

The Salvation of Doug

by William T. Sullivan

On a hill overlooking an automobile factory, lived Doug, a retired biochemist, and a retired geneticist (nobody knew his name). Every morning, over a cup of coffee, and every afternoon, over a beer, they would discuss and argue over many issues and philosophical points. During their morning conversations, they would watch the employees entering the factory below to begin their work day. Some would be dressed in work clothes carrying a lunch pail, others, dressed in suits, would be carrying briefcases. Every afternoon, as they waited for the head on their beers to settle, they would see fully built automobiles being driven out of the other side of the factory.

Having spent a life in pursuit of higher learning, both were wholly unfamiliar with how cars worked. They decided that they would like to learn about the functioning of cars and having different scientific backgrounds they each took a very different approach. Doug immediately obtained 100 cars (he is a rich man, typical of most biochemists) and ground them up. He found that cars, consist of the following: 10% glass, 25% plastic, 60% steel, and 5% other materials that he could not easily identify. He felt satisfied that he had learned of the types and proportions of material that made up each car. His next task was to mix these fractions to see if he could reproduce some aspect of the automobile's function. As you can imagine, this proved daunting. Doug put in long hard hours between his morning coffee and afternoon beer.

The geneticist, not being inclined toward hard work (as is true for most geneticists) pursued a less strenuous (and less expensive) approach. One day, before his morning coffee, he hiked down the hill, selected a worker at random, and tied his hands. After coffee, while the biochemist zipped up his blue jump suit, adjusted his welders goggles, and lit his blow torch to begin another day of grinding, the geneticist pueered around the house, made himself another pot of coffee, and browsed through the latest issue of Genetics.

That afternoon, while the automobiles were rolling off the assembly line, Doug, wet with the sweat of his day's exertions, took a sip of beer and as soon as he caught his breath began discussing his progress. "I have been focusing my efforts on a component I consistently find in the plastic fraction. It looks like this (he draws the shape of a steering wheel on the edge of a napkin). Presently I have been mixing it with the glass fraction to see if it has any activity.. I am hoping that with the right mixture I may get motion, although I have not had any success so far. I believe with a bigger blow torch, perhaps even a flame thrower, I will get better results."

The geneticist was only half listening because his attention was drawn to the cars rolling off the assembly line. He noticed that they were missing the front and rear windows, but not the side windows. As soon as the biochemist finished speaking (geneticists are very polite conversationalists), the geneticist proclaimed, "I have learned two facts today. The worker whose hands I tied this morning is responsible for installing car windows and the installation of the side windows is a separate process from the installation of the front and back windows."

The following day the geneticist tied the hands of another worker. That afternoon he noticed that the cars were being produced without the plastic devices the biochemist was working on (steering wheels). In addition, he noticed that as the cars were being driven off to the parking lot, none of them make the first turn in the road and they begin piling up on the lawn. That evening, to Doug's dismay, the geneticist concluded that steering wheels were responsible for turning the car and, in addition, that he had identified the worker responsible for installing the steering wheels.

Emboldened by his successes, the next morning the geneticist tied of the hands of an individual dressed in a suit and carrying a briefcase in one hand and a laser pointer in the other (he was a vice president). That evening the geneticist, and Doug (although he would not openly admit it), anxiously awaited to see the effect on the cars. They speculated that the effect might be so great as to prevent the production of the cars entirely. To their surprise, however, that afternoon the cars rolled off the assembly line with no discernible effect.

The two scientists conversed late into the evening about the implications of this result. The geneticist, always having had a dislike for men in suits, concluded that the vice president sat around drinking coffee all day (much like geneticists) and had no role in the production of the automobiles. Doug, however, held the view that there was more than one vice president so that if one was unable to perform, others could take over his duties.

The next morning Doug watched as the geneticist, in an attempt to resolve this issue, headed off towards the factory carrying a large rope to tie the hands of all the men in suits. Doug, after a slight hesitation, abandoned his goggles and blow torch, and stumbled down the hill to join him.

Reproduced from the Genetics Society of America Newsletter, April 30 1993. GENERations Vol. 1, No. 3

The author, William Sullivan, is a Professor in the Department of Biology, Sinsheimer Labs, University of California at Santa Cruz, Santa Cruz, CA 95064. He uses this story to explain the rationale behind mutational analysis in his introductory genetics classes, and suggests that it may be useful for teaching students the basic differences between genetics and biochemistry.

In GENERations Vol. 1, No. 3 William Sullivan described the Triumph of Genetics over Biochemistry through a parable entitled "The Salvation of Doug." We are pleased to provide a forum for Doug's reply.-- Ed.

The Demise of Bill

by Douglas R. Kellogg

On a hill overlooking an automobile factory, lived Bill, a retired geneticist, and a retired biochemist (nobody knew his name). Having spent a life in pursuit of higher learning, both were wholly unfamiliar with how cars worked, and they decided that they would like to learn about the functioning of cars. Having different scientific backgrounds they each took a very different approach. Bill, not being inclined towards hard work (like most geneticists), immediately came up with a scheme that he thought would lead him to an understanding of cars. The next morning he went down the hill and tied the hands of one of the workers in the factory. He then went back up the hill and sat down to a cup of coffee. As he was just starting to sip his cup of coffee, he heard some banging noises and went out to the garage to see what was going on. When he looked in the garage he found that the biochemist had gotten one of the cars from the factory and was already covered with grease and oil as he was doing something under the hood. When Bill asked the biochemist what he was doing, he replied: "I'm taking the car apart to see how it works". The geneticist laughed and then sat down to enjoy his cup of coffee while he made fun of the biochemist. Bill spent the entire day drinking coffee while the biochemist struggled and sweated under the hood of the car."

Towards the end of the day, as the exhausted biochemist was washing up, the geneticist pointed at the factory below. Cars were rolling out of the factory, and each one lacked a particular circular device (the steering wheel). Moreover, each of the cars failed to make the first turn in the road as they left the factory, and all the cars were piling up on the lawn. "Hah!" exclaimed the geneticist, "The worker whose hands I tied up today is responsible for installing the circular device, and the circular device is responsible for steering the car". The geneticist then asked the biochemist what he had learned that day. The biochemist said that he had been focusing on a small white object (the spark plug) and that he did not yet know what it did. The geneticist hooted with laughter.

The next day, the geneticist, emboldened by his success, went back down the hill and tied the hands of another worker. He then went

back up the hill to get a cup of coffee. As he sat down to his coffee, he heard an explosion in the garage. He ran out to see what happened, and he found the biochemist picking himself up off the ground, his face all black and most of his hair burned away. When Bill asked in amazement what had happened, the biochemist simply replied: "I have found that the liquid in the tank of the car is fairly explosive". Later that day, when they looked down at the factory to see the effect of Bill's experiment, they observed that there were no cars coming out of the factory. Bill seemed puzzled.

This continued for many days. The geneticist gloated over his every discovery. For instance, at the end of one day the cars that rolled out of the factory were missing the front and rear windows, but not the side windows. Bill told the toiling biochemist: "The worker whose hands I tied today is responsible for installing the front and back windows, and this process is independent of installing the side windows." One evening, as they were drinking some beer and arguing, the biochemist asked Bill "Now that you have learned so much, tell me how the car works." Bill seemed puzzled by the question, but after thinking awhile he said that he had noticed that whenever the cars don't have the round things (the tires) they are completely unable to go anywhere at all. He therefore concluded that these round things were actually responsible for moving the car. The biochemist had another sip of his beer and noticed how beautiful the sunset can be after a good day of hard work.

Meanwhile, the biochemist, after many hard months of work, thought that he was beginning to define some pathways. In one pathway, he found that the explosive liquid in the tank moved through a small tube to a device that turned it into a vapor, and that the vapor was sucked into some cylindrical chambers. In another pathway, an electrical current flowed from a battery to the white devices he had studied earlier, and then formed a spark that ignited the explosive vapor, thus forcing a piston out. The biochemist had also gone down the hill and taken the time to look at the cars that failed to leave the factory when Bill had tied the hands of some of the workers. He found that they were lacking carburetors, spark plugs, drive shafts, gasoline, etc. By studying these cars, he was able to confirm some theories that he had developed regarding the functions of the cars components.

After awhile, the geneticist decided that he now knew enough about cars, and he wanted to get one so that he could go out while he waited for the results of his experiments. He decided to get a Volkswagen Camper Van. The day he got his van, he stopped by the garage to see what nonsense the biochemist was up to. The biochemist was sitting in the car pumping the clutch, and each time he did a stream of liquid shot out from underneath the car. He told Bill that he thought the liquid in the tube leading from the clutch pedal to the clutch played a critical role in disengaging the gears from the drive shaft. Bill laughed and then drove off to spend the day at a Three Stooges Film Festival that was showing at a nearby theater.

One day, several weeks later, Bill spent the day surfing and then got in his van to go home. But when he turned the key, nothing happened. He wasn't sure what was wrong, and he wondered whether or not his car might need new wheels. He tried the key several more times and then got out and started to walk. Pretty soon it started to rain. He tried to hitchhike but nobody seemed to want to pick him up, and he did not make it home until late that night. When he got home, the biochemist asked him where he had been, and Bill told him what had happened. Bill confessed that he did not know what to do, but the biochemist said that he might be able to help. The next day, they drove back to Bill's stalled van in the biochemist's car--a 1964 Valiant with a V8 engine and a push-button transmission. The geneticist couldn't help noticing how smoothly the biochemist's car ran. When they got to Bill's car, the biochemist rapidly determined that one of the battery cables no longer made a good connection, and he had the car running in no time at all. As Bill drove away, he just shook his head.

Bill's car kept breaking down, and every time it did the biochemist had to go out and fix it. He tried to teach Bill how cars work, but Bill didn't seem to understand and was always more interested in his hand-tying experiments. The story came to an end when Bill's car crashed into a tree. He had been driving along just fine when a fruit fly crawled into his eye and caused him to swerve off of the road. Unfortunately, he was not wearing his seat belts because when he had tied the hands of the worker that installed them, the cars that came out of the factory seemed to function fine, and Bill had

concluded that seat belts were vestigial and not important to the functioning of the car. Remarkably, Bill survived the accident, but as soon as he got out of the hospital he got a new car and had the biochemist help him start taking it apart.

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GENERations, Volume 2, Number 11994 Genetics Society of America, March 31, 1994