Dynamic thermography in France

by R. AMALRIC, J. LEVRAUD, D. GIRAUD, C. ALTSCHULER, F. MOUTON

Cancer Centre, Marseilles (France)

SUMMARY. Infra-red thermography started in France in 1965; it has considerably developed during the last 5 years.
At the present time, 105 thermographic systems are used in France; they are divided between the various regions and are one third in the State district areas and two thirds in private medicine.
Between 1972 and 1976, almost 300 studies were published by French thermographers on various topics: fundamental thermology, mainly senology, classification of images, thermographic prognosis, thermographic follow-up of cancers or non cancerous diseases after treatment.
A list of the main theses of Medicine for degrees devoted to telethermography (with references) is given.

Key words: infra-red thermography, history, units, clinical applications.

HISTORY

Telethermography started in France in August 1965 with the setting-up of a Barnes device in Strasbourg (Pr. Gros); this was the first application of infra-red in the diagnosis of various medical diseases.

As early as March 1966, these images were produced (among others from foreign countries) during an International Conference of Medical Thermography which also took place in Strasbourg. These were the first steps in France in static telethermography (thermistor); the negatives (made in 1 to 3 minutes by reflection on a mirror) were still defective and while they have discouraged some specialists they have urged others ones to continue this new technique.

Other Barnes devices were installed in Paris, Rennes and Besancon; parallel tests were made in 1966 with the Smith Pyroscan in various Centres, in particular in Paris, Marseilles and Rennes as well as with the Bofors camera (Strasbourg, Marseilles); but they were not too successful, the thermograms being difficult to interpret at that time.

At the same time, other pioneers were interested in certain prototypes being perfected, e. g.: M. Gautherie in Strasbourg with the experimental L.E.P., Pr. Robert in Nancy with the Thermorama and Pr. Schmitt in Lvons with the 815 I.R. Interesting results were achieved but for various reasons these devices have not been commercialized.

DYNAMIC INFRA-RED THERMOGRAPHY (I.R.T.)

The real development of thermography started in France with the implantation of the first high-speed cameras and especially the setting up in Tours (Pr. Th. Planiol) of the first AGA 665 Thermovision in December 1969, followed by that of Marseilles in June 1970.

The clinical results achieved with these systems were produced by the same authors in 1972, during, a *first Seminar on infra-red thermography*, presided over by Pr. Marques in Toulouse. Starting from that date, many specialists from various fields (physicists, radiologists, radiotherapists, surgeons, gynecologists) took an interest in this method: with various state and private centers equipped with devices in existing departments of radiodiagnosis or medical physics and isotopes.

In 1973, in Bordeaux under Pr. Lagarde's, the Second Seminar on Infra-red thermography took place, at the end of which the Club Francais de Telermographie Clinique (C.F.-

T.T.C.) was created; from the beginning about a hundred specialists were brought together who since that time meet every year at a new Seminar:

The third was held in Bendor, in 1974
(President: Dr. R. Amalric)
the fourth in Tunis, in 1975
(President: Pr. N. Mourali)
the fifth in Strasbourg in 1976
(President: Pr. R. Thierre).

Every year the number of participants increases and the Sixth Seminar which has just taken place in Marseilles in May 1977 (President: Pr. J. M. Spitalier) has gathered 350 physicians and over, coming from 30 various countries.

In parallel, the number of C.F.T.T.C. members has increased regularly (it has exceeded 300 by 1976), infra-red cameras are more and more numerous and improved; finally, the French literature on Thermography never stops increasing and improving.

Regarding *equipment,* France had 105 working ifra-red thermography units of various types up to December 31st, 1976 (Table I) (Fig. 1 and 2).

It should be noticed that ⅓ of these Units are in State institutions (15 Cancer Centers and 19 University Hospitals or Regional Hospital Centers) and for ⅔ in private practice (clinics equipped with telecobalt therapy equipments or private consulting rooms for radiodiagnosis) as it appears in Table II.

With regard to *publications* in France (or in foreign countries by French thermographers), their number is very large. Reviewing the medical literature of the past 5 years (1972-1976), we have found nearly 300, which is about 60 a year. These studies are divided into 270 articles, reports or lectures

Tab. **I. Type of working telethermography devices in France up to 12/31/1976.**

ACA Thermovision (680)	94
PHILIPS Thermodiagnose	7
I. R. BOFORS Camera	1
SPECTROTHERM (G.E.)	1
THERMORAMA (C.G.R.)	1
815 I.R. (C. S. F.)	1

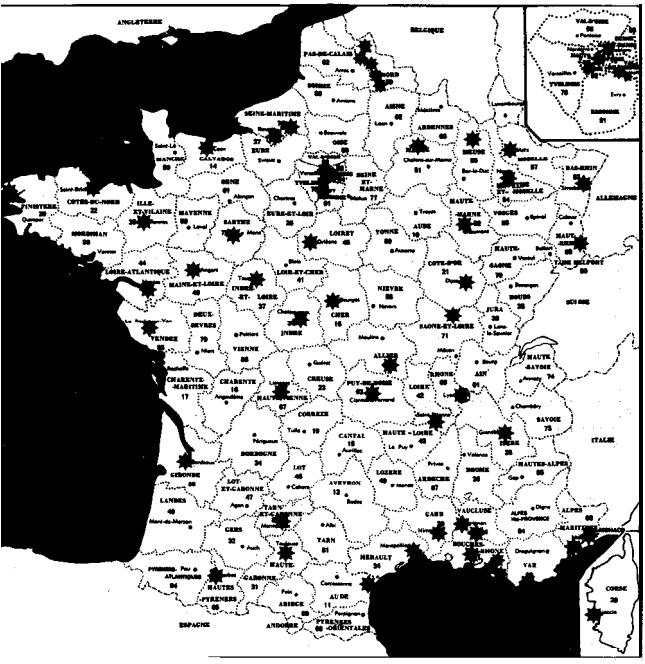

Fig. 1. Distribution of infrared thermographic systems in France.

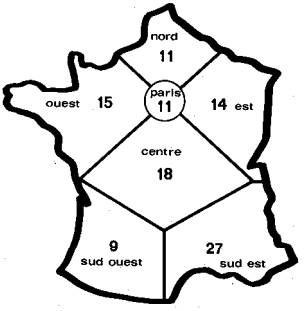

Fig. 2. Distribution of 105 French thermographic units in regions.

published in medical magazines and 25 theses for Medicine degrees.

The *topics* which form the subject of *origi,nal studies* with the name of authors are enumerated and we shall refer to theses in which the main point of bibliography can be found.

Fundamental thermology has been particularly studied by M. Gautherie (specific thermogenesis and its variations, physical and mathematical simulation of heat transfer in cancer of the breast, cutaneous thermochronobiology, etc.) by Pr. Houdas (physiology of skin temperature) and by Pr. Schmitt (thermo-regulation).

The breast, as everywhere, has formed the subject of 80% of studies and publications in the infra red thermographic field. Description of *fundamental vascular patterns* has been made by the School from Strasbourg (Pr. Gros) and Marseilles (R. Amalric, D. Giraud); they can practically be superimposed. Mammary thermograms have been described with 8 elementary thermo-pathological signs by Strasbourg. A classification into 5 categories (from THl to TH5) has been set in 1970 by Marseilles on 4 suspicion signs and 4 malignant criteria; there is a close parallel between these 2 classifications (Table III).

It is known that in France we do not do << mass screening >> of breast cancers but that *we use noninvasive combined diagnosis* (clinical, thermal, radiographic and cytological) for patients consulting for a mammary symptom. This type of diagnosis has been particularly studied in Marseilles and many sub-clinical and or sub-radiological cancers have thus been detected (J. M. Spitalier, R. Amalric). The Schools of Strasbourg (Pr. Gros) and Rennes (Pr. Bellossi) also used ultrasound for this diagnosis in some cases.

The growth dates of breast cancers are the subject of many studies in particular from the Marseilles Groups which has defined the thermographic criteria of fast growing cancers and has particularly studied slow growth cancers : << cold >> cancers and the scirrhus types (J. M. Spitalier, R. Amalric, J. C. Pietra).

The prognosis of these cancers was shown by the Groups from Strasbourg (Pr. Gros) and Marseilles (J. M. Spitalier, R. Amalric) and Bordeaux (Pr. Lagarde, A. Le Treut).

The follow-up of treated breast cancers forms the subject of numerous studies:

Tab: II. **Distribution of 105 French tbermographic systems belonging either to state or private centres.**

State institutions: 35 (33%)	C.A.C.:	**16**	(15%)
	C.H.U. - C.H.R.:	19	(18%)
Private units: 70 (67%)	Private consulting rooms:	30	(29%)
	Clinics:	**40**	**(38%)**

Tab. III. **Parallels between the classification of mammary thermograms from Marseilles and Strasbourg.**

	Marseilles	*Strasbourg*
TH1	*Normal* thermogram	any elementary thermopathological sign
TH2	Abnormal thermogram of benign type	1 or 2 signs
TW3	*Suspicious* thermogram (1 suspicious sign)	**3** signs, except (a, b, c) or (a, b, g)
TH4	thermogram with oe malignancy criterion or several suspicious signs	**4** or 5 signs or (a, b, e) or (a, b,g)
TH5	Thermogram with *several* malignancy criteria	**6, 7** or 8 signs.

in Marseilles and Strasbourg for cancers treated by exclusive irradiation (R. Amalric, J. M. Spitalier, Pr. Gros)
in Nantes and Toulouse for operated breast cancers (Pr. Marionneau, J. Bonnard, Pr. Roulleau)
in Marseilles for the hormone chemotherapy (J. M. Spitalier).

Finally, *benign diseases of the breast* have been studied more especially:

in Strasbourg by Pr. Gros and P. Bourjat (cysts, fibro-adenomas, gynecomastia)
in Marseilles by R. Amalric, D. Giraud, L. Thomassin, F. Rousseaux (fibrocystic dysplasia, philloide tumours, cysts, fibro-adenomas, mastoses)
in Paris by R. Thierree (acute diseases of the mammary gland).

In *extra-mammary cancer,* many studies have been made, mainly by French Cancer Institutes:

on *cutaneous malignant melanomas,* for both diagnosis and prognosis in Strasbourg (P. Bourjat), in Lyons (Pr. Schmitt, A. Pierson) and in Marseilles (J. M. Spitalier, R. Amalric, C. Altschuler)
on ocular-orbital tumors in Versailles (G. Raynaud), in Marseilles (R. Amalric) and in Rennes (Pr. Bellossi)
on bone sarcomas and soft tissues in Bordeaux (A. Le Treut) and in Marseilles (R. Amalric).
on *thyroid tumors* in combined diagnostic profile with scintigraphy and ultrasound by the Groups from Tours (Pr. Th. Planiol, G. Floyrac), and Nantes (J. Weber, A. Thomas), Toulouse (A. Naja) and Rennes (Pr. Bellossi)
on the tumors of bursa with C. Lafaye (Clermont-Ferrand)
on the dysplasia and *cervix uterus* cancers with Y. Ayme and J. Martin-Lava1 (Marseilles)
on bone *metastases* (R. Amalric)
both ganglion (Pr. Plagne, G. Gauthier, Clermont-Ferrand)
pleural: J. Levraud (Marseilles).

Lastly, and more generally, the Marseilles Cancer Institute have studied:

the thermographic definition of *targets* for the choice of the best treatment,
« *total body thermography* » for superficial and semi-deep seated sub-clinical metastases detection, and particularly the contribution of infrared in the carcinoma strategy (J. M. Spitalier, R. Amalric).

The non cancerous applications of telethermography have not been disregarded, and many studies have been made:

in vascular peripheral pathology by the Groups from Montpellier (J. L. Lamarque), from Bordeaux (M. H. Dilhuydy), Clermont-Ferrand (C. Lafaye). The first thermal images of acre-osteolysis from vinyle chloride have been described by the Groups from Lyons (Pr. Schmitt, J. Berrod) and Marseilles (P. Lazard),
in cerebral vascular pathology Tours (Th. Planiol, Pr., L. Pourcelot) with combined isotopic and echographic scanning; by the groups from Nancy (Pr. Robert) and Nice (D. Aubanel) with arteriographic comparisons,
IN osseous *and osteo-articular pathology* with the thermographic study of the Calcitonin action on the Paget's disease by the Toulouse Groups (A. Naja) and that of fracture consolidation after osteosynthesis by Pr. Groulier in Marseilles.

Rheumatology forms the subject of many publications involving the assessment of lesions and their post-therapeutic follow-up by the Groups in Nancy (A. Bertrand), Strasbourg (P. Bourjat) and Montpellier (M. Rossi). The efficecy of isotopic synoviartheses has also been studied with thermography in Nancy (Pr. Robert) and in Toulouse (M. Lucot).
in dermatology, vaso-motor tests have been studied in dermatoses by the Strasbourg Group (D. Sellig) as well as the immunological reaction in carcinology by the Montpellier Center (J. C. Laurent, B. Serrou).
in plastic surgery, various studies have been performed by the team from Lille, with Pr. Houdas (burns and grafts), Bordeaux with A. Le Treut and J. Baudet (vitality of limb reimplantation) and Nice with D. Aubanel and F. Demard (vascularization of grafts and flaps);
in ophtalmology, the exophthalmo has been

studied by A. Bronner (Strasbourg) and the cornea1 physiology and also contact lenses by C. Lafaye and C. Bony (Clermont-Ferrand),

the *E.N.T. applications* has been explored in Strasbourg (R. Villeda) and in Toulouse (F. Torossian),

the *odontostomatology* formed the subject of studies at Strasbourg (Y. Quenneville)

various diseases of the *nervous system* have been scanned by thermography in particular by the Toulouse Group concerning facial neuralgia (Pr. Roulleau) and cephalea (P. Pujol) and in Marseilles by R. Julien for autogenic training.

Lastly, in the *pharmacological field*, the efficacy of many products have been tested using infrared thermography e. g. cerebral and peripheral vasodilatators (D. Giraud and L. Thomassin) in Marseilles, drugs for vasal diseases venous disease drugs (Pr. Houdas) in Lille and anti-inflammatory drugs (Pr. Bellossi) in Rennes.

Thus, French thermographers have practically explored the whole field of medical applications in infrared thermography during the past 5 years, as well in cancer and in many non cancerous diseases. This list is far from exhaustive.

In the cancer area, *cooperative studies* gathering an important number of cases have already been realized (breast, bone sarcoma, thyroid) and when completed will afford better assessment of the real contribution of infrared thermography in the diagnosis, prognosis and post-therapeutic follow-up of the rare and the more common malignant diseases.

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