Teaching Science in Remote Schools: The Struggles and Successes of Teachers From the Perspective of an Ethnographer

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Abstract
The remote population in Ghana has been on the increase in the last decade with the number of males being slightly higher compared to females. This affected the share of educational resources as the remote schools were disadvantaged in human and material resources. However, the basic schools in the remote communities had their students in the junior high schools sit for the basic education certificate examination (BECE) together with their age-mates in the urban communities. We, therefore, studied the struggles and successes of two teachers (a male and a female) in an attempt to teach science concepts to students in remote basic schools effectively. The two teachers met our main selection criteria of gender and have taught science in a remote school for 5 years and above. Through observer participation, interviews, and field notes qualitative data were collected from teachers, both during school hours and outside school hours, over a period of 14 weeks. The data in a form of text were broken into units of analysis using content analysis procedures. It was found that being a female teacher and a family woman and teaching science in a remote school was challenging. Though teachers struggled to effectively teach science to students in remote schools there were instances some students had attained grade 1 in science in the BECE. Implications of the findings are discussed.

Keywords: Female, Male, Remote Communities, Science Teachers, Teaching Science

Introduction

With the advent of the technology arises an increasing need for scientific literacy (Laidlaw, Taylor, & Fletcher, 2009), enabling the individual to invent, foster economic development, and aid problem-solving to make life worth living and much easier for humans' existence. One goal of science education is to prepare students to apply science in their everyday lives and society (Kahn, 2021). Scientific knowledge and science-based technology play a pivotal role in individuals' personal, social, and professional lives, and a comprehension of science and technology is thus central to a young person's preparedness for life (OECD, 2017). It is in light of these, the UN, World Bank, and OECD emphasize countries ensuring quality education and production of scientifically literate citizens. If there is an appropriate time scientific literacy would be of the essence to us, then, it is now as globally, humanity faces major challenges in providing sufficient water and food, controlling diseases, generating sufficient energy, and adapting to climate change (UNEP, 2012). This scientific literacy is developed through providing quality science education (OECD, 2019) to the citizenry.

In an attempt to instill scientific literacy among citizens exist a great disparity between the urban and rural (remote) areas (Murphy, 2022; Sumida & Kawata, 2021) despite a significant proportion of the population being remote settlers (Cheung, 2021). For example, Ghana has a total rural population of 43.3% of the total population, 30,832.019 (Ghana Statistical Service [GSS], 2021; World Bank, 2023) but there exist disparities between urban and rural education. In the case of the US, approximately 11.4 million children were growing up in remote areas, compared to 14.6 million in urban areas but remote science education was given little attention (Avery, 2013). Characteristically, remote areas are isolated with low population densities (Williams in Avery, 2013), and have fewer students in school/class perhaps because of the little to no priority given to education by the remote settlers (Pryor & Ampiah, 2003). Remote communities are often surrounded by fertile lands that are designed naturally to support their agricultural activities. Because, much of the research work into remote education has often found that the smaller number of children enrolled in schools in remote areas is a result of their engagement in agricultural activities (Pryor & Ampiah, 2003).

The existence of these disparities creates a major challenge for teachers teaching in remote areas. It is globally acknowledged that teaching in remote areas could be challenging (Avery, 2013; Cheung, 2021; Shikalepo, 2020; Zinger, Sandholtz, & Ringstaff, 2020). The challenges of teaching in remote areas are inadequate instructional resources, inadequate infrastructure, language barriers, unavailability of teacher professional development programs, community indifference to the education of children, and unavailability of social amenities (Adams & Woods, 2015; Buczynski & Hansen, 2010; Darling-Hammond, 2017; Garcia & Weiss, 2019; Shikalepo, 2020) For instance, Pryor and Ampiah (2003) reported that teachers expressed demotivation to teach in remote areas because of the conditions and behaviors of parents and students towards learning, hampering the work of teachers. Besides, some of the teachers in remote areas are young men (and women) from an urban background who intend to leave at the earliest possible to a community of urban characteristics. Those teachers disdain remote situations and were in pain to differentiate themselves from village people. For Adams and Woods (2015), when teachers who have been brought up and trained in urban areas are sent to remote and isolated communities to teach, they tend to have a monoculture that is different from their own. In Alaska, the weather conditions and cross-cultural classroom issues become major challenges to those teachers in adapting to the communities and providing instructions to students, and this is

worsened for beginning teachers. Leech, Haug, Rodriguez, and Gold (2022) asserted that those teachers who stay grew up in the area, already lived there as an adult, and/or had a spouse/partner with a job in the area. For Mulkeen (2006), children in remote areas may be considered more difficult to educate because they are likely to have less parental encouragement to go to school, and more alternative demands on their time, such as helping with agricultural tasks. When those children attend school, they may find the curriculum less relevant to their lives, and find less support for their learning from the home environment.

In professional development, teachers that need stronger support are those in remote areas (Garcia & Weiss, 2019). These professional supports such as the provision of professional development training will serve as the antidote to the deficiencies in pedagogical content knowledge (PCK) of the science teachers (Buczynski & Hansen, 2010). Teachers in remote areas need support but the support should transcend normal professional development to a professional learning community that provides teachers the opportunity to learn specific science domains and innovative practices for teaching science (Panizzon, 2011). However, in the US, the inequity in the provision of quality education to remote areas was further exacerbated by the lack of continuous provision of professional support to the teachers teaching in remote areas (Darling-Hammond. 2017).

In remote teaching, language is another strong factor in effective teaching. That is, in instances where the teacher does not speak the native language of the people, instruction is solely in English. However, students in these remote areas can form only a few phrases in English (Pryor & Ampiah, 2003), when the teacher's medium of instruction is English, he or she faces the challenge of explaining concepts to the understanding of students. In Ghana, the language policy for teaching and learning spelled out that the Ghanaian language is only used in kindergarten to primary school 3, and English is used in primary school 4 to 6 onwards (USAID, 2020). Consequently, science teachers in remote schools could be struggling to teach and observe the language policy.

In the context of science teaching, Cheung (2021) agreed with the literature that the low quality of education in remote areas is a result of the backwardness of curriculum content and instructional methods, insufficient funding, aging facilities, and shortage of teachers and teaching conditions. Sumida and Katawa (2021) in analyzing the gap between remote and urban education attributed the challenges to school and family characteristics. It is indisputable that science teachers play a pivotal role in guiding students to acquire the needed science knowledge and literacy, it is important that we pay attention to the teacher's environment, giving them the needed professional development training, and granting them access to the science instructional materials (Irby et al., 2021). Hence, providing science instruction should be a sustained priority (Zinger et al., 2020). However, it has remained a challenge and remote areas are the most affected. It must be noted that lack of content knowledge, time constraints, materials for hands-on activities and curriculum needs, isolation, and lack of professional development are the challenges the remote science teacher faces in their quest to instruct science. Similarly, John (2019) found that lack of laboratory equipment and poor implementation of practical experiments, a lack of qualified teachers, inadequate or poor status infrastructure, teachers had deficiencies in their PCK and were unable to explain science concepts well. These challenges may persist because attention has not been paid to teaching science in remote areas and no professional support might have been provided to the science teachers to be successful. On their part, Laidlaw et al. (2009) asserted that primary science is not being taught as effectively as it might be

because of low levels of teacher confidence and competence in relation to scientific PCK, insufficient resources, time constraints, and lack of support in the form of professional development.

Empirically, teachers in Ghanaian basic schools face a myriad of challenges in their quest to teach science (Adu-Gyamfi, 2014; Parker, Osei-Himah, Asare, & Ackah, 2018; Quansah, Sakyi-Hagan, & Essiam, 2019; Somuah & Orodho, 2016). For instance, the studies of Quansah et al. (2019) involving some remote junior high schools (JHS) in the Effutu Municipality in the Central Region, Ghana revealed that inadequate instructional materials and poor proficiency of learners in the English affected teaching and learning Integrated Science. Similarly, Adu-Gyamfi (2014) found the challenges to include loaded science examination papers, the attitude of students toward school science, the concept of improvisation, and students' preparedness toward new science lessons. In a related study, Tamanja and Pagra (2017) reported that lack of teaching and learning materials, a low pupil-teacher ratio, inadequate infrastructural facilities, a language barrier, and stress from the long ride of both pupils and teachers.

The results of the struggles of the remote science teacher have led to many of them seeking earlier transfers when posted to teach in remote areas (Leech et al., 2022; Pryor & Ampiah, 2003). Consequently, the shortage of high-quality science teachers is recorded in these remote areas (Cheung, 2021) because of the persistent difficulties in retaining teachers (Leech et al., 2022). In countries like the US and Japan (Cheung, 2021) and sub-Saharan African countries such as Mozambique, Lesotho, and Uganda (Mulkeen, 2006) to introduce remunerations and incentives with the view of attracting teachers to remote areas. However, Mulkeen (2006) argued that deploying teachers to remote schools remains a very daunting task and that countries that have strived to place incentives to attract teachers to remote areas have only gotten a minimal impact. Because such incentives have not been sufficient to match the numerous advantages the urban schools come with.

Another finding from the literature is the challenge of getting female teachers to teach in remote areas (Mitchell & Yang, 2012; Pryor & Ampiah, 2003). It is reported that systemic failures and designs have succeeded in denying women access to educational structures including not only teaching in remote areas but in urban areas as well (UNESCO, 2001). However, not that women are denied but they are simply not ready to teach in remote areas for varied reasons (Mulkeen, 2006; Pryor & Ampiah, 2003). Pryor and Ampiah (2003) found out that it was difficult to attract and retain women teachers in remote areas and that the only female teacher who was available moved there with her husband and regrets it. Mulkeen (2006) noted that in Malawi, female teachers rarely accept postings to remote areas unless they are with their husbands otherwise if even posted to the remote areas they request transfers based on marriage. Also, there have even been times when female teachers presented themselves as married to enable them to seek transfers. In analyzing teachers' gender in some African countries, it was reported that in Malawi, 82% of the teachers in the urban areas were females while 31% were females in the remote areas; in Mozambique, about 80% of the teachers were females, but they were unwilling to accept postings to the remote areas, and in Uganda and Tanzania, most female teachers are concentrated in urban areas and that it was difficult to attract female teachers to remote areas (Mulkeen, 2006). In Sekyere Odumasi District, Ghana, in 10 primary schools and five JHS in remote areas, Azewara, Korankye, Amankwah, and Takyi (2021) reported that there were only four female teachers in the JHS compared to 27 male teachers, and no female teacher in the primary compared to 35 males in the primary.

There are also widespread beliefs that women are ‘natural’ teachers for young children (Mitchell & Yang, 2012). Most studies have paid little attention to the experiences of female teachers both as teachers and as women, and when a remote component is also factored in, there is even less that is known about women’s experiences. More in-depth studies of women teachers and their experiences, and study and expand pre-service teacher education programs that seek to provide experiences for new teachers in remote areas will be needed (Mitchell & Yang, 2012). In the midst of these challenges, we ask an overarching question;

What are the struggles and successes of the teacher teaching science in remote areas?

Research Area, Participants, and Methods

This ethnographic study was conducted in two remote schools in the Bawku West District [BWD] of the Upper East Region, Ghana. BWD was divided into 13 educational circuits, with 257 public and private educational institutions. There were 91 kindergartens, 99 primary schools, 55 JHS, five senior high schools, one vocational institute, and one craft center. The unprofessional teacher ratio was 1:168 for KG, 1:90 for primary schools, and 1:35 for JHS. BWD had 174 communities with the following health facilities. One hospital, nine health centers, eight clinics, 31 National Community Health Planning and Services (CHPS) compounds with structures and six CHPS zones without structures, two supplementary feeding centers, one nutrition rehabilitation center, and five recognized chemical shops (BWD, 2021). BWD was one of the 15 districts and municipalities in the Upper East Region. BWD was located in the northeastern section of the region, with Zebilla as its administrative capital. BWD was bordered to the north by the Republic of Burkina Faso, to the east, by Binduri District, to the west, by Nabdam District, and to the south, by East Mamprusi District. Significantly, two tributaries of the Volta River (White Volta and Red Volta) run contiguous to the district’s eastern and western boundaries respectively. BWD was created in 1988 under the local government system by Legislative Instrument 1442 (GSS, 2014). BWD covered an area of approximately 1,096m and had a population density of 131.5 BWD was the biggest district in the region in terms of land area (GSS, 2014). It had the highest population of 144,189, comprising 49.1% males and 50.9% females, sharing 11.1% of the total population of the region (GSS, 2021). Of this population, 15.1% were settlers with urban infrastructure and 84.9% were remote settlers without urban infrastructure (GSS, 2021). The main Ghanaian language spoken in the district was Kusaal though other languages such as Mosie, Bisa, Frafra, and Twi, were spoken among minority ethnic.

In this research, two teachers teaching in schools located in communities where access to telecommunication networks was a challenge despite some few houses having access to electricity. The communities had a CHPS center that rendered health services to the inhabitants who were predominantly subsistence farmers, rearing livestock, and cultivating crops. The participant, John was a professional teacher, now pursuing a bachelor of education via sandwich mode. He taught science in this school for 5 years. John was not a native of the community but was posted there to teach after the completion of his initial teacher training. The second participant, Magdalene, was a professional teacher. She had taught science in a school in another remote community for 3 years before this present station where she had been teaching science for the past 5 years. Her highest academic qualification was a master's degree. She was born and bred in BWD.

The authors identified the schools and the science teachers in these schools during a teacher union sensitization tour. Author saw the environment of the school, interacted with the teachers, and sought for their consent to undertake research with them. Initially, only John was happy and gave his consent to participate. However, there were only three female teachers identified to teach science in the JHS in BWD. At first, one agreed to participate but declined days later with reasons that the researcher might be an investigator who wanted to seek information about her and subsequently use it against her job. Discussions with the rest of the female science teachers continued until one, Magdalene agreed to participate in the study. Magdalene like her other peers had married. She had three children, two of whom have started their primary education and the last one was still breastfeeding. After the participants had agreed to participate in the study, their headteachers were contacted. The purpose of the study was explained to the headteachers and permission was sought to conduct the study. The headteachers and the teachers were assured of confidentiality.

Author2 collected data using observer participation, observing how the teachers delivered their lessons, how their students show interest, and ask questions; inspecting their lesson notes, attendance register, instructional materials available, and teaching timetable, how they interact with colleague teachers and headteacher, and interviews in the form of normal conversation. A total of 14 weeks was spent collecting data. In week one, Author2 spent Monday to early Wednesday at about 9:45 am in the school of John and Wednesday from 12:15 pm to Friday with Magdalene. On Saturday and Sunday, Author2 visited the male participant at his residence. In the second week, Author2 spent Monday with the personnel in the district education directorate. This helped Author2 better understand and reconcile some of the issues raised by the participants. Author2 then visited the two participants from Tuesday to Sunday, a visit was paid to John at home as well. The activities in week1 and week2 continued till the 14 weeks were over. Both participants did not know about themselves until the last day of data collection. The data collected were carefully read through and themes were made out. The results and any inductive reasoning made of them were given to both John and Magdalene to critique to accept as true observations made.

Teaching-learning resources

Observations made in John's school showed inadequate teaching-learning resources for teaching science, an obsolete thermometer that was no longer functioning as the instructional material. John had well-prepared lesson plans, stating the relevant instructional materials required for the effective delivery of the lessons but the materials were not available. During his lesson delivery, he practically used exposition and one could see a clear difficulty in the conceptualization of concepts being communicated by John. John mentioned:

> *I will say today's lesson went well, though I needed to use some instructional materials to explain… but I don't have them. You know, without the materials the students cannot understand how you want them to.*

Even furniture for students to sit on and learn was woefully inadequate in Magdalene's classroom environment. It was not conducive enough for teaching and learning science. Observations of the classroom revealed students often compete for the little spaces of their dual desks. Magdalene had a well-prepared lesson plan showing indicators and the expected performance of her students. She indicated the instructional materials that needed to be used in teaching her lessons but no such material was available in the lesson delivery. Author2

enquired from her why she stated them even though she does not have them. Magdalene mentioned:

> *…If I do not indicate that, anybody supervising the lesson later may think I do not have a correct conception of science and its methodology.*

When Author2 enquired about her improvising, she responded:

> *…Yes, I can improvise but that takes time and I don't have much time. You see the charts, I need to look for colors, sit down and draw and that will take time.*

Magdalene added that she recently acquired a laptop and that is what she uses to download pictures to show her students.

> *The laptops they distributed. I mean the one teacher, one laptop, I received one. So, these days that is what I use to download pictures for my lessons. These days I don't think of improvisation*.

Teacher professional development

Teacher's content knowledge, teacher pedagogical content knowledge, and technological pedagogical content knowledge are major determinants of the teacher's success in explaining scientific concepts to students. Deficiencies in these are sometimes compensated for by providing continuous professional development to the teacher. John mentioned:

> *Some teachers say for the biology and Agricultural aspects, they can teach but for the chemistry and physics part they are afraid of those areas ...Yes. I believe in-service training will afford me the opportunity to learn and learn from others...*

Observations made from his lesson notebook suggested consistently for 3 years John never taught some of the science topics in the JHS curriculum. For instance, John struggled to recall the topic of basic electronics as part of the JHS curriculum. John expressed:

> *You see this topic West African Examination Council does not construct their test items on it besides the materials are not there and we do not have a science laboratory.*

Magdalene recalled there were only three teachers for the entire JHS. Hence, she opted to teach mathematics and science. Since then, she has been teaching science and had developed an interest in teaching it. However, she had only attended one science workshop in the recent training for the implementation of the new science curriculum. Magdalene expressed:

> *No, I don't attend in-service training. It was just last year they invited us for the training for the new curriculum…*

Language barrier

Another challenge so identified was John's struggle to choose a medium of instruction. It was observed that at some point in time, John tried to use the native language of the students

to communicate some of the science concepts. Because most of the students could not express themselves well in English. John was always met with frustrations. He at a point quizzed:

> *What do you want me to do? Teach you English or 'Kusaal'*?

Largely, the class remained dominant by the few who could express themselves in English. Even so, that was not without errors. Those few students appeared to make John excited and most often called on them to work on any given task:

> *As you can see, when you came to my class, they could not speak English very well. If had I understood the local language, I would have used that one. ...but that is also not allowed.*

Absenteeism

Observations of the class register and students' attendance to lessons showed that John's students often absent themselves from school. During observations of John's lesson, of the expected 22 students, eight were absent. John expressed:

> *Oh! it is a common thing for students to be absent themselves here. You will not always get all the students in school. Today is even better...*

When Author2 visited John at his residence, I was taken to some illegal mining sites where we saw some of his students working there though they were young.

The duality nature of a female science teacher

One major challenge Magdalene faced was her combining household work with teaching. At home, she attends to her children and family chores. Though Magdalene was staying in a nuclear family, she had to prepare family meals, fetch water and wash their clothes. Magdalene mentioned:

> *Saturdays are so tight may be Sundays after church is better… Because of the pressure at home, I usually prepare only Monday lessons on Sunday evenings and prepare for the rest of the week on Tuesdays. …If you look at how women have so many things to do at the home, it is difficult being a good science teacher and a female…*

Teacher successes

Amidst the language barrier, lack of teaching-learning resources, and professional development programs for John, he managed to always get some of his students to do well in the external examinations (Basic Education Certificate Examination [BECE]). Analysis of their 2019 results revealed that of the 23 students who sat for the BECE, eight attained grades 1-5; 10 attained grades 6-8; and five attained grade 9. John mentioned:

> *My students' results. Hmm!!! Not bad though but I wish my students perform better than that. For grades 1, 2,3, and so on in science, …two of my students attained grade 1 in science. Some too got 2, 3 but most of them attained 7, 8, or 9.*

It thus, appears that John does a great deal of work in helping his students to succeed in their academic pursuits. John sometimes organizes a supplementary class for the few students who will come to help guide them learn the science, and that has helped greatly in the students' performance.

Beyond the challenges that Magdalene faced, she appeared to be excited about teaching science. Magdalene expressed:

> *…Eiii, the science, there is a lot. …But I just realise I like the subject. ...I don't need to struggle. If you are teaching a subject that you struggle with, you may be boredom.*

Like John, Magdalene's students also do well in the external examinations. She noted that her students also attained grades 2, 3, 4, 5, and so on in the BECE.

Conclusion

The finding that science teachers in remote areas lack adequate instructional materials for the effective delivery of lessons resonates with the assertion of (Adu-Gyamfi, 2014; John, 2019; Parker et al., 2018; Quansah et al., 2019; Somuah & Orodho, 2016) that the teachers do not have adequate instructional materials. It is not out of place to reason that the absence of these instructional materials will further widen the existing disparities (Cheung, 2021; Murphy, 2022; Sumida, & Kawata, 2021) between the quality of scientific literacy (OECD, 2019) inculcated into the students in the remote areas. Since teachers use instructional materials as alternative channels of communication (Samuel, 2009), their absence implies that the science teacher will consequently resort to guiding students to rote learning. Though teachers made conscious efforts at some point in time to improvise these materials, lapses in improvisation also have repercussions on scientific conceptions by students. It could even be that the lack of instructional materials makes science teachers struggle and will want to leave the remote areas for urban areas (Leech et al., 2022; Pryor & Ampiah, 2003). The way forward will be granting them access to the science instructional materials to help in their instructions.

The findings that teachers teaching science in remote areas of Ghana for several years without receiving regular professional development training confirms teaching basic science is problematic because these remote teachers do not get support in the form of professional development (Darling-Hammond, 2017; Laidlaw et al., 2009; Zinger et al., 2020). Hence, we must pay attention to the teacher's environment, giving them professional development (Irby et al., 2021). Because, like any other teacher, remote teachers might have deficiencies in their PCK and will probably need to address that through professional development (Buczynski & Hansen, 2010). The Ministry of Education through the Ghana Education Service may have to extend professional development support to the remote teachers who so need it most (Garcia & Weiss, 2019) to help them develop professional learning communities (Panizzon, 2011).

The findings that remote teachers struggle in teaching science as a result of the language barrier agree with Zinger et al. (2020) that the challenge remote teachers face was the language barrier. The study further agrees with Pryor and Ampiah (2003) that, students in remote areas can make or form only a few phrases in English, and when the teacher's medium of instruction is English, he/she faces the challenge of explaining concepts to the

understanding of students. However, the national policy on the medium of instruction is English, hence, teachers must make a conscious effort to guide students to increase their vocabulary level and their ability to communicate in English, less remote science teachers will continue to struggle.

In remote schools, absenteeism is a major challenge to science teachers. Poised as they may be to instruct the science concepts to students, they are often met with student absenteeism. This finding resonates with the assertion of Pryor and Ampiah (2003) that the smaller number of children enrolled in schools in remote areas is a result of their engagement in agricultural activities, being the dominant occupation of their parents. Thus, parents pay no attention to their ward's education (Averey, 2003). This makes the remote science teachers frustrated as they keep on repeating lessons due to students' absenteeism. This struggle might be why most of the teachers posted to the remote areas tend to leave as early as possible (Leech et al., 2022).

Also, working as a family woman and teaching science is a very herculean task. Because female teachers are surrounded by many activities both at home and school. The overwhelming nature of home duties makes women unable to prepare lessons and organize teaching-learning resources for the week. However, male teachers are likely to use Saturdays and Sundays to prepare lessons for the week. These untold stories of female teachers agree with Mitchell and Yang (2012) that attention has not been paid to the experiences of female teachers both as teachers and as women, and it is direr when a rural component is also a factor. There is even less that is known about women's experiences. We may begin to re-examine this untold part of women teachers teaching science in remote areas, and this is a duty call on science educators and researchers.

The finding that fewer females teach science in remote areas is worth noting. Because is reported from earlier studies that there are few female teachers in remote areas (Azewara et al., 2021; Mulkeen, 2006). It is not just systemic failure (UNESCO, 2001) but the female teachers are not ready to accept postings to teach science in remote areas (Azewara et al., 2021; Mitchell & Yang, 2012). The justification for staying and teaching science in a remote area on the basis of being a native and having family living around (Pryor & Ampiah, 2003) is not good for professionalism. This in part, may explain why not so many women are teaching science in remote areas.

In this ethnography, two teachers were studied in teaching science in remote schools. Though the two teachers were experienced teachers, they had their struggles and successes in teaching science in remote schools in terms of teaching-learning resources, language barrier, and teacher professional development. Teachers in remote communities through insufficient teaching-learning resources managed to have their students attain grade 1 in science in BECE. Hence, MOE through the Ghana Education Service and non-governmental organizations should pay attention to the provision of instructional materials to these remote schools for effectively teaching science to bring out the best in their students. In addition, there were few numbers of female teachers teaching science in remote communities in the studied area, and they were confronted with managing their homes as wives and teaching science effectively to students, hence, the Government and its development partners should decipher a policy that will attract females into science, and in particular teaching science in remote schools.

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