses as well as spontaneous, non-stimulated gesticulation as motor and sensory skills progressed over the course of the first weeks (Table 1).

It is not possible to go into all the manoeuvres recommended by André-Thomas to examine newborns – they take up nearly 500 pages in the book written with Saint-Anne Dargassies [6]. Simultaneously, André-Thomas published a 47-pages compendium for family physicians, richly illustrated (Fig. 9) [11]. The pioneering efforts of Andre-Thomas and his colleagues culminated in the English translation of the first systematized neurological assessment of the newborn in 1960 and in commercial form in 1964 [12, 13].

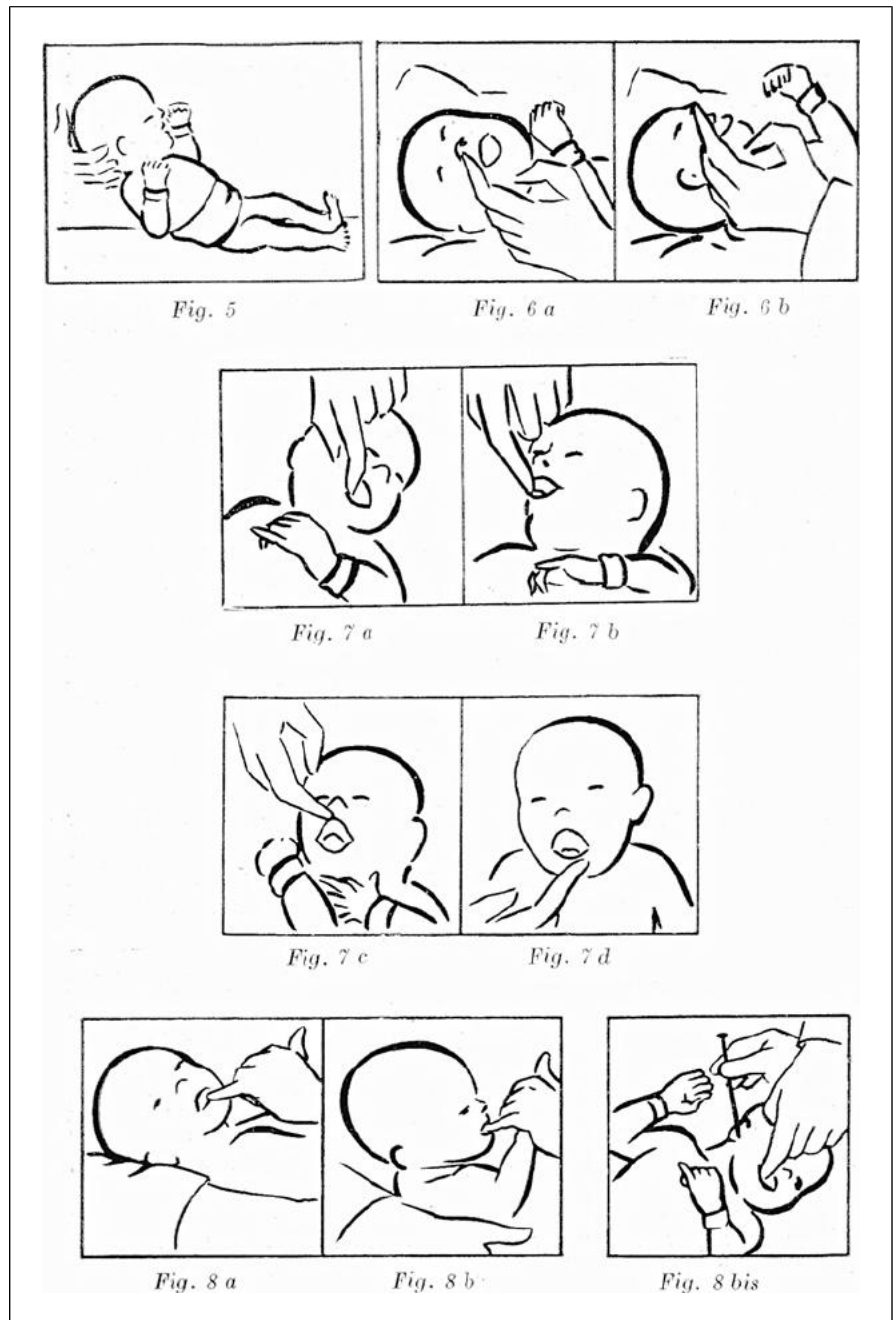
André-Thomas's work (*Études neurologiques sur le nouveau-né et le jeune nourrisson* [7]) paved the way for the German paediatrician Albrecht Peiper (1889–1968), the English paediatrician Peter Tizard (1916–1993), and British neurologist Victor Dubowitz (1931–). The third edition of Peiper's monumental textbook was published in English in 1963 [14], after the first German edition in 1949 (*Die Eigenart der kindlichen Hirntätigkeit*) [15]. Peiper clearly grasped the uniqueness of the neurology of the newborn, in line with André-Thomas. His didactic book has trained several generations of German paediatricians for newborn examination, quoting him repeatedly. Before Tizard, the possibility of sensory disturbances had been largely ignored in paediatric works (except those of André-Thomas). He showed that testing was feasible at a much earlier age than had been previously thought [16]. Dubowitz proposed assessing apparent gestational age of infants by considering both neurologic and external signs of development [17].

### Viewpoint on Pathology

André-Thomas focused the first half of his book on pathology, which had not been explored in depth before. Without his research, separating out multiple toxics, medication-induced, genetic, or metabolic pathologies would not have led to current understanding and treatments.

Several times, André-Thomas studied “medullary anencephalic children” in order to enrich neurophysiological knowledge. Early screening by ultrasound for this





**Fig. 9.** Diagram from the book “Examen neurologique du nourrisson,” 1955 (OW Collection).

severe, non-viable malformation leading to abortion has obviated this study method. André-Thomas compared the aptitudes of these anencephalic patients, for the few hours they were alive, to those of healthy children (Fig. 10). He observed facial expressions of satisfaction by applying sugar to the tongue and expressions of disgust by applying salt. The nociceptive afferences seemed to be preserved, without negative vocalisation, but with pulling away a pinched limb, or the contralateral rotation of the

face after strong stimulation, for example. He obtained osteotendinous reflexes in the upper limbs, and the plantar reflex was initially present in flexion, followed by extension of the toes. However, there were multiple variations from one case to another. In the cases of anencephaly, he noted the infrequency of spontaneous movement, the absence of the aptitude to walk, the presence of reflexes not found in healthy children, the presence of a strong sucking reflex coordinated with that





**Fig. 10.** Examination of an anencephalic child by André-Thomas (OW Collection).

of swallowing, and the coordination and orientational synergy of the head following nociceptive stimulations in contrast to reactions in response to labial stimulations. André-Thomas was particularly intrigued by generalised hypertonic seizures resembling epilepsy that rapidly died down but were repeated multiple times, for which he discussed a cause involving the basal ganglia due to their triggering by pressure applied to the “neural tube defect.” Finally, he described the macroscopic and microscopic anatomopathology of these cerebral sketches.

In his book, André-Thomas wrote several chapters on nervous system malformations but also on clubfoot and the sequelae of obstetrical accidents. Finally, in the year of his death, his *La locomotion de la vie fœtale à la vie postnatale*

(locomotion from foetal life to postnatal life) [18] was published as a summary of his works. Richly illustrated, it was co-written with his student, Suzanne Autgaerden.

### **Why the Work of André-Thomas Was Pioneering**

How did physicians before André-Thomas assess the neurological state of newborns? The study of normal newborns does not take up much space in the works on childhood diseases from his day. For example, Nicolas Puzos (1686–1753), in his posthumous treatise, published in 1759 and focused on childbirth and diseases in young children, took the position that the early days of newborn



**Fig. 11.** André-Thomas examining infants (OW Collection).



**Fig. 12.** André-Thomas examining infants (OW Collection).

life should be left to natural processes [19]. What mattered the most at the time was to save mothers! Antoine Louis Dugès (1797–1838), in his 1821 thesis, focused on asphyxia of newborns who presented “profound drowsiness” or dulling, characterised as follows: “The limbs are immobile and resolved, no crying or sneezing” [20]. He recommended “shaking them violently, causing them pain,” the only criteria considered being survival or death, without a long-term vision. Charles Michel Billard (1800–1832) was one of the first to refer to examining newborns in 1828 [21]. François Louis Isidore Valleix (1807–1855) followed in his footsteps when he defended his thesis on January 02, 1835 [22]. After having warned of the danger of linen being too tight so that newborns “can move their limbs and breathe freely,” these authors

focused on observing the child’s posture, the colouration of their integuments, judging their crying, both its timber and power, in order to gage the expression of their physiognomy and the condition of their pulse. In the multiple editions of his paediatric treatise, Eugène Bouchut (1818–1891), in the middle of the 19th century, insisted on observation to understand the language “that philosophers call natural language: the language of signs”; that is, to study “the physiognomy, the child’s traits and their eyes, movements, crying, and posture” [23].

In Germany, Otto Soltmann (1844–1912), in his thesis defended in 1877 in Breslau, developed comparable recommendations, including some segmental mobilisations of the limbs to gage muscle tone and locate tendon reflexes [24]. In *Pratique des maladies des enfants* (practices in childhood diseases), published in 1909 [25], René Cruchet (1875–1959) asked Jean Anderodias (1875–1959) to explain the clinical examination of newborns but only in case of pathologies such as apparent death and obstetrical paralysis (facial palsy, elongation of the brachial plexus, of the limbs, etc.).

In 1912, the Danish Knud Haroldsen Krabbe (1885–1961) described his examination of a 4-month-old foetus immediately after its expulsion. He found no reflexes but obtained contraction of the muscles with direct percussion. Notably, Joseph Babiński’s (1857–1932) plantar cutaneous reflex occurred in flexion without extension of the big toe [26].

In 1926, Eugène Apert (1868–1940) and Antonin Marfan (1858–1942) developed a methodical examination of all organs. For the neurological condition, they reviewed spontaneous movement, passive and active muscle tone, Moro reflex, and tendon reflexes, without failing to include vision, hearing, and so on.

At least, it must be recalled that Virginia Apgar (1909–1974) proposed in 1953 a system for point score evaluation of the physical condition of a newborn 1 min after birth, ever in use today. This score establishes a simple and clear classification of newborn infants which can be used to compare the results of obstetric practices, types of maternal pain relief, and the results of resuscitation. Ten years later, this innovation became an acronym the Apgar score, from the pen of Joseph Butterfield and Mervyn J. Covey [27, 28].

This shows that in one century, the neurological examination of newborns evolved slowly and progressively. Used to a neurological examination based on adults, André-Thomas must have felt, in the 1930s, the need to perfect the assessment of the neurological condition and prognosis of babies. This is directly linked to his anthropological and phylogenetic vision of nervous system

development. His systematisation of the neurological examination based on solid science made it possible for him to ensure a neurophysiological and pathophysiological continuity from childhood to adulthood, which had been studied very little before his time.

## Conclusion

The 30 years during which André-Thomas was administratively retired were a period of intense clinical and experimental research, underpinned by the methodical doubt that characterised all his medical work. Always inclined to think experimentally, André-Thomas brought together countless and detailed clinical observations before proposing the manoeuvres appropriate for the neurological examination of newborns and infants (Fig. 11, 12). Even today, with all the modern technology, André-Thomas's insights and knowledge guide the thoughtful clinician.

*Études neurologiques* was written with the literary style that characterised André-Thomas's illustrious predecessors in the 19th century: Duchenne de Boulogne, Vulpian, Charcot, and Dejerine. He epitomised the man of transition, in the shift from the anatomoclinical method of the 19th century towards the standardised investigation techniques of the 20th century. André-Thomas was never admired as after his death, a phenomenon that proves he was a great man [29].

However, it may be, André-Thomas was a pioneer for the neurological examination of the newborn. Relatively recently developed, its historical origins have in common a theoretical basis attributable to evolutionary theory, clinical neurology, and developmental psychology. For Stephen Ashwal, André-Thomas' works remain useful in the diagnosis of serious neurological diseases but have limited predictive value of the infant's future because his prevailing attitude was that the newborn functioned at a subcortical level: "What remains uncertain is to what extent this is true and whether the newborn possesses a cortical repertoire that requires a different method of examination, i.e., an examination that is easy and practical to use yet reflective of cortical disease and predictive of future outcome. It is also clear that a different conceptual perspective is necessary when examining the newborn. It is a perspective unique to paediatrics, child

neurology, and developmental psychology. It is a perspective related to the influence of evolution on the hierarchy of regional brain maturation and the need for the observer/examiner to be aware of these differences and how they change during post-conceptual life" [30].

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## Statement of Ethics

Ethical approval and written informed consent were not required as this study was based on publicly available data.

## Conflict of Interest Statement

The author has no conflicts of interest to declare.

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## Author Contributions

The author is the unique contributor for the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; drafting the work or reviewing it critically for important intellectual content; final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## Data Availability Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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