

Mathematics, Science, and George MacDonald

David L. Neuhouser
Taylor University

George MacDonald was a nineteenth century preacher, poet, novelist, and the foremost Victorian author of fairy tales. He wrote thirty novels, several volumes of poetry, five volumes of sermons, numerous fantasy stories, and three volumes of literary criticism. C. S. Lewis called him his master and said that he quoted from him either directly or indirectly in all of his books. More about his life and works can be found on the internet at www.tayloru.edu/cslewis.

In writing about George MacDonald choosing a college major, one of his biographers wrote that he chose “chemistry, a strange choice perhaps for a future novelist and poet and not an easy one for him to make.” (Raeper, p. 43) He further conjectured that MacDonald’s choice was based on “common sense and sound economics” rather than “his poetic yearnings.” (Raeper, p. 44) He also suggested that the study of chemistry did not sit easily on his sensibilities.” (Raeper, p. 44) Many would agree with the biographer that science is a strange choice for a future poet and novelist. However, I believe that the role of beauty and imagination is very similar in science, mathematics and literature, so it might not be so strange that someone could enjoy and appreciate mathematics and science as well as literature.

Many students, even mathematics majors, are surprised when hearing the claim that mathematics is beautiful. However mathematics and science are activities

“...of creative and imaginative human beings, not of computers or other machines. The creativity and imagination must be controlled by discipline and self-criticism, but that is equally true of other kinds of creative activity such as the writing of poetry. And because it is a creative and imaginative activity, there are satisfactions in engaging in it no different from those felt by creative artists in their work, and there is a beauty in the results that can be enjoyed by others in the same way that poems, pictures, and symphonies are.” (Goldstein, p. 4)

This view of mathematics and science could be supported by quotations from many famous scientists and mathematicians.

Some of MacDonald’s friends were interested in both the sciences and the arts. Charles Dodgson, a friend of MacDonald. was one of the most imaginative and creative authors of children’s books in the nineteenth century. Dodgson taught mathematics at Oxford University and under the pen name of Lewis Carroll wrote the Alice stories. John Ruskin, another friend, “was something of a polymath and he felt profoundly that every area of life was related to every other.” (Raeper, p. 215) Lady Byron, his friend, benefactor, and widow of the poet, “was fond of theology and mathematics and had written one or two

poems herself.” (Raeper, p. 132) Lady Byron’s daughter was an accomplished mathematician.

This paper explores the following questions. Did MacDonald understand the similarity between the role of imagination and beauty in mathematics, science, and literature? Did he enjoy studying and teaching mathematics and science? Did he believe that the study of mathematics and science tended to deaden the imagination and the enjoyment of beauty or did he believe that mathematics and science could enrich the imaginative and spiritual life? Did his views change over time?

MacDonald loved and revered his father, and so an interest in and love of the sciences could have developed from his father’s views. According to one report, “On one occasion his [George MacDonald’s father’s] prayer was full of the wonders of the telescope.” Obviously, his father believed that science aided one in praising God. (Raeper, p. 22) In a letter to his father, Nov. 1845, he wrote, “I am reading just now a recent publication, Darwin’s account of a voyage round the world, which, though in many places too scientific for me as yet, I think you would enjoy very much...” (Greville, p.93) So his father must have been enthusiastic about science. In any case George did study chemistry, natural philosophy, and mathematics at Kings College in Aberdeen. Natural philosophy, a precursor of physics, was the study of nature and the physical universe.

On graduating from King’s College, MacDonald thought about studying medicine, but did not, probably because of lack of finances. However, his interest in medicine continued. Later he wrote an essay on “The History and Heroes of Medicine,” that was published in *A Dish of Orts*. Four of his fictional heroes, Paul Faber, Alec Forbes, Willie MacMichael, and Mr. Christopher were doctors, and his oldest son, Greville, became a medical doctor.

At various times throughout his life, he taught mathematics and science. “. . . he taught arithmetic at the Aberdeen Central Academy from February to November, 1843 ‘with great spirit and skill’ in the words of Mr. Thomas Merton, the school’s headmaster.” (Raeper, p.50) In 1849, at Highbury College, where he was studying for the ministry, MacDonald gave his fellow students “one free lecture a week in Chemistry.” (Raeper, p. 73) “With a University degree and his three years’ experience of teaching, he was so much above his fellow students that his volunteered help – to dull students, or in the Chemistry class he instituted – was much appreciated.” (Greville, p. 115) In 1854, MacDonald, “besides lecturing on English Literature and Natural Philosophy, . . . held classes in mathematics” at the Ladies’ College in Manchester. (Greville, p. 218) Louisa wrote to George in 1854 when he was in Manchester,

“I am so pleased that you are going to interest yourself with your loved chemistry again. I think it will make you much happier than anything else you could have just now. . . “I am so glad, dearest George, that you are really going to begin the wonders of your Cabalistic art - . . . I shall not be afraid of the magic of your bottles and crucibles and liquids and essences and shall only be too delighted to be admitted into your mystic chamber or laboratory sometimes.” (Greville, p. 73)

In 1860, "He had been asked to lecture on Natural Philosophy at Bedford College [a Ladies College in London] in addition to his own subject, English Literature." (Greville, p. 325) Then in a letter to his wife, Jan. 6, 1860, "Will you tell Mrs. Reid [Principal of Bedford College] that I will make trial of the Natural Philosophy. I have very little doubt I shall succeed. I know plenty for them and know it well, too..." (Greville, p. 325) This at least shows his confidence in his understanding of science and his willingness and enthusiasm to teach it to others.

In an essay, MacDonald expressed his views about the role of imagination in science.

"'But the facts of Nature are to be discovered only by observation and experiment.' True. But how does the man of science come to think of his experiments? Does observation reach to the non-present, the possible, the yet unconceived? . . . It is the farseeing imagination which beholds what might be a form of things, and says to the intellect: 'Try whether that be not *the* form of things;' which beholds or invents *a* harmonious relation of parts and operations, and sends the intellect to find out whether that be not *the* harmonious relation of them – that is, the law of the phenomenon it contemplates. . . . Lord Bacon tells us that a prudent question is the half of knowledge. Whence comes this prudent question? we repeat. And we answer, From the imagination. . . . And the construction of any hypothesis whatever is the work of the imagination. The man who cannot invent will never discover. The imagination often gets a glimpse of the law itself long before it is or can be *ascertained* to be a law." (*Dish of Orts*, p. 12-3)

MacDonald quoted Coleridge as saying "that no one but a poet will make any further *great* discoveries in mathematics and Bacon says that 'wonder,' that faculty of the mind especially attendant on the child-like imagination, 'is the seed of knowledge.'" (*Dish of Orts*, p. 12-3) This shows MacDonald's belief that poetry and science are similar enough that one is an aid in the other. It is likely that he believed that poetry develops the imagination in ways that increases one's ability to discover new mathematics. In one of his novels, MacDonald says of his hero, ". . . already he saw a glimmer here and there in regions of mathematics from which had never fallen a ray into the corner of an eye of those grinding men – and that was mainly because he read books of poetry and philosophy of which they had not heard." (*Castle Warlock*, p. 164)

In the *Marquis of Lossie*, he refers to the "secret of life", actually the Christian Gospel, as "the vital germ of all that is lovely and graceful, harmonious and strong, all without which no poet would sing, no martyr burn, no king rule in righteousness, no geometrician pore over the marvelous *must*." (*Marquis of Lossie*, p. 249) No matter what he might have meant by all of that, the last phrase shows his love and appreciation for proof in mathematics and his belief that mathematics is beautiful.

The fact that many of the heroes and heroines in MacDonald's novels love mathematics is evidence of MacDonald's love of it. For example, the Christian mentor of Malcolm in *The Marquis' Secret* said, "A bit of bread and cheese before I go to bed is all I need to sustain nature, and fit me for understanding my proposition in Euclid. I have been in the habit, for the last few years, of reading one every night before I go to bed." (*Marquis of Lossie*, p. 109) In the same novel, in order to control his spirited horse, Malcolm sat on the horse's head until it calmed down and quietly traced "a proposition of Euclid on the sand with his whip." (*Marquis of Lossie*, p. 167)

The girls as well as the boys in MacDonald novels love and do well in math. In *Castle Warlock*, Cosmo explains to a friend, "You see Miss Elsie, Aggie and I were at school together and happened to take up mostly with the same things, in particular with algebra and geometry, and so can hardly hold our tongues from them when we are together." [Rough translation from the Scottish dialect] Their teacher said that Aggie understood Euclid and algebra "better than any boy he had ever had to teach, Cosmo himself included." (*Castle Warlock*, p. 223)

MacDonald characters love science, as well as mathematics. Willie, in *Gutta Percha Willie*, is a mechanical whiz with levers, waterwheels, kites, locks, etc. and becomes a medical doctor.

"He [Willie] would show her [his eight year old sister] such lovely things! – for instance, liquids that changed from one gorgeous hue to another; bubbles that burst into flame, and ascended in rings of white revolving smoke; light so intense, that it seemed to darken the daylight. . . Willie found it very amusing to hear Agnes, who was sharp enough to pick up not a few of the chemical names dropping the big words from her lips as if she were on the most familiar terms with the things they signified – *phosphuretted hydrogen, metaphosphoric acid, sesquiferrocyanide of iron*, and such like." (*Gutta Percha Willie*, p. 178)

In *St. George and St. Michael*, one of the characters, Lord Herbert, is a mechanical genius and invents many wonderful machines. (see pages, 89, 123f, 133f) Other characters discuss Euclid in a fishing boat during a storm or draw diagrams in the sand while studying a proof. Two brothers discuss the "metaphysical necessity for the sine, tangent, and secant of an angle belonging to it's supplement as well" (*What's Mine's Mine*, p. 95) In another novel, the hero is found nearly frozen in a snowstorm and in his delirium is murmuring something about conic sections. Probability in gambling and life insurance problems, ellipsoids, polyhedra, parallelograms, trapeziums, Arabic numerals, trigonometry, and calculus all appear in his novels.

His love for science and mathematics is shown in his fantasies as well as in his other writings. For example, in *Lilith*, a fantasy for adults, the protagonist, Mr. Vane, says I devoted a good deal of my time . . . to the physical sciences. It was chiefly the wonder they

woke in me.” (*Lilith*, p. 1) One of the devices in *Lilith* is that the hero travels to a space of seven dimensions thus anticipating some of the modern physical theories of our universe. His guide on his journeys through this strange universe, “spoke much about higher dimensions, telling me there were many more than three, some of them concerned with powers which were indeed in us but of which as yet we knew absolutely nothing.” (*Lilith*, p. 41) Vane meets some children who are good but naïve and seem to be incapable of growth. His thoughts about them were, “Knowledge no doubt made bad people worse, but it must make good people better. I was convinced they would learn mathematics.” (*Lilith*, p. 69)

So far all of the evidence in this essay has shown that MacDonald had a deep appreciation for mathematics and science. However, there are a number of indications that he had reservations about the value of each. While he was still a college student he wrote to his father, “I am in some doubts whether or not I should study Chemistry.” (Raeper, p.46) And later, he wrote, “What a mercy I was not allowed to follow out Chemistry!” (Greville, p. 108) He “worried that the study of science would damage his ability to write poetry.” (Raeper, p. 46)

Although he appreciated the role of imagination in science, he seemed to consider it to be inferior to its role in poetry. “In the scientific region of her duty of which we speak, the Imagination cannot have her perfect work; this belongs to another and higher sphere than that of intellectual truth – that, namely, of full-globed humanity, operating in which she gives birth to poetry – truth in beauty.” (*Dish of Orts*, p. 14-5) In contrasting Science with Nature, he wrote, “I would not be supposed to depreciate the labors of science, but I say its discoveries are unspeakably less precious than the merest gift of Nature, those which, from morning to night, we take unthinking from her hands.” (*Unspoken Sermons*, p. 197) “Let a man go to the hillside and let the brook sing to him till he loves it, and he will find himself far nearer the fountain of truth than the triumphal car of the chemist will ever lead the shouting crew of his half-comprehending followers.” (*Unspoken Sermons*, p. 69)

He explains the difference between science and poetry in the following passage:

“Ask a man of mere science, what is the truth of a flower: he will pull it to pieces, show you its parts, explain how they operate, how they minister each to the life of the flower, he will tell you what changes are wrought in it by scientific cultivation; where it lives originally, where it can live; the effects upon it of another climate; what part the insects bear in its varieties – and doubtless many more facts about it. Ask the poet what is the truth of the flower and he will answer: ‘Why, the flower itself, the perfect flower, and what it cannot help saying to him who has ears to hear it.’ The truth of the flower is not the facts about it, be they correct as ideal science itself, but the shining, glowing, gladdening, patient thing throned on its stalk – the compeller of smile and tear from child and prophet.” (*Unspoken Sermons*, p. 63-4)

It seems that, although he enjoyed science, it eventually disappointed him. An old shoemaker in *Donal Grant* says,

“‘The heavens declare the glory of God, and the firmament showeth his handiwork.’ I used, when I was a lad, to study astronomy a little, in the hope of better hearing what the heavens declared about the glory of God: I would fain understand the speech the day cried across the night to the other. But I was very disappointed. The things the astronomer told simple folk were very wonderful, but I couldn’t find in my heart that they made me think any more of God than I did before. I don’t mean to say they might not be competent to work that in another, but it wasn’t my experience.” [Rough translation from the Scottish dialect] (*Donal Grant*, p. 166)

Notice that the shoemaker does not claim that astronomy would be of no value to anyone in learning more about God, only that it had not helped him.

In *What’s Mine’s Mine*, Ian is helping two young ladies to learn from nature and uses some astronomy to help.

“Look up,” he said, “and tell me what you see. – What is the shape over us?”

“It is a vault,” replied Christina.

“A dome – is it not?” said Mercy.

“Yes a vault or a dome, recognizable at the moment mainly by its shining points. This dome we understand to be the complement or completing part of a correspondent dome on the other side of the world. It follows that we are in the heart of a hollow sphere of loveliest blue, spangled with light. Now the sphere is the one perfect geometrical form. Over and round us then we have the one perfect shape. I do not say it is put there for the purpose of representing God; I say it is there of necessity, because of its nature, and its nature is its relation to God. It is of God’s thinking; and that half-sphere above men’s heads, with influence endlessly beyond the reach of their consciousness, is the beginning of all revelation of men to God. (*What’s Mine’s Mine*, p.213)

So far Ian is just using nature, not science, to help the young ladies learn more about God. But then he uses the current scientific view to help in that understanding of God.

“Think then how it would be if this blue sky were plainly a solid. Men of old believed it a succession of hollow spheres, one outside the other; it is hardly a wonder they should have had little gods. No matter how high the value of the inclosing sphere; limited at all it could not declare the glory of God, it could only show His handiwork. In our day it is a sphere only to the eyes; it is a foreshortening of infinitude that it may enter our sight; there is no imagining of a limit to it; it is a sphere only in this, that in no one direction can we come nearer to its circumference than in another. This infinitive sphere, I say then, or, if you like it better, this spheric infinitude, is the only figure, image, emblem, symbol, fit to begin us to know God.” (*What’s Mine’s Mine*, p. 214)

It must have been scientists, especially astronomers, who changed our view from that held by “men of old” to the view “in our day.” In this case science helps. So as we read the novels, we must keep in mind that characters may differ from one another and that they may be at different stages in their development. I believe that this is a clue to other apparent contradictions in MacDonald’s statements concerning mathematics and science. MacDonald’s views may have changed over time.

In *Castle Warlock*, Cosmo tells how his ideas about nature changed as his “scientific knowledge” increased. He starts by telling how a mountain stream refreshes him. “Always when he grew weary, or when the things about him put on a too ordinary look, he would seek this endless water. Let the aspect of this be what it might, it seemed still inspired and sent forth by some essential mystery, some endless possibility.” (*Castle Warlock*, p. 5) When he learned that the water came from the sky he was even more delighted. But then he “discovered something sad about the stream.” (*Castle Warlock*, p. 5) The water in the sky came from the ocean, which in turn got it from the stream.

‘Like a great dish, the mighty ocean was skimmed in particles invisible; these were gathered aloft into sponges all water and no sponge; and thence through many an airy, many an earthly channel deflowered of its mystery, his ancient, self-producing fountain to a holy, merry river, was *fed*, - only *fed*! It was but a cistern after all! He grew very sad, and well he might. Moved by the spring eternal in himself, whereof the love in his heart was a river-shape, he turned away from the deathened stream, and without knowing why sought the humanity in the castle.’ (*Castle Warlock*, p. 5)

There seem to be stages in one’s development or in the path of learning of science. Thus, for a while science reveals more beauty and mystery but then it seems to destroy that beauty and mystery.

How do we reconcile his obvious delight in mathematics and science and his disappointment with them? I believe that resolution comes in his essay, “A Sketch of

Individual Development.” He describes several steps in individual development. He starts by comparing Science and Poetry.

“For at the entrance of Science, nobly and gracefully as she bears herself, young Poetry shrinks back startled, dismayed. Poetry is true as Science, and Science is holy as Poetry; but young Poetry is timid and Science is fearless, and bears with her a colder atmosphere than the other has yet learned to brave. It is not that Madam Science shows any antagonism to Lady Poetry; but the atmosphere and plane on which alone they can meet as friends who understand each other, is the mind and heart of the sage, not of the boy. The youth gazes on the face of Science, cold, clear, beautiful; then, turning, looks for his friend – but alas! Poetry has fled.” (*Dish of Orts*, p. 51)

Notice, that it is in the mind and heart of the boy where science destroys poetry, not in the mind and heart of the sage. There is more development to come. Analysis seems to kill. “From quantitative analysis how shall he turn again to ‘the rime of the ancient mariner,’ . . . ‘What is the storm to me any more!’ he cries; ‘it is but the clashing of countless water-drops!’” (*Dish of Orts*, p. 51) But then when man comes into the picture, there is still mystery; and hope returns.

“He finds relief in the discovery that, the moment you place man in the midst of it the clashing of water-drops becomes a storm, terrible to heart and brain: human thought and feeling, hope, fear, love, sacrifice, make the motions of nature alive with mystery and the shadows of destiny. The relief, however, is but partial, and may be but temporary; for what if this mingling of man and Nature in the mind of man be but the casting of a coloured shadow over her cold indifference? What if she means nothing – never was meant to mean anything!” (*Dish of Orts*, p. 51-2)

Alas the joy is only temporary. We have already passed from joy to disappointment back to joy and then to disappointment again.

But then another element is added, love. “When love awakes, he forgets himself for a time, and many a glimpse of strange truth finds its way through his windows, blocked no longer by the shadow of himself. . . . The changelessness amid change, the law amid seeming disorder, the unity amid units, draws him again. He begins to descry the indwelling poetry of science.” (*Dish of Orts*, p. 54-5) So, again the disappointment was only temporary. But, alas, the process continues, for as MacDonald poetically describes an evolutionary process, the joy departs again. “. . . soon comes a change. So far as he can see or learn, all the motion, all the seeming dance, is but a rush for death, a panic flight into the moveless silence. The summer wind, the tropic tornado, the softest tide, the fiercest storm, are alike the tumultuous conflict of forces, rushing, and fighting as they rush, into the arms of eternal negation.” (*Dish of Orts*, p. 56-7) However, this is not the end either.

“Then a dim light breaks upon him, and with it a faint hope revives, for he seems to see in all the forms of life, innumerably varied a spirit rushing upward from death – a something in escape from the terror of the downward cataract, of the rest that knows not peace. ‘Is it not,’ he asks, ‘the soaring of the silver dove of life from its potsherd-bed – the heavenward flight of some higher and incorruptible thing? Is not vitality, revealed in growth, itself an unending resurrection?’ The vision of the oneness of the universe, ever reappearing through the vapours of question, helps to keep hope alive in him.”

But which is the correct view? What if it all means nothing? Then there is only despair. If science is all there is then there is no hope. However, “He cannot believe that its structure exists for the sake of its laws; that would be to build for the sake of its joints a scaffold where no house was to stand. Those who put their faith in Science are trying to live in the scaffold of the house invisible.” (*Dish of Orts*, p. 58) Science alone will always eventually disappoint.

Then he turns to poetry for a time. “He finds harbour and comfort at times in the written poetry of his fellows. . . For a moment, the fine figure, the delicate phrase, make him jubilant and strong; but the jubilation and the strength soon pass, for it is not any of the *forms*, even of the thought-forms of truth that can give rest to his soul.” (*Dish of Orts*, p. 58-9) So poetry alone cannot satisfy either. Is there anything else? “History attracts him little, for he is not able to discover by its records the operation of principles yielding hope for his race. Such there may be, but he does not find them.” (*Dish of Orts*, p. 59)

Then, at last, MacDonald claims to have found the answer.

“But through all the man’s doubts, fears, and perplexities, a certain whisper, say rather, an uncertain rumour, a vague legendary murmur, has been at the same time about, rather than in, his ears – never ceasing to haunt his air, although hitherto he has hardly heeded it. He knows it has come down the ages and that some in every age have been more or less influenced by a varied acceptance of it. . . It is the story of a man, represented as at least greater, stronger, and better than any other man. With the hero of this tale he has had a constantly recurring, though altogether undefined suspicion that he has something to do. . . .” (*Dish of Orts*, p. 65-6)

His conclusion is, “Fact or not, the existence of a God such as Christ, a God who is a good man infinitely, is the only idea containing hope enough for man!” (*Dish of Orts*, p. 70) MacDonald concludes the essay with his usual message of obedience leading to knowledge of God and that is what gives meaning to science, poetry, history, and all of life.

He said the same thing in the quotation given earlier from *The Marquis of Lossie*, where he said the "secret of life", actually the Christian Gospel, is "the vital germ of all that is lovely and graceful, harmonious and strong, all without which no poet would sing, no martyr burn, no king rule in righteousness, no geometrician pore over the marvelous *must*." (*Marquis of Lossie*, 9. 249) That is, God as revealed in Christ is what gives meaning to poetry, mathematics, and, in fact, everything else. And, nothing else by itself has meaning, not even poetry.

The resolution to what seem to be contradictory views in MacDonald is that it was a process for him; science and mathematics delighted him, and then disappointed him. They only can delight if there is a loving Father God behind it all. But if there is, then they can be a great source of joy.

MacDonald quotes Goethe, "This to God's children is full measure, It edifies and gives you pleasure." His comment then is, "This is true concerning every form in which truth is embodied, whether if be sight or sound, geometric diagram or scientific formula." (*Dish of Orts*, p. 195)

Early in this paper several questions were raised. Did MacDonald understand the similarity between the role of imagination and beauty in mathematics, science, and literature? I believe that he did understand that similarity and that his views on that are in complete agreement with most mathematicians and scientists. Did he enjoy studying and teaching mathematics and science? I believe that his novels and letters show that he did enjoy them very much, although he went through periods of doubt about their value. The essay on "Individual Development" clarifies the stages through which he went. And I believe he thought that every thoughtful person who studies science and mathematics would go through at least some of these stages. Did he believe that the study of mathematics and science tended to deaden the imagination and the enjoyment of beauty or did he believe that mathematics and science could enrich the imaginative and spiritual life? I believe that his final conclusion was that they could be enriching. The fact that his views changed over time accounts for the varying views that he expressed in letters, essays, and sermons and the views expressed by characters in his novels. Since he believed in individual development, it is not surprising that his fictional characters would show those changing views.

I will conclude this paper with the following quotation from MacDonald's essay, "The Imagination" from *A Dish of Orts*.

"The Glory of God is to conceal a thing, but the glory of the king is to find it out,' says Solomon. [Prov.25:2] 'As if,' remarks Bacon on the passage, 'according to the innocent play of Children, the Divine Majesty took delight to hide his works, to the end to have them found out; and as if kings could not obtain a greater honour than to be God's playfellows in that game.' One more quotation from the book of Ecclesiastes, setting forth both the necessity we are under to imagine and the comfort that our imagining cannot outstrip God's making.

‘I have seen the travail which God hath given to the sons of men to be exercised in it. He hath made everything beautiful in his time; also he hath set the world in their heart, so that no man can find out the work that God maketh from the beginning to the end.’

Thus to be playfellows with God in this game, the little ones may gather their daisies and follow their painted moths; the child of the kingdom may pore upon the lilies of the field, and gather faith as the birds of the air their food from the leafless hawthorn, ruddy with the stores God has laid up for them; and the man of science

‘May sit and rightly spell
Of every star that heaven doth shew,
And every herb that sips the dew;
Till old experience do attain
To something like prophetic strain.’”
Dish of Orts, p.41-2

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