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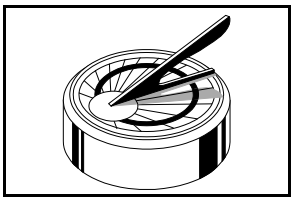

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"Talent develops in quiet places, character in the full current of human life."
Johann Wolfgang von Goethe, 1749-1832

A new Smithsonian Institution resource demonstrates the value of using museums to educate gifted students. Although these are exceptional examples, most communities have historical sites or museum programs that can enhance the teaching of history, one of the least understood subjects in the public school curriculum. The National Air and Space Museum opened a center in December 2003, the Udvar-Hazy Center located at Chantilly, Virginia – a large hangar-like structure which houses beautifully restored airplanes hanging from the rafters and at floor level. Some examples of the military and commercial aircraft which show the history of flight and various uses are World War One biplanes, World War Two planes including a Flying Tiger fighter and several bombers (e.g., the B-29 Enola Gay), the Clipper Flying Cloud (1940s passenger plane for South American flights), and the more recent Concorde (passenger jet for transatlantic flights) donated by Air France. The exhibit also has the fastest plane – the Lockheed Blackbird manned reconnaissance jet with a top speed of Mach 3.3 (2,250 mph).

The Udvar-Hazy Center was recently enhanced by the McDonnell Space Hangar which contains the space Shuttle Enterprise and many other large space exploration artifacts. For gifted students interested in flying and space exploration, this museum offers a unique opportunity to study the development of aircraft from primitive flying machines to space rockets. To view information about the museum on the internet, see the following link: http://www.nasm.si.edu/museum/udvarhazy. If you would like some photos of the airplanes on display for instructional purposes, send me your email address: giftededpress@comcast.net.

In this issue Kai Brunkalla has written an informative article on teaching mathematics to gifted students, elementary through high school levels. He is a mathematician (Ph.D., Kent State University) and Assistant Professor at Walsh University in North Canton, Ohio. The article by Tony Burnett, an award winning New Zealand teacher of accelerated classes and gifted children, describes some of his teaching experiences and ideas about the gifted. He is the author of both the popular science book **The Search for Simplicity** (2002) and a stimulating science series for bright young children entitled, "Talking to Grandpa," which will be published by Gifted Education Press in the Spring of 2005. You can view information on his excellent science book and biographical study on the Crathes Press website: http://www.Crathespress.co.nz. Ronald L. Rubenzer has written an useful article on the development of test taking skills which should help to prepare gifted students for taking the SAT, AP Exams and other high-stakes tests. He is a practicing psychologist in Greensboro, North Carolina. Michael Walters completes this issue with an essay on the great opera singer, Robert Merrill.

Maurice D. Fisher, Ph.D. Publisher

MATHEMATICS EDUCATION FOR THE GIFTED, ELEMENTARY LEVEL AND BEYOND

BY KAI BRUNKALLA
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Gifted students need to be nurtured and encouraged to make the most of their gifts. This is particularly true for mathematics. Many of the great mathematical minds saw problems and concepts in a new and creative way. *"To be a scholar of mathematics you must be born with talent, insight, concentration, taste, luck, drive and the ability to visualize and guess*" (Halmos, 1985). Educators have to provide an environment in which mathematically gifted students can grow, express themselves, have their questions answered and their curiosity satisfied.

There is a difference between two types of mathematical giftedness. Some students are classified as gifted in this subject based upon an overall high IQ, and others have "only" a special ability in math (Stanley, 1979). I make no such distinction in this article. Both types of students face the same challenges in today's mathematics classrooms and will benefit greatly from increased awareness and attention to their particular needs. Educators must rise up to the challenge to meet the needs of our young enthusiastic mathematicians. I will focus on four items that are important to gifted students and teachers alike.

1. Memorization Is Important

A word of warning at the beginning: no matter how talented you are in mathematics, there is always some part that will be made easier by memorizing "basic" facts. Students who do not memorize simple addition and multiplication facts will have a much harder time mastering later skills. While this is less of a problem for gifted students, especially in the early grades, as they can make up for the lack of memorization with their gifts, it will be increasingly difficult to advance without prior memorization. As every new topic in mathematics builds upon the previous one, the availability of math facts becomes one of the main building blocks of the new topic.

Many gifted students have a more than average aversion to memorized "dull" facts and it can be very difficult to bring them back to memorization. "Not all useful learning is intrinsically interesting," Yermish observes (2003). Being easily bored, the repetitiveness of memorization might take a greater toll on gifted students. It is important for teachers and parents to use a wide variety of tools to help their child memorize the basic factors. Flash cards, manipulatives, tables and other tools help to reinforce their basic knowledge of mathematics. There are many computer programs that help this process become more tolerable by making it into a game. Or, on the low tech side, traditional flash cards can be used with a stopwatch to make it a speed game. Students must be told how important memorization is and it should be explained to them that this will be the foundation of later mathematical excellence. However, this does not mean that we should hinder progress. On most occasions, math facts can be taught alongside more advanced subjects. This can help to reinforce the importance of those facts to gifted students as a price to pay for faster advancement and deeper understanding of the more advanced topics. But every new step in mathematics requires a certain amount of automatization in lower level mathematics. Students in calculus are kept back by their lack of algebra skills, those in algebra are kept back by their lack of arithmetic and so forth. This of course applies on smaller scales as well; they need to master addition before subtraction and multiplication before division and the memorization of the former always helps to excel at the latter. Students who know their addition facts will have very little trouble to then move to the fact families and on to subtraction problems.

Memorization might make students moan and groan. Gifted students especially might question why they must take the time to do it, but a good teacher will resist the temptation to bypass this important step. Educators should stress how important it is to memorize facts such as addition tables, multiplication tables and the arithmetic properties such as the distributive and commutative property. A solid foundation will make it easier for the young math student to use his or her talents to study more complex and abstract mathematical concepts in the future.

2. Focus on Concepts

Educators know that sometimes the problems given in class are very straightforward and do not present gifted students with a real challenge. As a teacher, you should be able to explain why such problems are given and how the solution is but a stepping-stone to solutions of more difficult problems. For example, it is easy to find the prime factorization of 6. But in cryptology, we need to factor numbers with hundreds of digits. This easy problem is used to introduce the concept of prime factors. Practicing these problems leads to creating algorithms and developing strategies that can be used in more complex real world applications.

The addition of problems in the teaching curriculum that emphasize conceptual knowledge should be considered for everyone, but are essential for gifted students. The concepts should be a focal point of every unit that is taught in the classroom, since they are asked in the standardized tests our students are required to take. For mathematically gifted students the question of "why" is more engaging than the procedure of "how."

The depth of conceptual understanding that can be taught is greatly dependent on the teacher's mathematical ability and training, especially in the elementary school level. This training is commonly regarded as an unnecessary burden to the teacher and takes a backseat to subjects such as literacy training. On the other hand, the depth of knowledge and understanding of the teacher is one of the greatest assets for gifted students.

While most teachers are very comfortable with the procedures of basic math, it has been my experience as an education consultant and a university math professor that some elementary school math teachers are ill equipped to explain the underlying concept. For example, when the question is raised concerning why we subtract in the long division algorithm, many teachers do not have satisfactory answers. However, every teacher knows that we subtract.

Teaching the procedural part of mathematics, rather than conceptual understanding, unfortunately is already enough of a challenge to average students. It can be a real source of boredom for gifted students. I have found that very few teachers are including facts about the similarities between addition and multiplication in their classrooms. However, gifted students, knowing that both are Abelian groups, might use this as a tool for discovery of the properties of other operations. Similarly, their understanding of the concept of long division might lead them to be able to discover and apply the same procedure for numbers in different bases or the application of this procedure to polynomials.

Educators of the gifted should take time to teach concepts and structures. This type of knowledge will encourage deeper understanding, better skills and more creativity. If we provide access to the mathematical concepts, this will increase gifted students' problem-solving skills. *"Understanding underlying mathematics is much more powerful for developing problem-solving capabilities than merely applying algorithms"* (Tretter, 2003). The access we provide to the underlying concepts and ideas will enable them to grow mathematically and allow for a deeper kind of learning.

Learning about mathematical concepts rather than mathematical procedures, requires a certain level of abstract thinking that cannot be expected from every student, especially in the earlier grades. Some say that learning about the concepts might pose a problem for average students in a mixed ability classroom. The criticism is that the depth of gifted students' thinking may discourage average students from the pursuit of mathematics and that it may prevent average students from achieving the best possible result.

Many studies have been conducted and many programs have been tried to improve the knowledge of elementary school teachers in mathematics (Alamprese and Erlanger, 1989). We cannot be afraid to look deeper into what we are teaching. Gifted students are always asking "why." We cannot be afraid of our students or afraid of their questions. We cannot be afraid to look deeper into the mathematical concepts we teach. Once teachers have mastered a concept, then they will be better able to answer the question. This training in mathematics will impact many other disciplines. "*Every new body of discovery is mathematical in form, because there is no other guidance we can have*" (Charles Darwin) (quoted in Rose, 1988). The impact of mathematical concepts cannot be overstated. In our data driven world, mathematical knowledge and the understanding of mathematical concepts are essential.

3. Nurture Creativity in Problem Solving

Written problems are unfortunately not always clear and gifted students might interpret them in non-standard ways. This is especially true if we deal with "real life" situations that require some experience with the subject matter.

The following example is similar to a math review problem that is in a popular third grade math textbook in the United States: "Suzie places icing flowers on a birthday cake. She puts an icing flower in each corner of the cake. Then she puts icing flowers along the side of the cake. When she is finished, each side of the cake has 7 icing flowers. How many icing flowers are on the cake?" The answer of a gifted student showed a picture of a triangular cake with 18 flowers on it. The answer is correct and it does make sense. However, the teacher marked the problem wrong because the book had the answer as 24 icing flowers. But the problem did not indicate that a rectangular cake had to be used. The student's solution fits the problem. This creativity should be nurtured and appreciated, even celebrated. The student did not follow the usual path but was instead thinking creatively. Teachers should be perceptive to gifted students' needs and try not to stifle their creative problem solving skills. Yes, it was not the standard answer that was in the textbook and it was not the answer that the teacher was looking for, but none the less, it was an alternative correct answer.

This type of creative problem solving is highly valued in many branches of industry where it is called "thinking out of the box." We should encourage this type of solution as long as it is mathematically reasonable. In many real world situations there are missing pieces of information and people who are able to fill in the gaps with acceptable assumptions will be an asset to any type of endeavor.

It is important to communicate with students about their ideas and about their possible misunderstandings and mistakes. The gifted are more easily frustrated by an incorrect solution because they might be accustomed to getting the correct answer. Problem solving skills are not limited to the actual procedure of solving equations. Reading and understanding problems are very important. Story problems and using math sentences are great exercises that force students to extract the important information and then translate the description in order to solve the problem. They must learn how to put the pieces of the puzzle together to solve the problem and then to ultimately come to a conclusion.

Working through this process presents a good opportunity to excel. However, if they are not given enough instruction on the importance of the steps needed to come to a conclusion, they might have a more difficult time when faced with more complicated problems. The challenge for the teacher is to properly emphasize the importance of the steps, even in "easy" problems.

For example: A car and a train travel from Cleveland to Pittsburgh, a distance of 120 miles. It takes the car 2 hours to travel the distance and the train travels 40 miles per hour faster than the car. How long does it take the train to get from Cleveland to Pittsburgh?

Solution:

Given information: Distance d = 120 mi, time the car traveled t_c = 2h, difference in speed of the train and the car $v_t - v_c = 40$ mph

Wanted information: Time the train traveled t_t.
Unknown quantities: Speed of the car v_c, speed of the train v_t.
Formula needed: distance = rate * time

Speed of the car:	$120 \text{ mi} = v_c * 2\text{h}$
	$120 \text{ mi} / 2 \text{ h} = v_c$
	$60 \text{ mph} = v_c$
Speed of the train:	$v_t - v_c = 40$ mph
	$v_t - 60 \text{ mph} = 40 \text{ mph}$
	$v_t = 100$ mph
Time the train traveled:	$120 \text{ mi} = 100 \text{ mph} * t_t$
	$120 \text{ mi} / 100 \text{ mph} = t_t$
	$1.2 \text{ h} = t_t$

It took the train 1 hour and 12 minutes to travel from Cleveland to Pittsburgh.

While this looks like a lot of work for an easy problem, the ability to break any problem down into smaller pieces and manageable steps is a valuable lesson that can be learned from these examples. Following this procedure will enable students to break down larger, more complicated problems in the future. Most gifted students however, have a difficult time accepting the need for steps. This is especially true when the problem is fairly straightforward, such as the case given in the previous example. They may resist the tedious work of writing all of this out and as a result, they would not develop the skills needed to dissect problems into smaller sub-problems. As mathematical problems grow more complex and become more and more multistaged, even the most gifted mathematician will be eventually forced to break problems down into smaller pieces.

4. Enhance Communication in the Classroom

Communication is a very important component to teaching mathematics to the gifted. They tend to solve problems in creative ways, and are capable of expressing more creative solutions than their teachers and parents might be accustomed to discussing. Educators should be willing to take the time to understand and try to follow these solutions in order to verify their logical structure. The question "why" is important. We have to ask students why the solution is correct and why the method of finding the solution is a valid solution. For example, if a student is asked to draw a line through a square that cuts the square into equal pieces, the most "normal" answer is to draw one of the two diagonals. The other common solution is to draw the perpendicular bisectors of any of the sides. However, any line drawn through the intersection of the two diagonals (center), will also be a valid solution to the problem. Failure to acknowledge a student's correct but alternative solution, can result in frustration, and this frustration might unfortunately invoke aversion to math. Educators need to communicate with students by asking them why they came up with a certain solution. Even if the solution is incorrect, talking it over with gifted students may lead to a deeper understanding of the mathematical problem. More importantly, it validates their ideas. When they are invited to discuss mathematical possibilities, they tend to leave the classroom with a positive outlook on their ability to excel in math.

Further, it may be a welcomed challenge for gifted students to be allowed to explain to their classmates why a certain solution works or does not work. They should be able to explain any type of solution to validate their work. It should be emphasized in class that gifted students can correctly interpret their own and other students' solutions. This process will reinforce the solution process and give them better communication skills in mathematics.

Creative solutions can also take the form of alternative algorithms to the ones familiar to us. Gifted students may be able to "create" alternative division algorithms without being taught. These algorithms should be evaluated on the basis of mathematical validity first and ease of use second.

It is this skill of communicating mathematics and the interpretation of mathematics that is lacking in most students and, sadly, some teachers. It is almost impossible for some students to explain or describe an equation like $2x + 5 = 3x - 1$ in their own words and then, correctly interpret the meaning. Although, most are able to solve the above problem without too much difficulty.

Communication is important for gifted students because they might be in positions in which they will have to explain their solution and their thought process to others in order to be understood. Many times they use shortcuts and methods unfamiliar to others. They know a problem is correct but might have a difficult time explaining why their solution is appropriate for the problem and why it is correct. It should be a main goal of mathematics education for these students to enhance their communication skills. Increased communication skills in math will allow them to reduce frustration later in life. We all want to be understood!

Asking for written and oral communication in mathematics beyond the collection of symbols is a new idea to many students. This ability to translate and interpret mathematical symbols into a standard language is an important skill for all students. Gifted students sometimes have more trouble understanding why interpretation and checks are important in mathematics, as they might be "sure" that they solved the problem properly.

We should stress however, that it is still important for the gifted to show all steps taken in their work. These steps are crucial in explaining solutions and help to communicate ideas more clearly. This practice should be reinforced very early so it will become an important part of their environment. Gifted persons have to be able to explain their train of thought to all types of people throughout their life. Educators are not doing gifted children any favors by allowing them to use shortcuts early in their life (or mathematical career) just because they seem to have a good understanding of the problem or they seem to "get it." It is far better that they learn and practice good communication techniques in the classroom than later in life when they are trying to explain an idea in the boardroom.

Making the Connection

None of the issues mathematically gifted children are confronted with can be seen in isolation. All of the above topics are intertwined and can relate to other areas. We have to acknowledge that learning can only take place when we connect the topics to students in an engaging fashion. This connection has to be made to all other fields of study. A deep knowledge of mathematics will validate the study of biology and vice versa. Connections between subjects is an increasingly important motivational tool for the gifted.

Many of the above issues can be easily addressed in a gifted education program. Our society needs teachers who are able to understand and teach mathematics and who are trained in gifted education. Administrators and policy makers should give educators the leeway needed to be able to engage in a deeper teaching of mathematics. Unfortunately, many gifted programs are being eliminated or reduced. It is a great challenge to try to incorporate advanced mathematics skill building techniques in a mixed-ability classroom.

Gifted students and mathematics educators are faced with many more problems that go beyond the scope of this article. For example, the recently emphasized importance and increased use of standardized tests has taken time from instruction of more interesting, in depth topics. The demands of No Child Left Behind have decreased the focus on gifted education. The newly emerging standards put emphasis on the conceptual understanding of all students. While this is generally regarded as positive, it has taken some focus away from gifted programs because now all students have to acquire a deeper understanding of mathematical concepts, and this may or may not be a realistic goal.

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SOME OBSERVATIONS FROM THE SHARP END

BY TONY BURNETT HIGH SCHOOL TEACHER OF THE GIFTED
NORTH CANTERBURY, NEW ZEALAND

My very first class was almost my last. I had received my first appointment as a teacher of Science at a prestigious boys high school here in New Zealand and, through the intervention of some malicious God or a stroke of bad karma, I found myself facing up to a room-full of hairy sixteen year olds expecting me to dispense words of wisdom on Biology. Biology? Wasn't that the one area of science I didn't feel comfortable with? Hadn't I made that abundantly clear in my CV? Also at my interview? Physics, yes. Chemistry or Math, yes. Biology? No, thank you. Perhaps it was a slow night on Mount Olympus or wherever the old Pagan Gods were supposed to be sitting in those days. Perhaps they just wanted a laugh. Whatever it was, it worked. They got their laugh, all right.

The first day of the school year and, of course, the first 'emergency.' Mr Eccks had unexpectedly taken ill and was expected to be away for at least two weeks. Two weeks? Panic! The Principal strode in. *"Any volunteers?"* he asked, with an outward optimism I'm sure he didn't feel. Silence. All eyes carefully avoided contact. *"C'mon Staff, someone must be able*

to step in for a while. Into the breach, dear friends, and all that." Suddenly, staff seemed terribly preoccupied with other things. "*Anyone available?"* More silence. Not a whisper anywhere. But wait! Isn't it said that necessity is the mother of all invention? The Principal, bless his cotton socks, had a sudden inspiration!

"Mr. Burnett, I can see you are raring to go. I know the feeling myself. I can remember when I was a beginning teacher ……many years ago, of course. How would you like to get your teeth into some serious work right from the start?"
"Umm, er, doesn't Mr Eccks teach Biology? I'm afraid I don't know anything about……"
"Nonsense, Mr Burnett. Nonsense. You're much too modest. I'm sure you'll do a fine job. A really fine job."
"Well…… really……. I don't think……"
"Good! That's the spirit! Exactly the attitude we need. I can see you are going to fit in very well here. Staff Members of this school are always prepared to step forward in an emergency."
"But……Biology isn't …"
"Good show. Very commendable. I'm glad that's settled. Remember, my door is always open if I can be of help in any way. Carry on, staff."

The Principal turned to his Deputy and began discussing other matters. The staff relaxed. Conversation resumed. Did somebody mutter something about a lamb to the slaughter? For 'lamb' read 'beginning teacher' and for 'the slaughter' read '6B Biology in Room 23.' Ahh, the privileges of power. The 'new boy' (me) had been skilfully press-ganged into an experiment in speed learning. My learning, that is, not 6B's. My further protestations were met by the Principal giving me an avuncular pat on the shoulder and expressing, loudly, his confidence in my 'ability to cope.' Having thus relieved himself of a heavy load of misplaced confidence he retreated to his office, commonly known as 'The Sanctum,' and occupied himself with more pressing matters. With a growing sense of apprehension I approached the senior Biology teacher, Mr Why.

"Mr. Why?"
"Yes."
"I am Mr. Burnett, the new Science teacher. The Principal has instructed me to take 6B Biology in Room 23 and has suggested that I ask you for help and a current lesson plan."
"He's what? (Expletive deleted). *Isn't this your first teaching job?*
"Yes."
"Good Lord. Well, when is 6B Biology scheduled, do you know?"
"Yes. In five minutes, I think."
"(Expletive again deleted). *Do you know any Biology?"*
"No, I'm afraid not."
"Heaven help us! Look, there's nothing much I can do for you at the moment. 6B aren't a bad bunch. Just stride on in there, put on a bold front, and introduce yourself with as much confidence as you can. Believe me, there's nothing worse than a new teacher looking nervous at the start. I suggest you begin with 'The Functions of Living Matter.' Some of them will have met the topic before, but I usually go over it myself at the beginning of each year."
"What is it?"
"Good heavens! Don't you know?"
"No."

At this point Mr. Why muttered several things under his breath. I'm not sure what he said but for some reason the paint suddenly began to flake on the walls.

"Look, there are seven functions of living matter and you can remember them by the mnemonic 'Mrs Gren'. You know: movement, respiration, stimuli, growth, reproduction, energy and nutrition. If you use a bit of imagination that should just about be enough to get you through the first period. Okay? Oops, is that the time? Must run!"

I must be a coward. I felt as if I'd been ordered to advance with the bayonet against a Panzer Division. Still, how bad could it possibly be? Other teachers had started out like this and survived……hadn't they?

Ah, here we are. Room 23. I opened the door, walked in with as brisk a manner as I could manage, placed my books firmly on the desk and looked around. Sure enough, arrayed there in front of me were several rows of rugged looking young men gradually coming to silence as each, in his own fashion, looked me over. With what I hoped was a lot more confidence than I felt, I wrote my name in large letters on the board and said*, "Good morning, class. My name is Mr. Burnett and I'm here to teach you Biology. Let's start the new year off in the right way and not waste time, shall we? We are going to start with The Functions of Living Matter."* I wrote the topic on the board and looked around. The class had all opened their folders and were busy writing out the heading. 'Hmm, what was I worried about? This isn't too bad after all. Now…..let's see…..Mrs Gren, wasn't it, so I suppose the first thing must be 'movement' …."
"Right-oh Class. Number one……movement." A pause as they diligently wrote it down. *"Number two……respiration."* Another pause. 'Ha. This is a breeze. Nothing to it at all. Am I really being paid for this?'

Well, in the old nursery story for children, wasn't it Chicken Licken who thought the sky was falling? It never did though, did it? It stayed up there and, if my memory is correct, the cunning old fox ate poor Chicken Licken in the end. I used to laugh at Chicken Licken for being so silly, but I was younger then. The sky can fall all right. I know because it fell on me that morning in Room 23. I was just starting to relax when from the back of the room there came a click of the fingers. I looked up. A hand was in the air. Ahh, my very first classroom question. A proud moment indeed.

"Yes", I said brightly, *"What is it?"*
Back came a reply I've never forgotten. *"Mr Niger……Sir."*

'Hmm. That's odd. I could have sworn he said Mr Niger. At least that's what it sounded like. I must have mis-heard him.'
"Pardon?"
"Mr Niger……..Sir."
'He *did* say Mr. Niger. I'm sure of it. Has the poor fellow got a speech impediment? Have I unwittingly insulted his ethnicity in some way? Hang on; what's that tattoo on his arm? Hmm. It's a bit too far to tell from here. He's a tough looking character, though….'
*"C'mon Mr Burnett. Whatsamatter?…...**Mr Niger!**"*
'Holy Moses, where's the door? I'm in here with a madman…….oops, I'm a teacher now…..mustn't say 'madman'…..I mean, 'a person with a debilitating intellectual challenge', of course…must remember. Wait a minute; perhaps he's a Biafran? No, it can't be that. What the…..?'

From the next moment came my lifelong interest in gifted education. A pleasant, curly haired young man sitting quietly off to one side understood my confusion in an instant, and came to my rescue. He spoke with the brevity and precision I have since come to recognise as a common characteristic of the highly intelligent.

"It's another mnemonic Sir," he said. "*Movement, respiration, nutrition and so on. We did the topic last year. Probably you've been talking to Mr Why. He always uses Mrs Gren."*

Just like that. Precise. Complete. The sky returned to its rightful place and I thanked my saviour with a relief obvious to every single member of 6B Biology. As it turned out, Mr Why did not prove to be of much help to me thereafter but I must say he was right about one thing. 6B weren't a bad bunch at all. I managed to survive my first (and only) two weeks of Biology and the class might actually have learnt something too. I know I did. My rescuer went on to win a scholarship to University and that's not an easy thing to do. There are not many University Scholarships given out in New Zealand. Some of the Staff expressed surprise at his success. I didn't.

That first—and only—brush with teaching Biology bought me face to face with one of the major problems concerning teachers and gifted children: Child prodigies aside, just how can the gifted reliably be identified as such? Bright children are not usually well catered for in a standard classroom. The young man who came to my rescue was exceptionally intelligent and yet, until he won his scholarship, the true extent of his ability went largely un-recognised. Perhaps that was exactly what he intended. It does happen. Peer opinion is hard to ignore when you're a teenager. 6B was a good class in a good school where hard work and ability were admired, not mocked, but I have known it otherwise. I've taught in schools where gifted pupils, especially girls in mixed classes, have taken real pains to appear no brighter than their classmates. It's such a pity, and, of course, quite an unnecessary waste of talent too.

In my experience, most teachers badly underestimate the capabilities of bright pupils. By and large, most children will work to the level of the teacher's expectation. If the environment is positive and the expectation is high then high quality learning usually follows. The ideal is to place a gifted child alongside classmates of similar ability under the care of a gifted teacher, but, as everyone knows, the ideal and the reality are often a long way apart. Any focus on the gifted implies their prior identification, of course, and sometimes that's not easy. It's of little consequence if a pupil is wrongly identified as gifted. After all, they can always return to a regular program if they find themselves out of their depth. The problem arises in *failing* to identify someone as having exceptional intelligence. A gifted child 'forgotten' in a standard classroom can soon suffer from frustration, boredom, resentment, loss of self-esteem and so on……all behavior that tends to confirm the original opinion of his/her intelligence. In other words, disinterest or disruption is often taken as confirmation of no more than average ability—if that—and it then takes an exceptionally perceptive teacher, or perhaps some form of professional psychological intervention, to have the initial assessment reversed.

In saying that I am assuming—as is usually the case here—that blanket IQ testing has not been done, but even if it were I'm not sure it would make much difference to the argument. If a high IQ score places a pupil in a gifted class and they subsequently struggle then other factors, such as having missed vital work in a previous year for instance, can be identified and corrected. If it becomes obvious that the pupil really is misplaced then he/she can easily be offered a return to the standard program. As I mentioned before, a problem is more likely to arise from a gifted child who scores badly on the test and is therefore *not* recognised. There are several reasons why this can (and does) occur. The child may have been upset, or unwell. Perhaps he/she was distracted or excessively nervous during the test. IQ testing, if attempted here at all, is usually done by the school itself and may not always be carried out to an acceptable professional standard. In rare cases some personal factor can mean a gifted child might *deliberately* perform poorly. That is not as silly as it sounds. For some pupils—especially girls—who come in from feeder schools to enrol in High School for the first time, the wish to remain with their friends is sometimes the over-riding factor. If disguising her real ability is the only way a gifted young pupil can remain in the company of her former friends, then so be it. There is no doubt that IQ scores can be a helpful guide to a pupil's ability but, in my opinion, that's all they should be; a guide, not the sole arbiter. Other pointers are needed too.

Okay, if gifted pupils are to be given an enhanced program, or perhaps placed in an accelerated class, then they first need to be reliably identified and it's here that the teacher's own intelligence and experience comes into play. Just what qualities, beyond IQ, should teachers look for if they wish to identify giftedness? Well, the usual list includes concentration, creativity, perception, curiosity, wide interests, speed of learning, and so on. We all know—or should know—what the signs are, but (unfortunately) many teachers here still seem to take their cue solely from the quality of work the pupil produces……a most unreliable indicator. Quality of work is far too dependent on

pupil interest—and on the inter-relationship between teacher and pupil too—to be used as any sort of guide to giftedness. I can remember once suggesting that a rather scruffy pupil be professionally tested for high intelligence. A colleague, who taught the boy English, was surprised. *"Oh no,"* he said. *"He's not bright. His English assignments are terrible."* I could sympathise with my friend. The young fellow's Math wasn't too good either, but that was beside the point. He was tested by a professional Psychologist and scored very highly indeed. And what made me think that he ought to be tested? Simple. He was a natural comedian. I don't, myself, have any foolproof method of deciding how bright a pupil might be but there's one characteristic that I've always regarded as being a key ingredient of high intelligence……a quick *sense of humour*. I've never met a highly developed sense of humour that didn't signal a highly developed intelligence lying behind it. Not yet, anyway. To me, quickness of humour indicates quickness of mind. If that quickness is also allied to subtlety then I regard the question as decided; the person displaying it is highly intelligent. My example concerns the scruffy young man but a connection between humour and intelligence has been my experience many times. Of course, the observation doesn't work in reverse. Absence of a sharp sense of humour does not necessarily indicate an absence of intelligence. Anyway, here's how the young man was able to convince me of his real potential.

I was teaching Math to a co-ed class of teenagers and it happened to be Valentine's Day. That morning a few of the girls had been sent flowers and during a break in the lesson I was gently teasing them about their 'red roses' when a young lady proudly announced *"My boyfriend gave me Gypsophila."* As quick as a flash the scruffy young man said *"Gee, that's terrible. Get him to the Clinic right away."* Hmm…..perhaps you had to be there but, believe me, it was funny at the time. And the outcome? There were two. The young man had his potential confirmed and was provided with extra time and tuition in his 'specialty' (art). The young lady, from that time on, cheerfully bore the nickname *'Gyp.'*

There is no question that health, above all else, is what every prospective parent wishes for his/her children and looks for at birth if not before. Modern techniques such as intra-uterine scans, blood sampling and DNA testing make congenital abnormalities less and less likely these days, but the possibility of a difficult birth, medical misadventure, or some other problem is always in the back of the mind. A normal healthy baby is every new parent's relief and delight.

Alright then, health is number one, but in the few months following birth other less obvious considerations also come into play……beauty, certainly, and perhaps physical stature too. A particularly handsome boy or pretty girl undoubtedly has an advantage in life over others less attractive and parents instinctively know this. It's one of those ironies of adulthood that although we are often reminded *'never to judge a person by appearances'* most people, consciously or otherwise, do exactly that. It's not politically correct to say so these days, but if two young women of equal qualification and experience, one pretty and one plain, apply for the same position then I know where my money would go if asked to bet on who will be given the job. Physique, especially for boys, is also a factor, with a strongly positive bias towards athletic body shape and height. *"He's growing well, isn't he? He's going to be tall."* is a comment guaranteed to please any parent but once we have made the nod towards health and (perhaps) pleasing appearance, the most valued other attribute is undoubtedly *intelligence*. Everyone knows that a high IQ (we will assume for the moment that a high IQ score equates with high intelligence) makes it far more likely that a person will be able to operate successfully in his/her environment. Whether that necessarily equates to a higher probability of personal success or happiness is another story altogether, but the majority of people certainly believe it does.

Raising a gifted child is not always a bed of roses though. It can be difficult for busy parents to maintain a variety of positive stimuli and many gifted children quickly become bored with conventional schooling, but any such problems pale besides those involved with mental sluggishness. Most parents with a healthy new baby are completely satisfied if their child displays norms of behavior typical of its age group. Any development slower than the norm can be a cause of anxiety while that in advance of the usual standard is often a source of pride. Of course, we must always guard against excess. The overzealous parents who bombard everyone they meet with examples of their pride and joy's latest foray into genius are familiar to us all. The scenario usually goes something like this: baby has just regurgitated his/her breakfast and Mum calls Dad…….

"*Darling, come quickly. Little Billy has just said his first word."*
"Really? So soon? What did he say?"
"I'm not absolutely sure. It sounded like 'splurk.' "
"Good heavens. He's a genius. 'Splurk' is Swahili for 'Hello mother.' " And so on...

Well, it's easy to joke about such biased enthusiasm but all parents are anxious that their child should appear to be at least as well developed, both physically and mentally, as others of the same age. Be careful here. Comparisons between children are inevitable, I suppose, but they can also be a quite unnecessary source of anxiety and I would like to sound a word of warning. Not all highly gifted children go on to be considered exceptions in later life, and the reverse is also true; many people of genius were not thought remarkably intelligent during their childhood. Some, as we will see below with Einstein, were actually thought to be backward. The problem is that judgements are always made against typical human behavior while highly gifted behavior is *not* typical. The simplest way is to make it easy for yourself and avoid comparisons if you can. The following anecdotes should illustrate what I mean.

One pleasant Saturday morning—several years ago—I was quietly browsing through the morning paper when I noticed an unusual advertisement. It was in the Positions Vacant section and displayed a prominent header. *"Can You Solve This*

Problem?" it asked. Curious, I took a closer look. Here is what was written.

One man said to another, "I have three sons whose ages I want you to tell me from the following clues. Stop me when you think you know.
1) The sum of their ages is thirteen years.
2) The product of their ages is your age.
3) The eldest is a good swimmer."
"Stop!" said the second man, "I know their ages".
What were they?

The item went on to invite any interested readers to forward their answers, and their reasoning, to a given address. A reply to all submissions was promised within two weeks but nowhere was there any indication as to the purpose of the ad. Well, as far as I was concerned it was a challenge that couldn't be ignored so I duly sent my answer in and, sure enough, a few days later came a letter confirming my solution and, to my surprise, offering me a job. Fair enough I suppose. After all, the ad was in the Vacancies column……anyone looking too closely in that section was very probably open to a new position but I was happily settled and had no wish to change, especially as the offer involved the mathematical modelling of share price fluctuations. I declined with regret but I believe the advertisement was a success and several suitable people were recruited from it. How it all worked out in the long run I have no idea but it was interesting in terms of the overall purpose that the ad tested only logical reasoning……no mathematical skill was involved at all. (If you would like to try the problem for yourself then attempt it now, before reading down any further.)

Well, as I said, it was all some years ago and I have never seen another ad like it since. Perhaps the venture was a failure and everyone was reduced to sackcloth and ashes, but I hope not. Anyway, here is the answer.

Since the ages sum to thirteen, the possibilities are 11, 1, 1; 10, 2, 1; 9, 3, 1; 9, 2, 2; 8, 4, 1; 8, 3, 2; 7, 5, 1; 7, 4, 2; 7, 3, 3; 6, 6, 1; 6, 5, 2; 6, 4, 3; Now lets look at the second clue. For each of the twelve options above the products are, in turn: 11, 20, 27, 36, 32, 48, 35, 56, 63, 36, 60, 72. Now comes the tricky bit. Many people come to a sudden halt here because they don't know the age of the person being spoken to but the point is, they don't need to know. The person himself would know his own age so why didn't he call out *"Stop!"* after the second clue if any of the products matched his age? The fact that he *needed* the third clue means he was unable to decide between the two options with a product of 36. The third clue decides it. The sons were aged 9, 2, and 2.

Well, the question is: '*What does this little exercise say about intelligence?*' The answer is, '*Very little.'* Solving this type of problem says more about interest and confidence than it does about brain speed and power. Perhaps the best we can say about something like this is that success means a person is unlikely to be *below* average in intelligence, while failure means nothing at all. In a more general vein….*it is always dangerous to make a judgement from a negative outcome.* Often the brightest people can overlook a simple step that others of lesser ability might notice immediately. Be reluctant to judge intelligence by failure. Look for positives. The following story will illustrate what I mean.

A well-known anecdote involving a 'test' of intelligence concerns an ebullient genius named John von Neumann (1903—1957). John was born into a wealthy Hungarian banking family in Budapest on December 28th 1903 and quickly showed a remarkable intellectual capacity. By the age of six he could converse with his father in Ancient Greek and could easily divide two eight-digit numbers in his head. Two years later he had mastered calculus. As he advanced through his teens he quickly established an international reputation in mathematics and in 1930 he was invited to join the Princeton Institute For Advanced Studies—then newly established—as one of its first Professors. Albert Einstein fled Germany for America in January 1933 (when Hitler took power) and became the first Professor of Natural Philosophy (Physics) at the Princeton Institute so young John von Neumann was soon in good company. (Einstein was born in 1879 in the Bavarian town of Ulm, Germany, and died at the Institute in 1955.) Anyway, a Princeton student, having heard about the amazing mental powers of this new mathematics Professor, decided to put him to the test with the 'cyclists and fly problem.' It went something like this. *Two cyclists, thirty km apart on a straight road are cycling at steady speeds towards each other, one at ten km/hr and the other at twenty km/hr. A fly, flying at fifty km/hr, lands on the nose of one cyclist and then immediately takes off and flies to meet the other. After another 'touch and go' on the nose of the second cyclist, the fly returns to meet the first, and so on, back and forth, until the two meet. The question is: How far did the fly travel in total?*

In my younger days I can recall being given this problem myself and in the evening I sat down to have a look at it. I calculated the first three or four distances traveled by the athletic fly and realized that the results were successive terms of an infinite series. Since I knew the formula for the sum of an infinite series I was able to calculate the result quite easily. It was fifty kilometers. I was feeling rather pleased with myself until told by the student who had given it to me that I had '*overlooked the obvious.'* And so I had. The cyclists were coming towards each other with a combined speed of thirty km/hr. Since they started thirty km apart and traveled with no change of speed or direction they would meet after one hour. Now the fly was in the air for the entire time and since it was flying at fifty km/hr it must have covered a total distance of fifty kilometers. Easy. Well, as I said, von Neumann was given this problem and promptly gave the answer; *"Fifty kilometers."* The surprised young man said, *"Congratulations. You know, when most people are given this problem they don't see the easy way and try to work it out as the sum of an infinite series."*
"What easy way?" said von Neumann, *"That's how I did it."*

Okay, what does this little story tell us? Should we conclude that von Neumann was a little dim because, like myself and most others who attempt this problem, he overlooked the simple shortcut to the answer, or should we stand in awe of the intellectual power that allows almost instantaneous mental calculation of both the individual terms and the sum of an infinite series?

Well, we don't have to think about that too much, do we? The story strikes our imagination precisely because such tremendous mental speed is possessed by very few of us indeed. John von Neumann did much to establish the field of Game Theory—now an essential component of business and military strategy—and along with the British genius Alan Turing is regarded as one of the 'founding fathers' of modern computing. In his time he was widely regarded as *"the most intelligent man in the world."*

Quite a title, not easily earned, but the point about both these stories is that any judgement on the level of a person's intelligence should, within reason, be made on positive indicators only, not on negative ones. High intelligence is reliably indicated by success while failure says little or nothing at all. Von Neumann's ability to calculate the answer in his head far outweighs any lack of acumen he may have shown in failing to see the 'easy' way. I'm sure most readers will agree, but it's a point that parents of young children would do well to keep in mind. Over the years I have had contact with many parents worried that their child might be mentally 'slow' and almost always their concern has been based on a *negative comparison*. Equally often their fears have proven groundless. Typically, the conversation has begun something like this:

I am really worried about little Billy, Mr Burnett. I don't think he is making the progress that he should.
What makes you say that, Mrs. Smith?
Well, my neighbor has a little boy the same age and his mother says that already he can tie his shoelaces and that only last week she noticed him sitting in the sandpit reading Plato's 'Republic.' Billy hates wearing shoes and yesterday, when I gave him a copy of 'The Three Little Pigs,' he tried to take a bite out of it!
And so on…..

Well, it's easy to poke fun at a situation like that but it can be a real worry if your child seems to be lagging behind in development compared to others, even allowing for the exaggeration many proud mothers slip into when describing their own nearest and dearest. Perhaps it was actually *Thomas The Tank Engine* in the sandpit rather than *The Republic*. The best advice I can give in a situation like this is *"Don't worry."* After all, as I mentioned earlier, comparisons are made according to the norm of human expectations and, by definition, genius is characterized by *abnormal* behavior. Historical precedents abound. Einstein himself probably provides the best example. It has always been rather fashionable for some to undervalue Einstein's ability, and I can remember being told by a teacher during my own schooldays that "*Einstein may have been clever at Physics but he was hopeless outside that field and couldn't do even the simplest everyday tasks."* Not so, of course. Einstein was a competent recreational sailor, a skilled violin player, maintained contact with a close circle of friends all his life, wrote effectively on a range of topics from Education to Citizenship and, in 1948, was offered the presidency of the fledgling state of Israel. In addition, he found the energy to forever change our ideas about space and time (Special Relativity), lay the foundations of the Quantum Theory, discover $E = mc^2$, study Tensor Calculus, invent the 'curved space' theory of gravity (General Relativity), and win the Nobel Prize. Little wonder that he is often mentioned in the same breath as Archimedes and Newton in any discussion on the greatest ever intellects.

Anyway, leaving aside the question of his later genius, the young Einstein was slow to speak compared to other children of similar age and this caused his parents (Herman and Pauline) real concern. He was their first child and his mother became so worried about his so-called 'problem' that she arranged for him to be examined by a Doctor. She was quickly reassured. Albert was fine, but it shows how easily parents can come under pressure if their child does not conform to the established norms. Apart from the odd temper tantrum, commonly displayed by all young children at some time or other, Albert seemed quiet but otherwise perfectly normal. It was only when his disinclination to talk was measured against other children of his age that a difference became apparent. There was nothing wrong with him; it was simply in his nature to prefer thought rather than speech. Nothing changed when he began his formal schooling either. Albert was friendly to his fellow pupils but introspective and solitary by nature, often wrapped in his own thoughts. Much to his mother's relief he performed at or near to the top of his class, but from the very beginning he rebelled against the strict discipline and rote learning typical of the German schools of the day. He hated being forced to learn material that was outdated or otherwise did not interest him, regarding the whole business as totally counter productive. In later life he said: *"When I was young the only thing that interfered with my learning was my education."* Forced learning is poor learning. Avoid it for your children if you possibly can.

I will have more to say about education and its problems in the next issue of ***GEPQ*** but a turning point came for Einstein in 1884. The incident shows how even minor events that might occur early in childhood can have an effect out of all proportion to their perceived importance. Often children can be influenced for life, as was true in this case. What happened? Outwardly, not much. Albert was five years old and his father gave him a compass. Nothing very significant in that, you might think, but the simple instrument amazed him. He turned it around and around with fascination. How could the needle possibly 'know' which way was North and never be wrong, even in the dark? What was making it move? To the fascinated child it was obvious that there had to be something at work……but what? Whatever it was certainly couldn't be heard, felt, or seen, so what other forces, equally well hidden, might be operating all

around us? How could we possibly learn about them? From this simple incident, Einstein's urge to examine the world around him took hold and remained with him all his life. The rest, as they say, is history. If any reminder is needed, Einstein's fascination with the compass confirms the importance of positive early experiences on developing young minds. Early education is really important……but it must be right. More harm than good can easily result if it isn't.

In the next issue I will outline a few thoughts, culled from my own experience, on what I think are key factors involved in the development of intelligence. I will also describe an innovative system that I have seen operating successfully in High Schools here…..perhaps not the whole answer to the problem of educating gifted pupils in regular classrooms but a good compromise between the ideal and what is, all too often, the grim reality. ʊʊʊʊʊʊʊʊʊ ʊʊʊʊʊʊʊʊʊ

ONE MINUTE TEST-TAKING TIPS

Excerpted/modified from book *HOW THE BEST HANDLE STRESS* (Warren Publishing, ©2003)
BY RONALD L. RUBENZER

The "Testing Triathlon": Being Fact-Smart; Test-Smart; Stress-Smart

Top test performance requires developing ***three different types of smartness***, tapping into different "brain-domains": Students must be **Fact-Smart (Left-Brain); Test-Smart (Left & Right-Brain)** and **Stress-Smart (Right-Brain).** If one thinks of testing today as a Triathlon, success is assured. Test-Triathlon training could begin three months before the big event. Build skills with several short sessions weekly.

Of course, you use many parts of your brain when thinking, but different parts are used to varying degrees based on the task at hand. This is like the fact that you use much of your body just to drink a glass of water, but different parts of your body are more or less involved (eyes, hand, arm, shoulder, back muscles and hopefully your mouth).

TOP TEN TEST-TAKING TIPS (THREE MONTHS PRIOR TO TEST)

Left-brain training **to become Fact-Smart:**

❑ 1) Teach positively: Students learn more when they like the teacher (William James-Harvard, 1899).
❑ 2) Teach memory mechanics. The basic rule is repetition, repetition, repetition.
❑ 3) Require students to develop their own flashcards and stack the deck with only the memorized facts.
❑ 4) Answer the core question, without being tripped up by "word traps" (irrelevant details) or generalizations (always, never, everywhere).

Both-brain training **to become Test-Smart:**

❑ 5) Be clerically correct: For the young, when in doubt, check their skills out (attention, handwriting, reading skills).
❑ 6) Provide "test rehearsals" (if approved). All great performances start with rehearsal.

Right-brain training **to become Stress-Smart:**

❑ 7) Test for test-anxiety. "Stress is sand in the machinery of thought." All classes will have "test-anxious" students. "Test-anxious" or "math-anxious" students underachieve on tests. As adults they avoid rewarding jobs requiring many tests or using complex math. "Computer-phobics" short-circuit their own growth by just plain refusing to acquire 21st century skills. The "anxious" resist change.
❑ 8) Consume "food for thought" just before the test session. Eat fruit, followed by a drink of water.
❑ 9) Relax: See your mental health professional on test-anxiety reduction tips. Use humor to relax. See a movie the night before the "big event."
❑ 10) Learn from those who do best-on-tests. Test-Prep can boost test scores by 10%! (Scruggs & Mastropieri, Purdue University, 1992).

Regarding the reasoning component of testing, there are some possible ways to help a child's verbal reasoning:

Very basically, building vocabulary, learning to see the relationships between ideas and things and building a child's social intelligence (problem solving) would be useful. Teaching a child basic math reasoning principles are important (making change, etc.). Playing scrabble, crossword puzzles, and reading beyond one's grade level would appear to be helpful. Taking AP courses whenever possible is also useful. Taking Latin would be a great vocabulary builder and would help with grammar (which the New SAT requires).

Dr. Rubenzer (Certified as School Psychologist III, Principal, Gifted Education Doctorate-Columbia University); licensed Psychological Associate, Health Services Provider.1-336-272-8090) has tested well over 2,500 individual students from preschoolers through college age. He now does private testing in Greensboro NC, writes, does SAT prep and conducts workshops on "enjoying wellness while improving performance and quality of life at home, work and school."

TRIBUTE TO A GREAT OPERA SINGER: ROBERT MERRILL (1917-2004)

BY MICHAEL E. WALTERS CENTER FOR STUDY OF THE HUMANITIES IN THE SCHOOLS

". . .At the old house, whenever I walked in, I had that marvelous feeling – what am I doing here, a kid from Brooklyn?" The New York Times, Obituary, October 26, 2004.

This was a comment made by the American operatic baritone, Robert Merrill, who died in October 2004. His life represents a profile in giftedness. He grew up in a Polish-Jewish neighborhood in the Williamsburg section of Brooklyn, New York. His mother was an aspiring soprano who was discouraged by her family from engaging in a musical career. Later she became her son's mentor for his musical development.

As a child, he suffered from a serious stutter that was only alleviated when he sang. He originally wanted to be a baseball player, and he even played semi-pro baseball for awhile. While working as a mover of clothes racks in Manhattan's garment district, he passed by the old Metropolitan Opera House located between 39th and 40th Streets on Broadway where the opera star, Lawrence Tibbett, was rehearsing. Mr. Merrill was so impressed that he wanted to become an opera star like Mr. Tibbett. One of the leading voice teachers in New York City, Samuel Margolis, offered to teach Merrill gratis after hearing him sing.

His first tryout at a Met audition (in 1941) was a failure. He then had a job singing at a summer resort in the Catskills, New York. There he encountered an agent, Mo Gale, who found work for him in Radio City Music Hall and with the NBC Concert Orchestra. At the same time, he would make occasional appearances on radio station WFOX singing popular songs of the 1940s. Besides Mr. Tibbett his other role model was Bing Crosby.

After he was accepted by the Metropolitan Opera in 1945, Mr. Merrill sang for over three decades with this world renowned organization. Among his specialties were the Italian and French opera repertoires, e.g., ***La Traviata*** and ***Carmen***. Recently I had a discussion with someone who knew Mr. Merrill personally. This individual worked for the law firm that was the legal counsel for the Metropolitan Opera. He gave me several important facts about Mr. Merrill's life and personality: Sir Rudolf Bing, the Director of the Met from 1950-72, told my friend that Mr. Merrill was one of the most reliable and competent performers he ever dealt with. Also, Bing indicated that Mr. Merrill performed with such ease and grace. He was a late bloomer (for an opera singer) who discovered his talent in his late teens. My friend also said Mr. Merrill was famous for singing the National Anthem for the New York Yankees on opening day (for three decades) and during their World Series appearances. In addition, he sang at Jewish religious ceremonies, e.g., bar mitzvahs.

Robert Merrill was part of a generation of talented opera singers, including Jan Peerce and Richard Tucker, who all possessed similar social backgrounds. Among his other close friends were African-American opera stars such as Marian Anderson, William Warfield, Jerome Hines and Leontyne Price. Robert Merrill's profile of giftedeness shows that he, like his professional colleagues, came from a modest social background. Although many of the patrons of opera have traditionally been wealthy, it is ironic that the greatest performers have been from the working and middle classes. Opera has indeed been a workshop for the development of giftedeness.