Answer to Puzzle from Week-18 of IFT-Posten

<u>**Puzzle**</u>:

Carol was creating a family tree, but had trouble tracking down her mother's birthdate. The only clue she found was a letter written from her grandfather to her grandmother on the day her mother was born. Unfortunately, some of the characters were smudged out, represented here with a "**___**". (The length of the line does not reflect the number of smudged characters.)

Dear Virginia,
*Little did I know when I headed to work this Monday morning, that by evening we would have a beautiful baby girl. And on our wedding anniversary, no less! It makes me think back to that incredible weekend day, **J___ 27th, 19___**, when we first shared our vow to create a family together, and, well, here we are! Happy eighth anniversary, my love.*
Love, Edwin"

Question: When was Carol's mother born? (Hint: This problem is inspired by Conway's <u>Doomsday Rule</u>.)

<u>**Answer:**</u>

John Conway's <u>Doomsday Rule</u> is his ingenious method to quickly map any date in history with its day of the week. He practiced it daily for years, and got so good that he could compute the day of the week for 15 dates in his head in under 10 seconds.

To solve this problem, you need to know some calendar rules:

- There are 365 days in each non-Leap Year.
- There are 366 days in each Leap Year.
- Leap Years occur every four years *except* in years that are divisible by 100, and *except-except* in years that are divisible by 400.
- Thus, 1900 is the only year in the 20th century that is divisible by 4, but *not* a leap year.

Since 365 divided by seven days of the week has a remainder of 1, any date will move forward one day of the week after every non-leap year. So if July 31st is a Friday in 2020, we know it will be a Saturday in 2021. And since 366 divided by 7 has a remainder of 2, any date will move forward *two* days of the week when it passes a leap day.

For example, since July 31st was a Wednesday in 2019, we know it must be a Friday in 2020. (The Leap Day occurred in February 2020.)

From Edwin's letter to Virginia, we can surmise the following three things:

- The month in which they were married was January, June, or July.
- They were married on a weekend day.
- Eight years later, their anniversary was on a Monday.

Almost all eight-year periods involve passing over six non-Leap Years and two Leap Years. This means you'd advance by one day of the week for each of the non-Leap Years, and two days of the week for each of the two Leap Years. In total, you'd advance by 10 days of the week, which is the same as advancing by 3 days of the week.

This means if Edwin and Virginia's wedding date was on a Saturday, eight years later should be a Tuesday, and if their wedding date was a Sunday, eight years later should be a Wednesday. But we know eight years after Edwin and Virginia's wedding was a Monday.

This can only occur if the eight-year period includes only one Leap Year, which means the eight-year period in question must have started in 1900! Furthermore, they must have been married *before* February 28th, as dates after February 28th in 1900 would still pass two Leap Days over an eight-year period.

So, since the month started with J, we now have the complete answer: Edwin and Virginia must have been married on January 27th, 1900, which means Carol's mother must have been born on **January 27th, 1908**!