Cloud Illusions

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I've looked at clouds from both sides now
From up and down, and still somehow
It's cloud illusions I recall
I really don't know clouds at all...
(from the song Both Sides Now, by Joni Mitchell)

How do you know what you see? As a teacher, I am continuously wondering how students know, and how they learn to know. As a scientist, I try to encourage others to base their knowledge on observation, questioning, experimenting, analysing, and looking for evidence.

Sometimes I am perplexed at how difficult this process can be. And at how the process of "knowing" is both facilitated and complicated by our use of language, and our reliance on social norms and voices of authority.

For example, yesterday I conducted a class for upper-primary school students on the topic of clouds. I began the class by giving each student a large sheet of plain white paper and some coloured pencils, and brought them outside to observe clouds and draw what they saw.

At the time, the sky was bright blue, with fairly small clouds scattered here and there.

The only instructions I gave them were to look carefully, draw what they saw, and use only those colours that they see in the sky. I said, "If you see green then use a green coloured pencil – if you see red then use a red coloured pencil. If you see black then use a black pencil."

I was doing this after years of seeing the children draw blue clouds on white backgrounds in their stereotypical pictures of mountains, sky and clouds. I had always wondered why they always seemed to make the clouds blue.

This time was the first time that I found the students at this school making clouds that were not blue. They drew nice big pictures, using an entire page for one picture. The results were child-like, but much more interesting that the carefully coloured geometric 'clouds' they had been in the habit of making previously.

While we were still outside, we also had a brainstorming session on what words describe the clouds. These are the words the students came up with to describe the clouds they were looking at: fluffy, large, different sizes, clear, white, blue ("Blue what?" "Blue sky"), soft, light - thin, like cotton wool, like snow, big, joined, shaped like a bird's face, shaped like a crocodile, a swimming pool, a map, no flies, a few birds, spreading out, disappearing, lesser clouds than sky. I noted down all their responses.

Today, I posted all their pictures on the walls of the classroom. We had a discussion on what they had done yesterday.

I asked the students some questions about the pictures of clouds they had drawn. Almost all the pictures showed white clouds (the uncoloured paper) and blue sky.

Only one or two students had drawn black outlines around the clouds with pencils. When I pointed to one of these and asked the class if this was the way the clouds really looked, they agreed that there actually were no black outlines.

One or two students had used a white coloured pencil on the white paper to show the clouds (maybe not having time to colour the sky in, or maybe not finding it necessary), with the result that the picture could hardly be seen.

I had also written the students' list of words to describe clouds on the board. I asked the class if they thought the words they had used were accurate. There were some differences of opinion here.

Then I asked the students to look out the window and tell what the clouds looked like today - were they the same or different? (Today was an overcast day.)

We didn't have time to go out, but the students crowded at the windows to get a good look. They said that it looked different now.

A few students said that today the sky is "clear". I asked them what they mean by "clear". They said, "There are no clouds." I asked them, "What is the colour of the sky, then?" They said, "The sky is white".

I pointed out that the other day they had said that the sky is blue and the clouds are white. They said that today the colour of the sky has changed.

One student said that he thinks the sky is white because it is completely covered with clouds. The rest of the class burst out laughing at this absurdity.

I said, "Well now some of you think the sky has no clouds, and others think the sky is completely covered with clouds. How can we find out who is right?"

I wrote the word "overcast" on the board and ask them what it meant. They said it meant that the sky is covered with clouds.

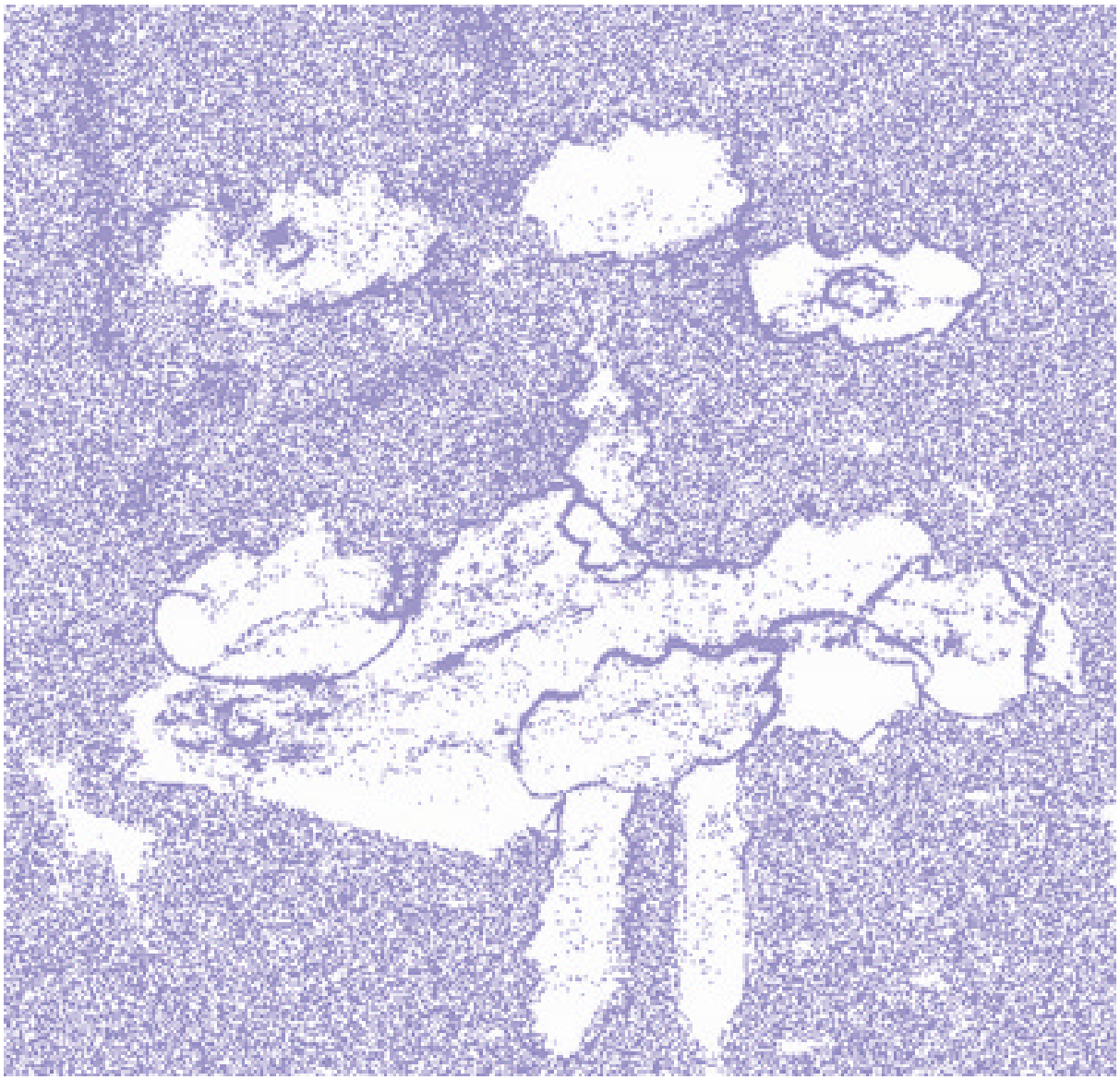
By this point we were already past the time for the end of the class, so we couldn't continue. I just told the students that if they took a trip in an airplane today, they would eventually get to a height where the sky would look blue - actually the white colour is due to clouds. They didn't seem ready to believe this, though. (A voice of authority is not always convincing.) And they certainly were not going to take a trip on an airplane! Later I thought I should have asked them why they can't see the sun if the sky is really clear. But we would have had to go outside for that, and actually sometimes these days the sky is hazy, looking completely white, but the sun is still shining and shadows are clearly visible.

This activity also got me to look more carefully at the sky, and now I am finding that the colours of clouds are surprisingly variable. I know that the colours of the sky and the clouds are due to the particular characteristics of absorption, reflection, and scattering of different gases. But it is not that simple.

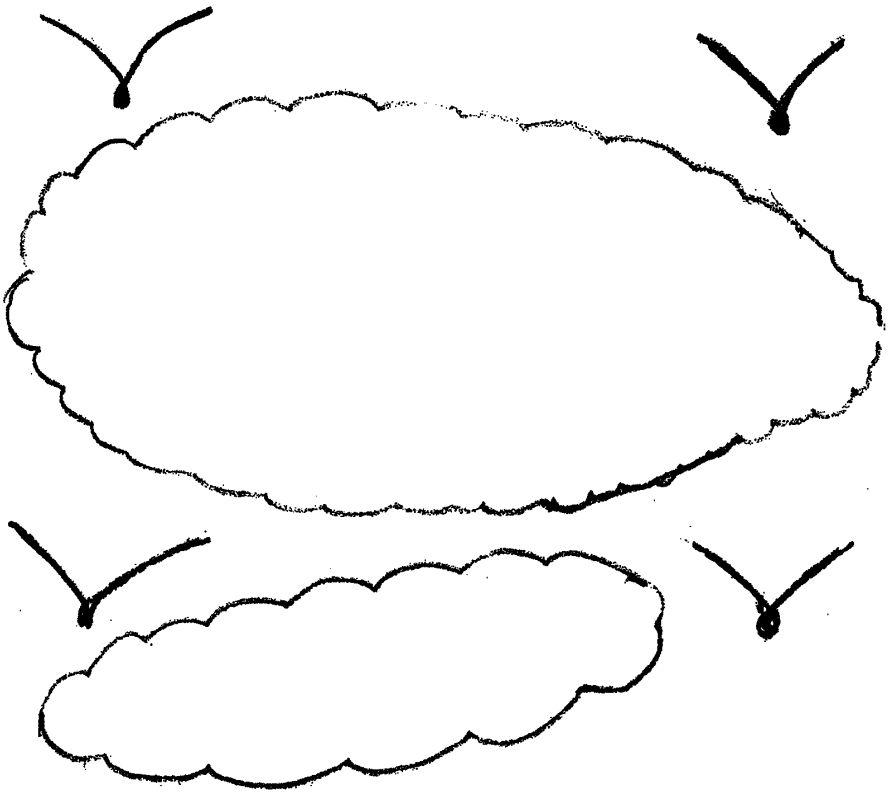
The colours we see are also depend on our social and individual experience and expectations. We expect water to be blue because we have seen the blue sky reflected in lakes and rivers. Will even a glass of water be blue? If the deep eternal ice of a Himalayan glacier will be tinted blue, then why are the high clouds which consist of nothing but ice crystals also not blue?

When we draw, do we draw what we see or do we draw what we know? And how do we "know", if not by seeing?

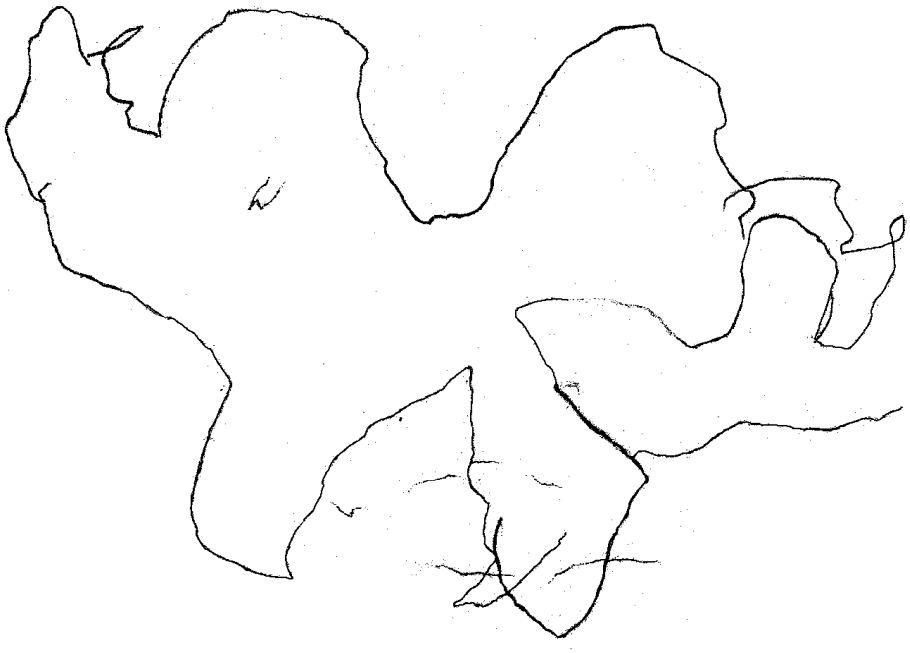
The same cloud when looked at from below or above may vary from black to white. But how can something be both black and white at the same time? Our unscientific, 'common-sense' thinking seems to be preventing us from understanding such phenomena. We need to open our eyes to take another look.



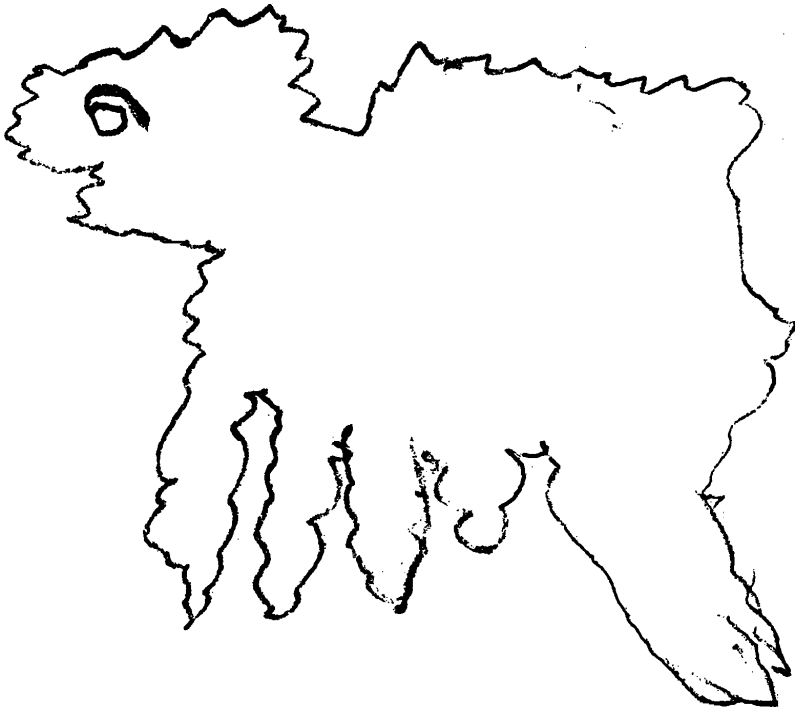
Clouds - A student drew this picture while looking at clouds and drawing what she saw.



This drawing shows what the student believed clouds should look like.



Here is a drawing of clouds based on observation of clouds



This student saw an animal in the clouds, and drew what she saw, as she interpreted it.

What colour are the clouds? What colour is the sky? Could the same cloud be both white and black at the same time? [photograph: Madhya Pradesh 2007, Karen]