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## THE SCIENTIFIC ASPECT OF THE GUAY CASE

FRANCHÈRE PÉPIN AND BERNARD PÉCLET

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On September 9th, 1949, at about 10 a.m., a Canadian Pacific DC-3 Airliner, took off from the airport of l'Ancienne Lorette, 8 miles from Quebec city, heading for Baie Comeau, Province of Quebec, with 23 persons on board.

Twenty minutes later, this aircraft exploded in full flight, at Sault-au-Cochon, approximately 45 miles east of its point of departure. Many witnesses saw a puff of white smoke billow out the left side of the plane. The main wreck rested 3 miles north of the St. Lawrence River, and fragments of the plane were scattered through the forest, in a one mile radius. All the passengers and members of the crew were killed.

What caused the plane to crash? How to explain, as many witnesses declared, the explosion in full flight? That is what we intend to bring out in this article.

To answer this intricate question, three problems had to be solved:

1. Was the crash due to a mechanical failure or malfunctioning of any part of the Douglas DC-3?
2. Was the accident due to a freak explosion caused by a substance normally found in the aircraft proper?
3. Was the disaster due to an explosive of a foreign nature placed on board with criminal intent?

The first possibility was brilliantly eliminated by M. F. M. Francis, aeronautical engineer, who concluded: "The cause of the crash of aircraft CF-CUA was the violent explosion, in the left baggage compartment, of an agency not normally part of the aircraft. The explosion rendered the control system inoperative and resulted in the aircraft's diving vertically to the ground under power from both engines". Mr. Francis proved that both engines of the aircraft were still operating when the plane touched the ground. (The tips of the blades of both propellers were bent forward.)

From then on, we began our tests in order to solve the second and third problems. Was the explosion to be attributed to an explosive substance likely to be normally carried or formed in the aircraft proper, and if not, could it be attributed to an explosive placed on board with criminal intent?

Before describing our experiments, a brief resume on the question of explosives should be of interest.

What is an explosive? It is a mixture or a combination liable to rapid decomposition, accompanied by a sudden development of gases, whose volume is increased by the exothermic character of the phenomenon. The explosive substances evolve, at a

given moment, a large volume of gas brought to a high temperature. The sudden expansion of those gases produces mechanical effects, more or less violent, depending on the wave velocity of the explosion.

Explosives can be classified into two categories. First, the detonating, high, violent, or shattering explosives, such as dynamites, D.N.T., T.N.T., R.D.X. The velocity of detonation of these explosives being high, the gasification is achieved with great speed. This gasification is identical with the vaporization of water, but the latter is very much slower. Second, the deflagrating or low explosives, such as black powder, smokeless powder, and gaseous mixtures. Their action simulates a prolonged combustion which causes inflations. Practically, flame is always produced and noticed when an explosive of this type is the cause of an explosion.

The mechanism of an explosion is not too difficult to explain. At the time of detonation or deflagration an explosive acquires a new form and is converted into gases whose volume is much greater than that of the agent itself. This increase in volume causes, at the same time, a shock and a pressure on the surrounding objects: that is the effective work of the explosive. The pressure is the same in all directions, however, the gases tend to escape by the way of least resistance.

#### WAYS TO IGNITE EXPLOSIVES

1. By shock.
2. By rise in temperature. This can be accomplished by sulfuric acid or sodium and water, in the inverted type of apparatus. It is possible, with such devices, to delay the explosion more or less.
3. By ordinary blasting cap with a safety fuse.
4. By electric detonator.
5. By detonating fuse.
6. By spark.

#### EFFECTS OF EXPLOSIONS

1. A disruption or an expansion (push effect) of the walls of the enclosure in which the explosion takes place. This effect varies with the explosive used. A high or detonating explosive, such as dynamite, gives a shattering effect, while a low or deflagrating explosive, such as a gasoline-air mixture, gives a swelling effect, normally producing one or more cracks localized where there is the least resistance. The shattering effect or "brisance" of the detonating explosives varies with the quantity of explosive used, its strength, its velocity of detonation, and its type.

2. Fragments are thrown in all directions, hence all surrounding objects become projectiles.

3. Production of flame in cases where a low explosive is used.

After these explanations, let us resume our particular case, which involved the following problems:

1. Where was the center of the explosion?
2. What was the nature of the explosive?
3. What was the cause of the explosion?

It was quite obvious that the explosion had occurred in the left baggage compartment, which contained the cargo and most of the baggage, since the main damage was localized at this very spot.

## WHAT WAS THE NATURE OF THE EXPLOSIVE?

Although the preliminary examinations of the material revealed that the explosion was surely caused by a high explosive, all normal substances on the aircraft proper, which might have produced the explosion, had to be eliminated.

The substances which might possibly cause an explosion and which were normally part of aircraft CF-CUA, were:

1. Carbon dioxide, under a pressure of 1000 psi, contained in a bottle located behind the co-pilot's seat. The undamaged bottle having been found intact at the scene of the crash, the explosion could not be attributed to it.

2. Storage Batteries. On the aircraft, two storage batteries were placed under the center aisle of the companionway. Was it possible that mixture of hydrogen with air could have caused such a violent explosion? Surely not, since both accumulators were found in their normal places, and there was no corrosive action in their surroundings. Moreover, very many factors eliminate this hypothesis.

3. The hydraulic accumulators. The liquid contained therein, being under a pressure of 850 psi, the violent explosion could not be attributed to it.

4. Alcohol-air and gasoline-air mixture. The explosion could not have been caused by such mixtures, since there were neither scorching marks nor expansion effect, but a marked shattering effect (brisance). Moreover, the center of the explosion being very localized, explosives of this type are eliminated.

5. Mixture of CO-air. A mixture of CO-air is liable to be formed and may be the cause of an explosion. The limits of explosibility of carbon monoxide and air being 12.5-74.2%, this possible cause had to be eliminated, by the fact that, in the blood of the victims, carbon monoxide was absent. Scientific facts show that a concentration of 1% CO in air would kill a human being within 2 minutes.

After discounting all these possibilities, we had to come to this preliminary conclusion: Since the explosion, which occurred in the left baggage compartment of the C. P. A. airliner, could not be explained by a freak explosion of the normal substances in the aircraft proper, it was evidently caused by an explosive placed on board by a criminal hand. After considering the high explosives likely to be used and after having obtained certain information from the investigators, we directed our researches toward dynamite, a high explosive which can be found in commerce or can easily be made at home.

Experimenting in conditions as close as possible to those existing in the baggage compartment of a DC-3 aircraft, we produced a dozen blasts using 60% Forcite dynamite. The purpose of these experiments was to determine the nature of the stains or deposits and the effects of a dynamite explosion on fibers and metal, in this case duraluminium, of which the plane was built. The dynamite was exploded using an electric blasting cap activated by a dry cell battery.

The macroscopic and microscopic examinations of each and all of the pieces submitted to our tests showed:

1. Absence of burns;
2. Marked shattering effect on the metal;
3. Very fine metallic particles and small pieces of cloth scattered in all directions;
4. Shredding, perforation, and stretching of fibers;

5. Blackish spots, where the gases had touched;
6. Brownish spots, where the gases had slightly touched;
7. Presence of fine copperish particles inlaid in fibers;
8. Presence of transparent crystals;
9. Absence of "meal". (Meal is a combustible substance which is added to dynamite in order to obtain a more complete combustion.) At the time of our tests, and even before, the manufacturer of dynamite was adding to it almond nut shells, cocoa beans hulls, or peach nut shells. We searched, without success, for one of these specific substances. The identification of the "meal" would have revealed to us, without knowing beforehand, the type of dynamite used and the date it was made. That is why we have constantly looked for it, with special care, throughout all our examinations.

A series of chemical and spectrographic comparative analyses were then undertaken on both stained and unstained material. The results were the presence of sodium nitrate crystals in the native state. This is, to our mind, characteristic of a high explosive of the dynamite type, since sodium nitrate is found only in high explosives of this nature. These characteristic crystals were always detected when dealing with dynamite explosions of the forcite type. There was also the presence of nitrate and nitrite; of sulfur, sulfate, sulfite, and sulfide; and of sodium, calcium, lead and copper. The presence of lead and copper could be explained by the electric blasting cap, which was then made of copper and which contained lead azide as explosive.

After this preliminary work, each and all of the pieces gathered in the forest at Sault-au-Cochon, and those brought to us subsequently, were examined in the same manner as reported above. This involved more than 500 chemical and spectrographic analyses.

The macroscopic and microscopic examinations together with the chemical and spectrographic analyses justified our conclusion that the explosion, which took place in the left baggage compartment of aircraft CF-CUA, was due to a high explosive of the dynamite type.

#### WHAT WAS THE CAUSE OF THE EXPLOSION?

A small piece of metal, painted blue on both side, found in a parka hanging from a tree, and a piece of duraluminium, from the left baggage compartment, gave us the clue to solve this very important question. The metal from the left baggage compartment showed a voluminous white, yellow, and black deposit. It was evident that a hard object had been thrown with force against this wall. The chemical and spectrographic analyses revealed that the deposit contained zinc, carbon, manganese, lead, tin, chloride, ammonium, sodium, copper, calcium, nitrates, and many other elements. It was thus easy to state that the identifying components of a dry cell battery were present in that deposit.

The examinations, measurements, chemical, and spectrographic analyses of the small metal piece showed:

1. That the thickness of the metal was the same as that of a No. 10 Eveready dry cell battery.

2. Blue paint on both faces. After examining all the different types of dry cell batteries that could be bought in commerce, the Eveready dry cell battery was *the only one* to show this characteristic of the top metal surface.

3. That the blue paint on the piece of metal was identical with the blue paint taken off an Eveready dry cell battery.

4. That the metal was identical with the metal of an Eveready dry cell battery.

5. The presence of the elements composing a dry cell battery.

From the above results, the following conclusions appeared self evident. First, one or more No. 10 Eveready dry cell batteries had been thrown against the wall by the explosion. Second, the presence of lead and copper could be explained by the projection of the elements of an electric detonator and that of lead copper and tin could be explained by the projection of certain parts of a clock.

As the investigation had revealed that no such dry cell battery was known to be on board, at the take off, and that a suspect, J. A. Guay, whose wife was on board the plane, had bought some, it was thus possible to deduct that the No. 10 Eveready dry cell battery, part of which had been found, had some connection with the explosion.

Despite our analyses, a link was missing. This link was found during a search at the house and workshop of Genereux Ruest, a friend of Guay and a skilled watchmaker. It consisted in a small piece of corrugated cardboard with multiple perforations and a blackish deposit. The microscopic examination and the chemical and spectrographic analyses of this cardboard showed:

1. Presence of two very fine copperish particles incrustated in the cardboard;
2. This metal was identical with the metal of commercial electric blasting cap;
3. Presence of all the normal elements found after the explosion of an electric detonator.

We were then in a position to state that the piece of corrugated cardboard had sustained the effects of the blasting of one or more electric detonators. It was reasonable to believe that a timing mechanism had been tested before using it.<sup>1</sup>

Following these numerous experiments, and considering the results obtained after examining and analysing the effects produced by many types of high and low explosives, other than dynamite, we could finally state: The explosion that occurred in the left baggage compartment of aircraft CF-CUA, whose debris was found in the forest, at Sault-au-Cochon, was due to a high explosive of the dynamite type, and in our opinion, based on experience, facts and research, this explosion was caused by a mechanical device composed of a clock, of one or more electric blasting caps and of one or more No. 10 Eveready dry cell batteries.

All our conclusions were confirmed by the evidence of witnesses during the trial and even by the accused himself who, before walking to the gallows, declared: "The experts were right in their conclusions."

<sup>1</sup> It is important to note, that in such cases, the search by chemical experts, at the places where a bomb or other objects could have been fabricated, often plays a primary role.

In the present case, upon our insistence, we had been authorized to search the residence and workshop of one of the suspects, since to our mind, it was possible to find traces left after the making of a bomb. This was substantiated, since we found the piece of corrugated cardboard and this notably helped the police. Subsequently, the suspect himself established the part that he had played in this tragedy, when a relative of his, who was present during our search, phoned him and said: "They found some paraffine". And he answered: "*That does not matter, it was not in the bomb.*"