

Preface

Millions of words have been written about rocketry and space travel, and almost as many about the history and development of the rocket. But if anyone is curious about the parallel history and development of rocket propellants—the fuels and the oxidizers that make them go—he will find that there is no book which will tell him what he wants to know. There are a few texts which describe the propellants currently in use, but nowhere can he learn *why* these and not something else fuel Saturn V or Titan II, or SS-9. In this book I have tried to make that information available, and to tell the story of the development of liquid rocket propellants: the who, and when, and where and how and why of their development. The story of solid propellants will have to be told by somebody else.

This is, in many ways, an auspicious moment for such a book. Liquid propellant research, active during the late 40's, the 50's, and the first half of the 60's, has tapered off to a trickle, and the time seems ripe for a summing up, while the people who did the work are still around to answer questions. Everyone whom I have asked for information has been more than cooperative, practically climbing into my lap and licking my face. I have been given reams of unofficial and quite priceless information, which would otherwise have perished with the memories of the givers. As one of them wrote to me, "What an opportunity to bring out repressed hostilities!" I agree.

My sources were many and various. Contractor and government agency progress (sometimes!) reports, published collections of papers presented at various meetings, the memories of participants in the

story, intelligence reports; all have contributed. Since this is not a formal history, but an informal attempt by an active participant to tell the story as it happened, I haven't attempted formal documentation. Particularly as in many cases such documentation would be embarrassing – not to say hazardous! It's not only newsmen who have to protect their sources.

And, of course, I have drawn on my own records and recollections. For something more than twenty years, from 1 November 1949, when I joined the U.S. Naval Air Rocket Test Station, until 2 January 1970, when I retired from its successor, the Liquid Rocket Propulsion Laboratory of Picatinny Arsenal, I was a member of the unofficial, but very real, liquid propellant community, and was acutely aware of what was going on in the field, in this country and in England. (It wasn't until the late 50's that it was possible to learn much about the work in the Soviet Union, and propellant work outside these three countries has been negligible.)

The book is written not only for the interested layman – and for him I have tried to make things as simple as possible – but also for the professional engineer in the rocket business. For I have discovered that he is frequently abysmally ignorant of the history of his own profession, and, unless forcibly restrained, is almost certain to do something which, as we learned fifteen years ago, is not only stupid but is likely to result in catastrophe. Santayana knew exactly what he was talking about.

So I have described not only the brilliantly conceived programs of research and development, but have given equal time to those which, to put it mildly, were not so well advised. And I have told the stories of the triumphs of propellant research; and I have described the numerous blind alleys up which, from time to time, the propellant community unanimously charged, yapping as they went.

This book is opinionated. I have not hesitated to give my own opinion of a program, or of the intelligence – or lack of it – of the proposals made by various individuals. I make no apology for this, and can assure the reader that such criticism was not made with the advantage of 20–20 hindsight. At one point, in writing this book, when I had subjected one particular person's proposals to some rather caustic criticism, I wondered whether or not I had felt that way at the time they were made. Delving into my (very private) logbook, I found that I had described them then, simply as "Brainstorms and bullbleep!" So my opinion had not changed – at least, not noticeably.

I make no claim to completeness, but I have tried to give an accurate account of the main lines of research. If anyone thinks that I

have unreasonably neglected his work, or doesn't remember things as I do, let him write to me, and the matter will be set right in the next (d.v.) edition. And if I seem to have placed undue emphasis on what happened in my own laboratory, it is not because my laboratory was unusual (although more nutty things seem to have happened there than in most labs) but that it was not, so that an account of what happened there is a good sample of the sort of things which were happening, simultaneously, in a dozen other laboratories around the country.

The treatment of individuals' names is, I know, inconsistent. The fact that the family name of somebody mentioned in the text is preceded by his given name rather than by his initials signifies only that I know him very well. Titles and degrees are generally ignored. Advanced degrees were a dime a dozen in the business. And the fact that an individual is identified in one chapter with one organization, and with another in the next, should be no cause for confusion. People in the business were always changing jobs. I think I set some sort of a record by staying with the same organization for twenty years.

One thing that is worth mentioning here is that this book is *about* a very few people. The propellant community—comprising those directing or engaged in liquid propellant research and development—was never large. It included, at the most, perhaps two hundred people, three-quarters of whom were serving merely as hands, and doing what the other quarter told them to do. That one quarter was a remarkably interesting and amusing group of people, including a surprisingly small number (compared to most other groups of the same size) of dopes or phoneys. We all knew each other, of course, which made for the informal dissemination of information at a velocity approaching that of light. I benefited particularly from this, since, as I was working for Uncle, and not for a rival contractor, nobody hesitated to give me “proprietary” information. If I wanted the straight dope from somebody, I knew I could get it at the bar at the next propellant meeting. (Many of the big propellant meetings were held in hotels, whose management, intelligently, would always set up a bar just outside the meeting hall. If the meeting wasn't in a hotel, I'd just look around for the nearest cocktail lounge; my man would probably be there.) I would sit down beside him, and, when my drink had arrived, ask, “Joe, what *did* happen on that last test firing you made? Sure, I've read your report, but I've written reports myself. What really happened?” Instant and accurate communication, without pain.

Conformists were hard to find in the group. Almost to a man, they were howling individualists. Sometimes they got along together—

sometimes they didn't, and management had to take that into account. When Charlie Tait left Wyandotte, and Lou Rapp left Reaction Motors, and they both came to Aerojet, the management of the latter, with surprising intelligence, stationed one of them in Sacramento and one in Azusa, separated by most of the length of the state of California. Lou had been in the habit, when Charlie was giving a paper at a meeting, of slipping a nude or two into Charlie's collection of slides, and Charlie was no longer amused.

But friends or not, or feuding or not, everything we did was done with one eye on the rest of the group. Not only were we all intellectual rivals — "anything you can do I can do better" — but each of us knew that the others were the only people around competent to judge *his* work. Management seldom had the technical expertise, and since most of our work was classified, we couldn't publish it to the larger scientific community. So praise from the in-group was valued accordingly. (When Irv Glassman, presenting a paper, mentioned "Clark's classical work on explosive sensitivity," it put me on cloud nine for a week. *Classical*, yet!) The result was a sort of group Narcissism which was probably undesirable — but it made us work like Hell.

We did that anyway. We were in a new and exciting field, possibilities were unlimited, and the world was our oyster just waiting to be opened. We knew that we didn't have the answers to the problems in front of us, but we were sublimely confident of our ability to find them in a hurry, and set about the search with a "gusto" — the only word for it — that I have never seen before or since. I wouldn't have missed the experience for the world. So, to my dear friends and once deadly rivals, I say, "Gentlemen, I'm glad to have known you!"

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